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Energy Conservation Opportunities at Guru Nanak Dev Engineering College, Bidar

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ABSTRACT: In present era, the gap between the generation and demand of power is increasing with increase in population population and lifestyle. There are two methods to overcome existing difficulty either by generating extra electrical energy or by conserving electrical energy. Energy auditing is carried out to reduce the gap between generation and demand.

KEYWORDS: Energy Auditing, Energy Management, World Energy Scenario Indian Energy Scenario, Cost Analysis, Peak Clipping.

I. INTRODUCTION

A. World Energy Scenario

There are three major primary sources of energy –coal, oil and gas. The coal consumption is heavily concentrated in the electricity generation sector almost 65% of the world's coal use is for electricity generation. The power generation accounts for virtually all the projected growth in coal consumption worldwide, as given in figure 1.

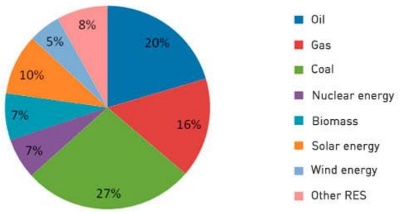

Figure 1 World Energy Scenario 2015

A. Indian Energy Scenario

The economic growth of a country as shown in figure 2 is often closely linked to its consumption of energy. As compared to developed countries, the per capita energy consumption is too low in India. It is just 4% of USA and 20% of the world average driven by the expanding economy, rising population and a quest for improved quality of life, energy usage in India is expected to rise to around 450 kgoe/year by 2010 from the person over 350 kgoe/year. Most of India's energy requirements are met through fissile fuels. The coal dominates the energy mix in India, contributing to 55% of the total primary energy production. Over the years, there has been a marked decline in oil production from 20% to 17%, but during the same period, the share of natural gas production has increased from 10% in 1994 to 13% in 1999. The decline India's oil production is mainly due to it being relatively poor in oil reserves, which amount to 5.9 billion.

Abbreviations

LED: Light emitting diode, LCD: Liquid crystal display, TL: Tube light, EMC: Electro mechanical choke, EC: Electronic choke, RR: Resistance regulator, ER: Electronic regulator, TF: Table fan, FTL: Fluorescent tube light, CF: Ceiling fan, CRT: Cathode ray tube, CFL: Compact fluorescent lamp.

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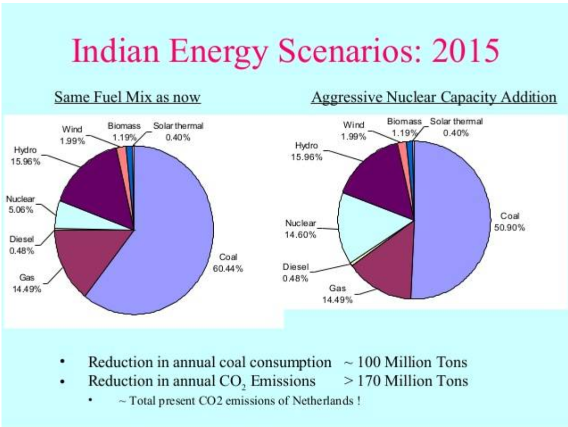

Figure 2 Indian Energy Scenario 2015

II. ENERGY AUDITING: ENERGY CONSERVATION OPPORTUNITIES

A. ECO (Energy Conservation Opportunities)

1. Capacity utilization
2. Fine tuning
3. Technology up gradation

B. Types of Energy Auditing

The types of energy audit to be performed depends on,

a) Function and type of industry
b) Depth to which final audit is needed, and
c) Potential and magnitude of cost reduction desired

Thus energy audit can be classified into the following two types.

1) Preliminary audit and
2) Detailed audit

C. Initial site visit and preparation required for detailed auditing

An initial site visit may take one day and gives the energy auditor/engineer should carry out the following actions:-

1. Discuss with the site's senior management the aims of the energy audit.
2. Discuss economic guidelines associated with the recommendation of the audit.
3. Analyze the major energy consumption data with the relevant personnel.
4. Obtain site drawings where available- building layout, steam distribution, compressed air distribution, electricity distribution etc.

D. Energy Auditing Equipments

1) Digital Lux Meter: is the device used to measure luminosity level.
2) Clamp Meter: An electrical meter with integral AC current clamp is known as clamp meter.
3) Watt Meter: The wattmeter is an instrument for measuring the electric power in watts of any given circuit.
4) Measuring Tape: A tape measure or measuring tape is a flexible ruler used to measure length, height and breadth.

III. DATA ANALYSIS

A. Equipment Wise Analysis Equipment wise analysis has been performed in order to identify to equipment, within electrical science block. During equipment wise electrical science block the equipment with power consumption less than 1% of total power consumption of same block were ignored so as to make the analysis result simple and easy to observe. Following figure 3 summarises the result of equipment wise analysis of power consumption.

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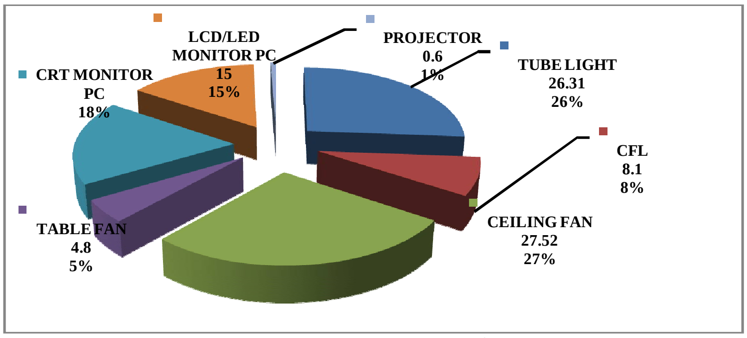

Figure 3 Equipment wise consumption pattern of electrical science block

B. Floor Wise Energy Consumption

The location wise energy consumption gives the energy consumed at each floor. So the ground floor consumes 37384.5kWh energy per year, first floor consumes only 26657.5kwh per year because in first floor there are no computer laboratory accept microcontroller lab and also due to less number of fans. The second floor consumes 32936.5 kWh of energy and finally the third floor consumes 40055.5 kWh of energy per year as shown in figure 4.

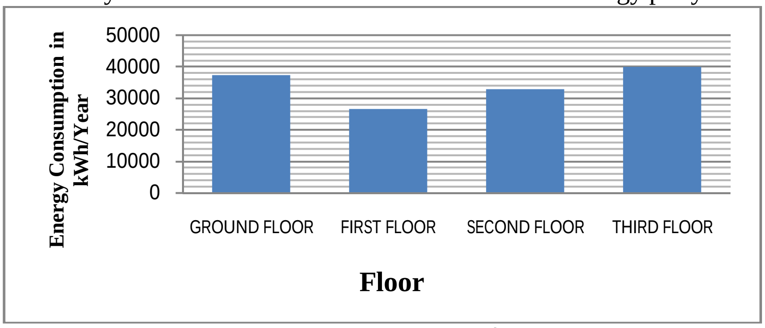

Figure 4 Floor wise energy consumption of electrical since block

IV. RECOMMENDATIONS FOR ENERGY CONSERVATION

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost analysis of implementation of recommended measures has been performed wherever necessary. Also, a number of general measures for energy efficiency have been listed. Described below are some important recommendations for better energy efficiency:

Replacing conventional ballast [choke] in the existing FTLs with electronic ballast [choke] FTLs

Dominant light source at most places in the campus is traditional 40W FTLs with conventional Ballast [Choke] which consumes 14-16W in addition to the 40W. As per our data collection, the campus has in total 307 conventional Ballast [Choke] FTLs. If these conventional Ballast [Choke] are replaced by electronic Ballast [Choke], 10-12W power can be saved per FTL.

Cost Analysis of Replacing Conventional Ballast [Choke] FTL with Electronic Ballast [Choke] FTL

Total No. of conventional Ballast [Choke] FTLs in Campus = 280
Average Power of conventional Ballast [Choke] FTL = 56W
Average Power of electronic Ballast [Choke] FTL = 44W
Power saved per FTL = (56-44) W =12W
Total Power saving = 280X12W = 3360W = 3.36kW
Average Use of FTL per year = 250X7h=1750h
Total Energy saved per year = 3.36X1750 kWh = 5880kWh
Saving in Rs. per year = 5880X7.35 = Rs. 43218
Average Cost of Replacing each FTL = Rs. 150

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Total Cost of Replacing all Conventional Ballast [Choke] FTLs = 280X150 = Rs.42000
Capital Cost Recovery time = (42000) / (43218) = 0.97yr
Hence, the capital cost recovery time for replacing all conventional Ballast [Choke] FTLs of the campus is around 0.97 years.

Cost analysis of replacing conventional ballast [choke] FTL with led tube light

Total No. of conventional Ballast[Choke] FTLs in Campus = 280
Average Power of conventional Ballast[Choke] FTL = 56W
Average Power of LED tube light = 20W
Power saved per FTL = (56-20)W =36W
Total Power saving = 280X36W = 10080W = 10.08kW
Average Use of FTL per year = 250X7h=1750h
Total Energy saved per year = 10.08X1750 kWh = 17640kWh
Saving in Rs. Per year = 17640X7.35 = Rs. 129654
Average Cost of Replacing each FTL = Rs. 595
Total Cost of Replacing all Conventional Ballast[Choke] FTLs = 280X595 = Rs.166600
Capital Cost Recovery time = (166600)/(129654) = 1.28yr
Hence, the capital cost recovery time for replacing all conventional Ballast [Choke] FTLs of the campus is around 1.28 years.

Replacing resistance regulator of fans by electronic regulators

Most of the buildings in GNDEC campus are very old and so are the fans. Most of the fans here have resistance regulators. According to the data collected, there are a total of 210 fans with resistance regulator while number of fans with electronic regulator is only 68. Saving of 8-10W per fan can be obtained by replacing resistance regulators by electronic regulators.

Cost Analysis of Replacing Resistance Regulators with Electronic Regulators

Total No. of resistance regulated fans in Campus = 181
Average Power saved per fan = 8W
Total Power saving = 181X8W = 1448W = 1.45kW
Average Use of fans per year = 250X7h=1750h
Total Energy saved per year = 1750X1.45 kWh = 2537.5kWh
Saving in Rs. Per year = Rs. 2537.5X7.35 = Rs. 18650
Average Cost of Replacing per fan = Rs. 150
Total Cost of Replacing all resistance regulated fans = 210X150 = Rs 27150
Capital Cost Recovery time = (27150)/(18650) = 1.45yr. Hence, the capital cost recovery time for replacing all resistance regulated fans of the campus is around 1.45 years.

Replacing the crt monitors with lcd monitors

Computers with CRT and LCD monitors are nearly equal in number. In total, there are 164computers with CRT monitor and 278 computers with LCD monitors. On an average, CRT monitors consume 180W while LCD monitors consume only 100W. This saving of 80W per monitor is very large. But, the LCD monitor is also costlier by Rs. 4000 to 8000.

Cost Analysis of Replacing CRT monitors with LCD monitors

Total No. of computers with CRT monitors in Campus = 164
Power saved per monitor = 80W
Total Power saving = 164X80W = 13120W = 13.12kW
Average Use of computers per year = 4hX250 = 1000h
Total Energy saved per year = 13.12X1000 kWh = 13120kWh
Saving in Rs. per year = 13120X7.35 = Rs. 96432
Average Cost of Replacing each Monitor = Rs. 4000
Total Cost of Replacing all monitors = 164X4000 = Rs. 656000
Capital Cost Recovery time = (656000)/(96432) = 6.8yr

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Hence, the capital cost recovery time for replacing CRT monitors by LCD monitors is 6.8years.

V. ESTIMATION OF EMISSION FROM COAL FIRED POWER PLANT

A thermal power plant can generate 1 kWh (1 unit) of electrical energy after burning 0.7 kg of coal. The thermal power plant has an efficiency of 21%, so to generate 1kWh of electrical energy it produces a mixture of CO_2, NOX, and SOX of 0.553 kg. Energy of 39177.5 kWh per year can be saved. For 39177.5 kWh of energy we are saving 27424 kg of coal per year, and saving a carbon emission of 21665 kg. 1 kg of coal generates 20 MJ of heat and 1 kWh generates 3600 KJ of heat, so for saving of 39177.5 kWh per year we save heat of 141 MJ per year.

VI. LOAD MANAGEMENT

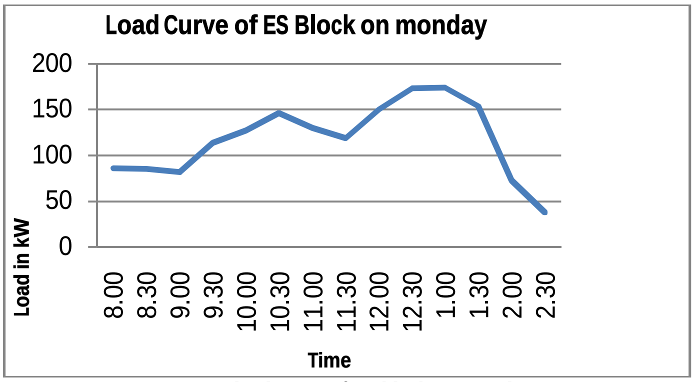

Figure 5 load curve of ES block on Monday

The load curve of Electrical Science (ES) block of Monday is plotted as shown in figure 5. Peak load is 170 kW, minimum load is 45 kW, average load is 100 kW.

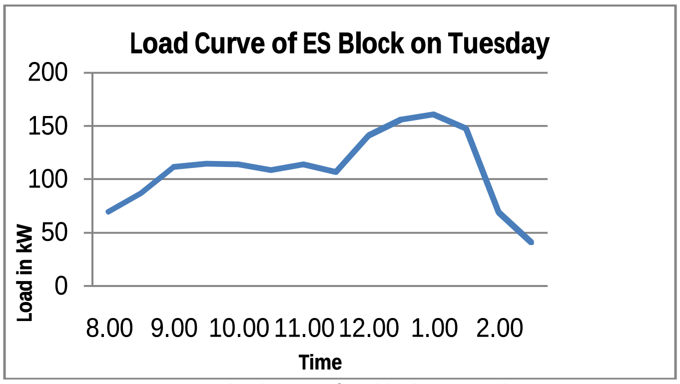

Figure 6 load curve of ES block on Tuesday

The load curve of Electrical Science (ES) block of Tuesday is plotted as shown in figure 6. Peak load is 160 kW, minimum load is 40 kW, average load is 95 kW.

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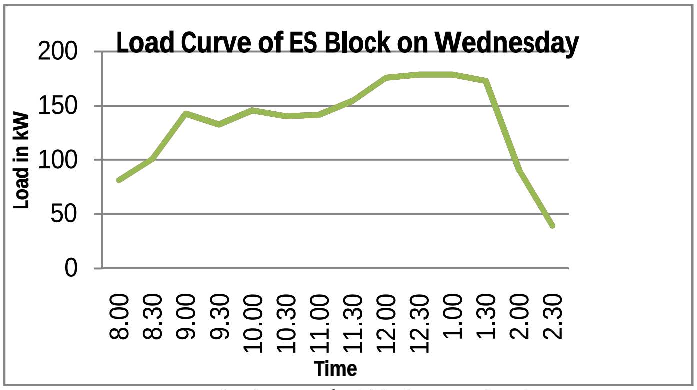

Figure 7 load curve of ES block on Wednesday

The load curve of Electrical Science (ES) block of Wednesday is plotted as shown in figure 7. Peak load is 175 kW, minimum load is 45 kW, average load is 100 kW.

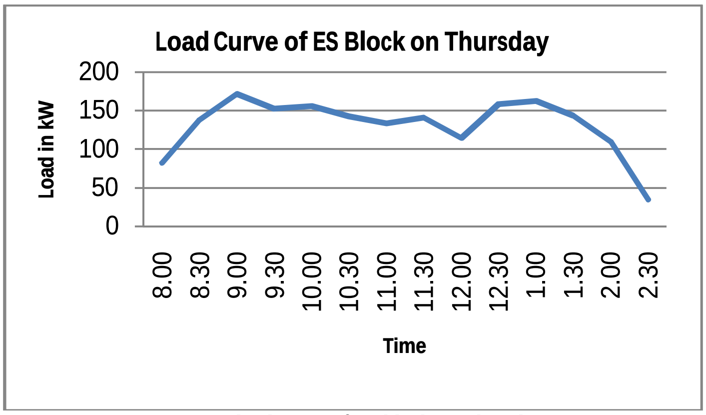

Figure 8 load curve of ES block on Thursday

The load curve of Electrical Science (ES) block of Thursday is plotted as shown in figure 8. Peak load is 160 kW, minimum load is 35 kW, average load is 90 kW.

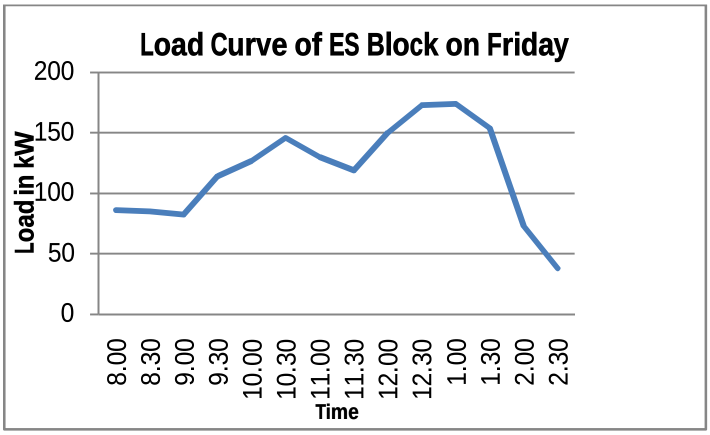

Figure 9 load curve of ES block on Friday

The load curve of Electrical Science (ES) block of Friday is plotted as shown in figure 9. Peak load is 170 kW, minimum load is 45 kW, average load is 100 kW.

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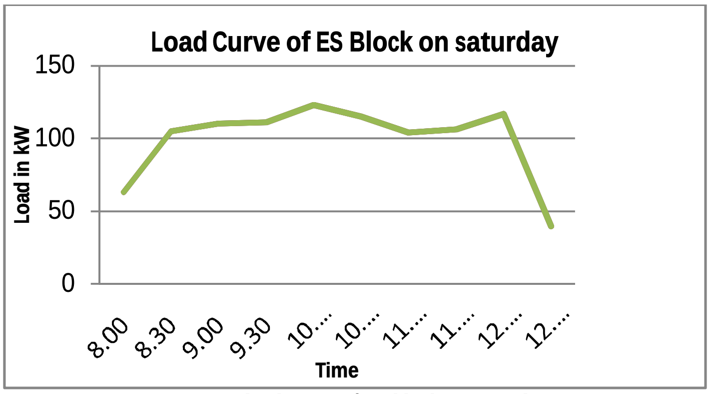

Figure 10 load curve of ES block on Saturday

The load curve of Electrical Science (ES) block of Saturday is plotted as shown in figure 10. Peak load is 120 kW, minimum load is 40 kW, average load is 80 kW.

From the above graphs we understand that on Monday, Tuesday , Wednesday ,Friday, and Saturday, the peak load is high during afternoon session whenever the labs are conducted, compared to morning session, so it is suggested that the lab timing should be shifted in the morning session so as to get the constant peak load from 8 to 2:30 pm . By following it energy can be saved.

VII. CONCLUSION

Data collection for energy audit of the GNDEC Campus was carried out by the team during year 2015-16. This audit was conducted to seek opportunities to improve the energy efficiency of the campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption. The energy auditing gives the idea of reducing wastage of electricity. The energy auditing not only related with the economy but it also reduces global warming, by reducing the use of fossil fuel for generation of electrical energy. In addition to all, it gives the information of latest energy efficient devices to be used in order to save electrical energy. The saving of electricity will meet the demand of the consumer helps in increasing per capita income of country in order to develop. By energy auditing 39177.5 kWh of electrical energy can be saved every year, with which an amount of Rs.287954 can be saved every year. By saving 39177.5 kWh of energy, we can save 27424 kg of coal per year, and saving a carbon emission of mixture of co_2, SOX, and NOX of 21665 kg to the environment.

The total capital amount required to replace existing equipments by energy efficient equipments is Rs 891750, and the payback period is 3.097 years.

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