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Energy Audit, Management in Distribution System with and without Renewable Energy

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Abstract- In this paper we have audited our collage Sardar Vallabhbhai Patel Institute of Technology (SVIT), Vasad. The total connected load of the institute is about 650KW which itself considered as a one of the major consumers of power. In order to reduce power consumption and conserve, energy audit has been taken place. A detail calculation is carried out with and without renewable energy source in the way that energy savings and financial benefit is achieved.

I. INTRODUCTION

In 21st century energy saving is one of most important things because in human life after food, shelter & clothing another most important thing is energy. Industries, college, school, malls, restaurants etc. are major load consuming components in electrical system. The demand of electricity is increases day by day but we have limited source for power generation. So, it becomes necessary to save energy and use it where is required.

Audit help us to find energy losses and proper solution for energy conservation of any energy related system. Hence, we have taken initiative to study the same for our institute named as Sardar Vallabhbhai Patel Institute of Technology-Vasad (SVIT-Vasad).

The SVIT is organized by The New English School trust (NEST), and it was established in 1997 on the banks of the river Mahi at Vasad-Gujarat. As on date, SVIT Vasad has technical courses i.e. engineering, Computer applications and architecture. It is observed that, this campus was facing over loading condition during peak hours, due to that the main switch at distribution panel was tripping frequently since from june-2017. Hence this energy audit was aimed at obtaining a detailed idea about the various end use energy consumption activities and detecting, computing and evaluating the possible energy saving opportunities.

II. SYSTEM DISCRPTION

The SVIT purchase power supply from GEB situated at Jarod Substation (11kV). This power is utilizing at a supply voltage of 440V, which is step down with a distribution transformer. The contract demand of

collage is 350KVA and average power consumption of 28,000KW per month. This institute implemented a tariff plan name as HTP-I. SVIT has also its own DG set, which is rated as 125 KVA, 415 V. During normal use, the power is consumed from GEB supply however during meetings, seminars and events DG set is switched on to avoid any kind of disturbance due to power cut-off. Hence, the distribution system of college run on GEB supply and DG set.

III. PROCEDURE

a) Initiative

The initiative of audit starts with an idea and the aim for energy saving. With proper guidance of faculties, the audit starts. Permission should be taken of either head of department or principal for further procedure of audit.

b) Preparation Data sheet

Audit starts with collecting data. The data should be collected is like

- Name of department
- Floor
- Name of class or laboratory
- Name of equipment
- Total numbers of equipment in every class or lab
- Load of that equipment
- Power consumption of every equipment every day every month and a year

This all data will be prepared on excel sheet. After preparing data sheet analysis of that data starts.

c) Analysis of data

The data sheet that we have prepared will give the total load and power consumption of every department, every equipment, every floor, every class and laboratory independently. So, we can find load or power consumption of any class or floor or department easily.

So, in the analysis we find total connected load of every department and every equipment. We make different bar chart and pie chart for the better interpretation of load distribution.

All charts will help us to understand where the more energy is going and which equipment is using more energy. So that we can find better replacement of it.

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d) Calculation for equipment replacement

When the more energy used equipment is found. The calculation for more energy efficient equipment is done for same. The energy saving, pay-back period and financial benefit is found for every equipment.

e) Calculation for Renewable energy source replacement

Which renewable sources are efficient, easily available and cost effective is to be found out? The energy saving, pay- back period and financial benefit is estimated to fulfil the energy demand of college by renewable energy sources.

f) Recommendations

The proper recommendations will be given to authorities or trustees about replacement, maintenance and green energy advantages with energy saving and financial benefit data.

IV. ANALYSIS OF DATA

Once audit is completed, analysis of data sheet starts. Using data, we create pie chart and bar chart for proper understanding of load distribution, energy flow and power consumption.

Here we have made different pie chart and bar char for understanding our audited data.

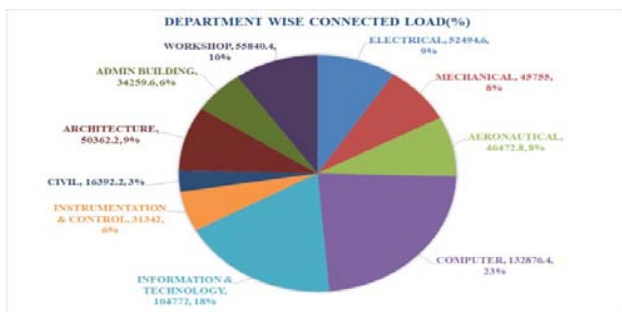


Fig. 1: Pie chart of Department wise connected load

In Fig.1 we have shown the load connected in every department. It is percentage for apprehend of which department has more connected load. The real calculated data is shown aside of percentage.

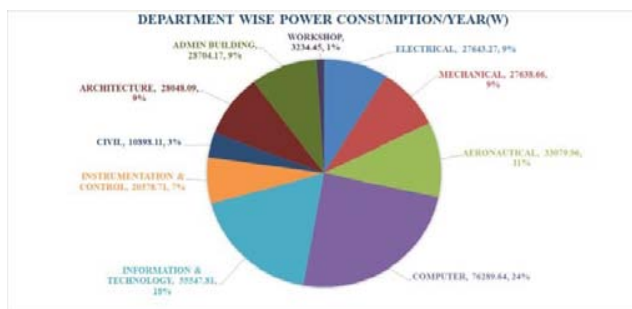


Fig. 2: Pie chart of Department wise power consumption per year

In Fig.2 we have shown actual power consumption of every department. The purpose of this pie chart is to interpret how much power is consumed by every department throughout a year and how much it is in percentage from total power consumption of college. The aside calculated data will help to determine which department is consuming more power and how we can reduce them.

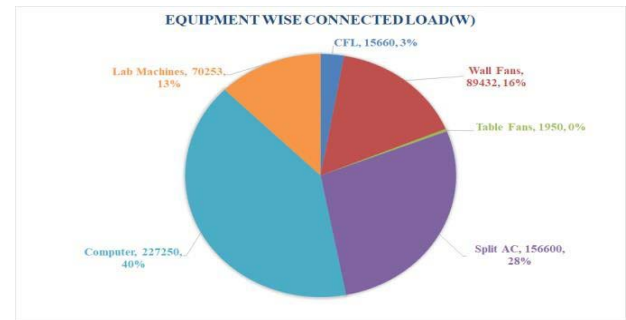


Fig. 3: Pie chart of Equipment wise connected load

From Fig.3 we can know that how much load is connected in college of every equipment. It shows that which equipment has more load.



Fig. 4: chart of Equipment wise power consumption per year (in KW)

This pie chart Fig. will inform us about actual power consumed by every equipment. The comparison of Fig.3 and Fig.4 will show us how much difference is in between the connected load of an equipment and actual power consumption of it and we can see that there is a quite difference between them.

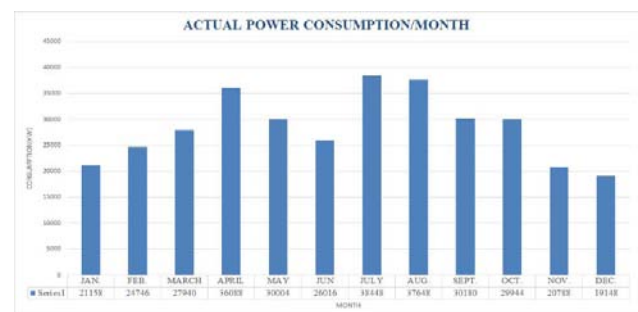


Fig. 5: Actual power consumption of college per month

Also Fig.4 will helps to determine which equipment is using more power and how can we reduce them.

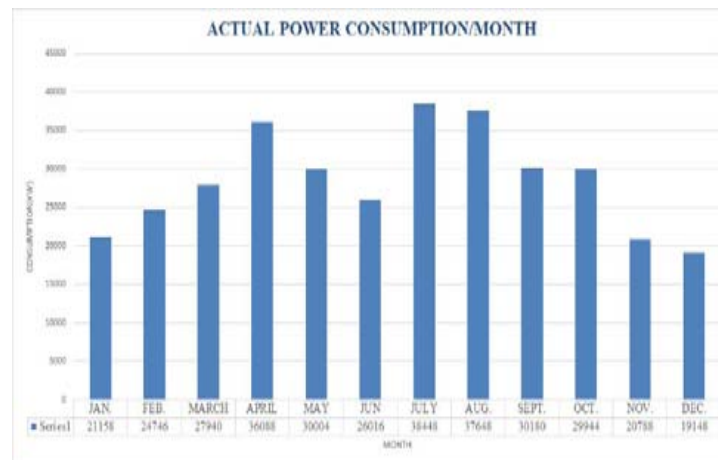


Fig. 5: A ctual power consumption of college per month

The Fig.5 shows the actual power consumption of college which is obtained by the light bill of year 2078-18.

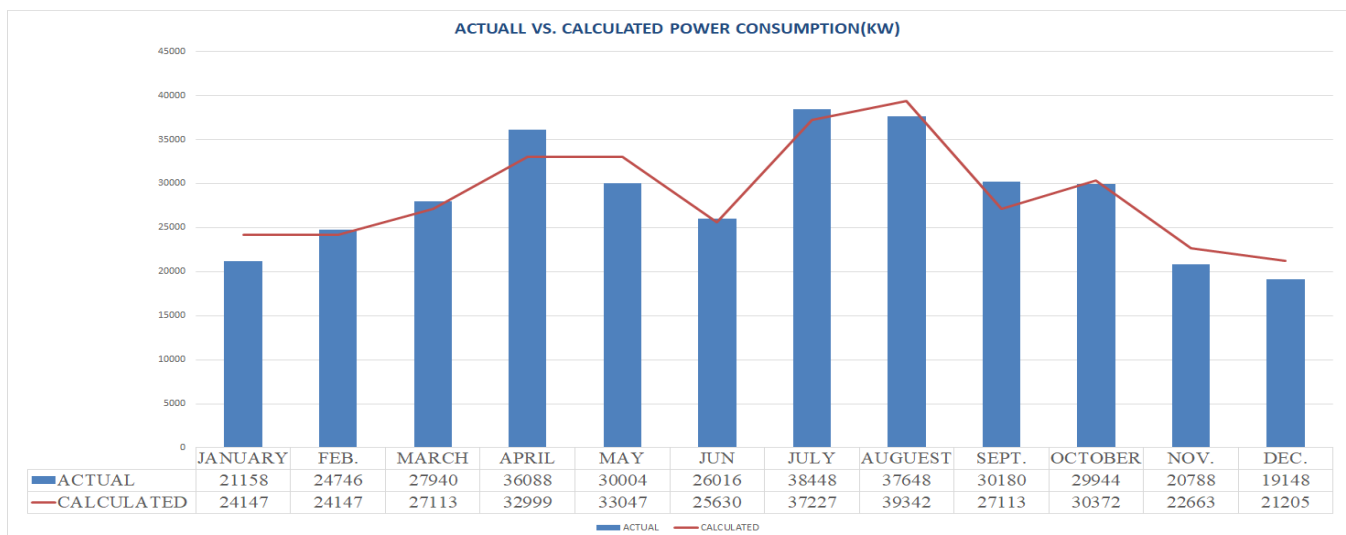


Fig. 6: Actual Vculated power consumption of college every month

The fig.6 is indicating the difference between actual power consumption data obtain by light bill and calculated by us. With line and bars, the difference observed clearly and this will help us to find error in our calculation and make it more efficient.

After analysing all the data and graphs we can know how we will reduce power consumption with minimum capital cost, more energy saving and for longer period.

Now the calculation is made for power savings by replacing aged equipment with new and energy efficient equipment for example replacing old Tube light

and CFL with LED tube light effectively reduces power consumption and saves light bill cost. The same calculation is made for all the equipment who has higher power consumption.

As an example, the calculation for replacing Tube light with LED is shown further down

V. CALCULATION FOR EQUIPMENT REPLACEMENT

In this portion we calculate exactly how much energy we can save and how much financial profit will

made with the help of capital cost and pay back period. Here we took tube light replacement example for understanding.

- Comparison Between Conventional light and LED light

Total No. of Lights = 1120

	Tube light	LED light
Power Consumption/hour	55 W	25 W
Power Consumption/year	50000 KW	22000 KW
Life Span	1.5 Years	5 Years
Cost	20 Rs/pc	400 Rs/pc

$$\begin{aligned}\text{Savings per Year} &= 50,000 - 22,000 \\ &= 28,000 \text{ KW/year}\end{aligned}$$

$$\begin{aligned}\text{Savings per Year in Rupee} &= \text{cost per unit} \times \text{no. of units} \\ &= 7 \times 28000 \\ &= ₹ 2,00,000\end{aligned}$$

For 5-year span

$$\text{Capital Cost of tube light} = \frac{\text{Span} \times \text{Capital cost} \times \text{Total no of lights}}{\text{Life span of light}}$$

$$\begin{aligned}&= \frac{5 \times 20 \times 1120}{1.5} \\ &= ₹ 75,000\end{aligned}$$

$$\begin{aligned}\text{Capital Cost of LED light} &= \frac{5 \times 400 \times 1120}{5} \\ &= ₹ 4,48,000\end{aligned}$$

$$\begin{aligned}\text{Total Savings in 5 year} &= 200000 \times 5 \\ &= ₹ 10,00,000\end{aligned}$$

$$\begin{aligned}\text{Pay-back Period} &= \frac{\text{Net investment of capital cost}}{\text{Net annual Savings}} \\ &= \frac{448000}{200000} \\ &= 2.25 \text{ Years}\end{aligned}$$

$$\begin{aligned}\text{Return on Investment} &= \frac{\text{Net annual return}}{\text{Capital Investment}} \times 100\% \\ &= \frac{200000}{448000} \times 100\% \\ &= 40\%\end{aligned}$$

$$\begin{aligned}\text{Total Savings in 5 years} &= 1000000 - 448000 \\ &= ₹ 5,52,000\end{aligned}$$

The above calculation shows us how much energy we can save by just replacing Tube lights with LED. It also shows us the amount we can save in the period of five years.

The same calculation is done for all other equipment replacement like 3-star air conditioner to 5-star air conditioner, large power using computers to less energy using and compact computers or laptops etc.

VI. CALCULATION FOR RENEWABLE ENERGY SOURCE REPLACEMENT

There are many renewable energies sources are available in present but for college solar source is most efficient way for energy generation Then any other renewable energy source.

In order to generate renewable energy for college some parameters should be known like,

- Area available for solar panel implementation
- Maximum power demand of college per day and per month
- Minimum power demand of college per day and per month.
- Average Solar power generation in that area in every season

The below shown table is a calculation of 1 KW solar panel

Area required	1 m ²
Minimum generation	3.5 KW
Maximum generation/day	7 KW
Average generation/day	4.5 KW

The next table is the energy requirement of college.

Minimum demand/day	1000KW
Maximum demand/day	1900KW
Maximum demand/month	20,000 KW
Maximum demand/month	38,500 KW

So, the capacity of solar panels that should be installed to generate power enough to satisfy maximum demand of college is 320KW.

With time load will increase, so does demand and power consumption. So, with the consideration of future demand the solar panels that should be install have capacity of at list 350KW.

The 1KW solar panel cost around ₹ 40,000. So,
Cost of 350KW solar panel = 350×4000
= ₹ 1,40,00,000

The annual cost of power consumption = ₹ 40,00,000

Above cost of power consumption of college if referred using college light bills.

$$\text{Pay back period} = \frac{14000000}{4000000} = 3.5 \text{ years}$$

Return on investment = 28.5 %

The above calculation is made base upon to fulfil maximum demand of college.

College don't get use the generated power. the generated power directly goes to GEB. The Gujarat Electric Board gives reduction in tariff of light bill.

The GEB gives reduction of ₹ 3 per unit generated.

The power generation capacity of whole campus is 600KW.

Here the solar panel is mounted on the roof top of all department and admin building.

Tariff of GEB	₹ 3/unit
Generation capacity	600KW
Generation of 1KW panel	1,600KW/year
Cost of 1KW panel	₹ 40,000

$$\text{Total generation capacity} = 600 \times 1600 = 96,000 \text{ KW/year}$$

$$\text{Tariff reduction in a year} = 96000 \times 3 = 28,80,000 \text{ ₹/year}$$

So, every year there will be savings of 96,000KW power and ₹28,80,000 in tariff.

$$\text{Capital cost of 600KW panels} = 600 \times 40000 = ₹ 2,40,00,000$$

$$\text{Pay-back period} = \frac{24000000}{2880000} = 8 \text{ years and 2 months}$$

$$\text{Return on investment} = 12 \%$$

- Another energy saving, we found while referring light bill of college

The contract demand of college is 350KVA and college have to pay fix charge to GEB of 85% of contract demand every month.

The actual consumption is very less.

Contract demand	350KVA
85% of demand	300KVA
Fixed charge/KVA	150 ₹
Actual consumption	180KVA

From the table just by reducing the contract demand we can save 18,000 ₹/month.

In summary of this calculation

	Savings	Pay- back period	Return on investment
Tube light replacement	1,10,000 ₹/year	2.25 years	40%
Renewable energy replacement (satisfying maximum demand)	40,00,000 ₹/year	3.5 years	28.5%
Renewable energy replacement (reduction in tariff)	28,80,000 ₹/year	8.1 years	12%
Contract KVA reduction	2,16,000 ₹/year	—	—

VII. CONCLUSION

From our comparative study, it can be proven that with the use of LED in place of tube light, the energy is saved up to 28,000KW which in turn a saving of 1.1 lakh per year is achieved. Another study shown that, with the penetration of renewable energy can also save energy up to 96,000KW per year which plays the major

role in energy conservation. Hence, by reducing contract demand a saving of 2.16 lakh per year is gained. Installing an automatic power factor control panel will also reduce tariff.

The analysis brings an entry point of new energy planner. It is also significant to reduce energy consumption and power losses.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Albert Thumann, Handbook of Energy Audits, Published by the Fairmont Press.
2. Bureau of energy efficiency, Ministry of power, Govt. of India.
3. Electricity Bills of SVIT, Vasad.
4. MS Excel Datasheet of Connected Load.
5. Manual of Equipment's & Name Plate Of Machines.
6. www.eai.in/ref/ae/sol/rooftop/power_output
7. <https://news.energysage.com/what-is-the-power-output-of-a-solar-panel/>
8. www.weea.org
9. www.beeindia.nic.in
10. www.gseb.com
11. www.mgvcl.com
12. www.energyefficiencyindia
13. Energy Audit: A Case Study by Sanjay Kumar, Tarlatan Kaur.