

Energy Conservation in Commercial Complexes

It is imperative to focus on energy conservation measures, as the capital cost required to get the benefits is less compared to the cost required for equivalent generating capacity addition. In most of the energy conservation projects, the payback period is less than one year, which is very attractive and the benefits are recurring. The present paper will discuss about various energy conservation opportunities available in large commercial complexes.

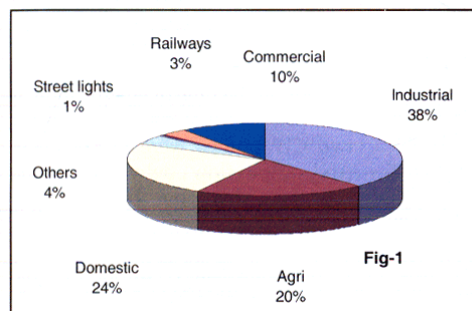
The demand for energy in India is growing at a faster rate to meet several constraints; it was not possible to meet the target set in the 9th and 10th Five Year Plans. During the above planned period, merely 50% of the target could be achieved [1]. At this juncture it is imperative to focus on energy conservation measures. The capital cost required to get the benefits is less compared to the cost required for equivalent generating capacity addition. In most of the energy conservation projects, the payback period is less than one year – which is very attractive, and the benefits are recurring. The present paper will discuss about various energy conservation opportunities available in large commercial complexes.

Background

Large commercial complexes in India account for 10% of total energy consumption. This figure is going to increase in the near future, as we see large numbers of shopping complexes and malls being added every day. The major electrical power consumed by these complexes is by lighting, air-conditioning and pumping loads.

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The energy consumption pattern of different types of consumers is depicted in Fig-1. From this figure, it is concluded that a major share of energy is consumed by the industrial sector, followed by the agricultural and domestic sectors. Commercial complexes are in the 4th position, consuming 10% of total energy.



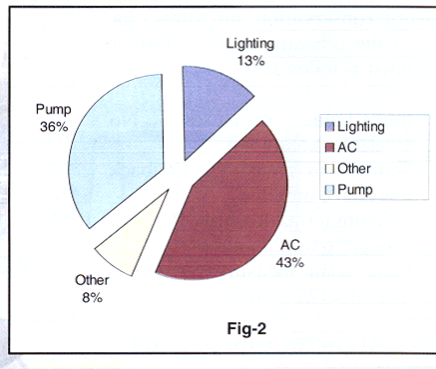
Importance of energy conservation

Typical commercial complexes in India consume energy @ 200 kWh/m²/year. As per the survey done by IIEC for BEE/USAID, under the 'ECO Project', energy savings of 27-40% are possible in an ECBC (Energy Conservation Building Code) compliant building. The Maharashtra Energy Development Agency (MEDA) has conducted a similar survey, and revealed a saving potential of 30-40% in the State of Maharashtra.

The Electrical Research and Development Association (ERDA) has conducted comprehensive energy audits at a large number of commercial complexes, and projected a saving potential of up to 39%. Hence, it can be concluded that there is ample scope for energy conservation in large commercial complexes – and the same should be tapped with immediate effect to bridge the energy supply and demand gap. This exercise will help in cutting down the specific energy consumption of a building from the present average figure of 200 kWh/m²/year to around 120-140 kWh/m²/year.

Approach for energy conservation

The load pattern of a typical commercial complex is depicted in Fig-2. Major energy is consumed by the air-conditioning and pumping loads. The optimal methodology of energy audit is as follows:



Data collection

1. Different types of equipment, their nos., ratings, etc.
2. Different forms of energy consumed by the facility.
3. Energy consumption data on monthly basis for the last three years.
4. In-house energy conservation measures implemented.
5. Any external audit conducted earlier, and the recommendations given.

Site measurements

The site measurements are conducted on-line with portable measuring instruments. The results obtained are collected in standard formats.

Detailed analysis

A detailed analysis is performed by using standard engineering techniques and computational tools such as software, etc. Various energy conservation measures are suggested in the energy audit report.

Implementation

Unless the energy conservation measures are implemented, the saving potential will not be realized. Hence, more emphasis should be given for the implementation of energy conservation measures, for which the schedule may be further classified as follows:

- Immediate measures: No investment required
- Short term measures: Payback less than 6 months
- Medium term measures: Payback between 6 to 12 months
- Long term measures: Payback more than 12 months

Various energy conservation opportunities

The various energy conservation measures suggested by ERDA, and which have been implemented by clients, are presented below:

Case-I

Air conditioning Plants

A commercial building comprises of two centralized air-conditioning plants of rating 570 TR each. Normally one plant is kept in operation to meet the air conditioning load of the entire complex. Specific Power Consumption (SPC) obtained for both the air-conditioning plants is 25% higher than the design value, and the same is due to 24% lesser cooling water flow to the condenser.

It is suggested that carrying out maintenance of the cooling water pumps will increase the feed rate to the condenser, thereby improving the SPC. This will result in a power saving potential of 38.4 kW and the equivalent monetary saving is Rs. 5.7 lakh per year. Considering the investment required, the payback period would be 3.1 months.

Case-II

Air Handling Units (AHUs)

The Air handling unit is generally called an AHU and is used to transfer the cooling load from the air-conditioning plant to the user points. For human comfort, 25°C is the ideal temperature, and the lesser the temperature maintained in the air-conditioned space, the more would be the energy consumption thereby increasing the SPC. In the commercial complex under study, the room temperature was maintained in the range of 10-23°C. It was suggested to maintain the temperature close to 25°C so as to reduce the power consumed by the air-conditioning plant.

This exercise has resulted in a reduction of 10 TR cooling load and the equivalent monetary saving is Rs. 3.0 lakh per year – without any investment.

Case-III

Optimization of lighting supply voltage

The average lighting supply voltage maintained across the lighting feeders was 250 volts. Normally for lighting, 230 volts is the ideal supply to give the desired illumination. Optimum supply voltage will reduce the replacement cost of lamps and the power consumption too.

The total lighting load of the complex under study is 118 kW. By reducing the supply voltage to 230 volts, a saving potential of 26.6 kW was realized. The saving potential is equivalent to Rs. 4.8 lakh per year, and considering the investment required the payback period is only 3 months.

Case-IV

Switching off CW pumps

The commercial complex under study has two air-conditioning plants of rating 225 TR each. The cooling water requirement is met by CW pumps of rating 22 kW. Generally, two CW pumps are operated at a time – irrespective of the number of air – conditioning plants in operation.

During the time of energy audit, it was observed that one AC plant and two CW pumps were in operation. And, the flow delivered to the condenser was more than twice the design value.

But immediately – during the time of energy audit, when one CW pump was switched off, the other pump could meet the cooling water requirement of one AC plant without any difficulty. The exercise has resulted in a saving of Rs. 9.43 lakh per year.

Case-V

Power factor improvement

The power factor plays a vital role in reducing system loss, and for getting incentives from the power utility. The commercial complex under study has an average power factor maintained at 0.976. No automatic power factor controller was installed. By maintaining the power factor at 0.985, the client will get an incentive for Rs. 19 lakh per year. Considering the investment required, the payback period would be 7 months.

Conclusions

- There is ample scope for energy conservation in large commercial complexes, which is in the range of 20-40%.
- Awareness among employees and good housekeeping measures, could save a good amount of energy.
- All the energy conservation measures suggested by ERDA have been implemented.
- Monitoring and control is mandatory to get the saving potential on a recurring basis.
- Top management support is required for effective implementation for energy conservation measures.

Reference Book:

Electrical India
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