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Energy Efficiency opportunity in Lighting

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Abstract:

Lighting is an extremely efficient way of altering perception. In India, lighting sector consumes one fifth of total electricity consumption. Lighting sector is one of the dominant energy guzzlers and also contributes significantly to peak load. Lighting measures have been identified as one of the most effective opportunity for reducing energy usage. Moreover, the energy reduction in lighting sector also has a secondary effect on the HVAC load and peak HVAC requirements of a building. This paper talks about the energy efficiency opportunity in an existing commercial building (hotel) and how it helps bring down HVAC load.

Description:

Building owners are facing significant challenges of increasing energy cost and unreliable networks. Rising operating budgets are directly linked to energy costs in lighting, HVAC and other building services. Lighting is the second highest component of energy consumption in a building. A proper building energy assessment (Energy Audit) can help building owners or facility managers understand their energy usage and take effective measures to reduce energy costs. The first step towards energy efficiency is to understand the current energy usage pattern. Energy Audit identifies the usage pattern and also helps figure out various energy conservation measures that can be implemented.

Assessment:

While performing energy audit in a commercial building located in NCR region, a detailed study has been performed to understand the lighting consumption pattern and the measures by which energy consumption can be reduced. In this study it was found that building uses following energy resources:

S.No	Fuel used	Units	Consumption	% share	Expenses
1	Electricity	kWh	4219763.86	97	4,00,24,533
2	PNG	SCM	117026.95	3	49,25,444
3	Diesel	Ltrs.	17577.46	0	5,82,615

Table 1: Overview of Energy consumption

In this energy audit study, emphasis was on lighting sector, and by performing study specifically for lighting it was identified that the building had a lighting load of 269 kW. As the building is operated by Grid and DG sets, weighted average price was calculated to be 9.42 Rs/kWh. In a hotel, lighting load varies as per usage in different zones. After performing detailed exercise we identified the number of fixtures under each category of lamp family. Details are as follows:

Connected Load Details of Lighting in Imperial Hotel				
S.No	**Type of Light**	**Watt**	**Total No of lamps**	**Total Load (kW)**
1	CFL	36	124	4.46
2	T5@28+2	30	730	21.90
3	T5@14+3	17	260	4.42
4	T8@36+4	40	30	1.20
5	Halogen	75	134	10.05
6	Halogen	50	3368	168.40
8	CFL	5	10	0.05
9	Bulb	60	754	45.24
10	Bulb	40	336	13.44
TOTAL LOAD (kW)		**269**		

Table 2: Lighting connected load

With this study we identified that main load in lighting is due to Halogen lights which is 178 kW. Halogen

lamps are energy inefficient lamps. As per the above mentioned results energy saving calculations was

performed to find out the feasibility of project.

Energy Conservation measures:

Recommendation 1:-

Replace Halogen lights by LED lights as they are inefficient lights and also increase the HVAC load.

Detailed calculation is as follows:

Connected Load Details of Lighting in Imperial Hotel				
S.No	**Type of Light**	**Watt**	**Total No of lamps**	**Total Load (kW)**
1	CFL	36	124	4.46
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TOTAL LOAD (kW)	**269**

Table 3: Energy saving by retrofitting

Indirect energy saving by reduction in cooling demand due to retrofitting is as follows:

Cooling load reduction by replacing Halogen lights in rooms	
Type of Light	**50W Halogen**
No of lamps	2400
Wattage	50
Connected Load (kW)	120
Running hours(hrs/day)	8
Operating days in a year	350
Existing cooling load because of lighting(Btu/hr)	409200
Existing cooling load because of lighting(TR)	34
Existing SPC of chiller(kW/TR)	0.8
Load consumed in cooling due to lighting(kW)	27
Average occupancy	30%
Energy consumed in a day(kWh/day)	65
Energy Consumed in a year(kWh/year)	22915
Avg.Energy charge(Rs/kWh)	9.42
Annual expense(Rs/year)	215861
Saving Model	
Type of Light	**10W LED**
No of lamps	2400
Wattage	10

Table 4: Energy saving due to reduction in cooling load

Combine summary of Energy saving me above mentioned measures is as follows:

Summary	
Total Energy Saved due to replacement of lighting(kWh/annum)	**80640**
Total Energy Saved due to reduction of cooling load(kWh/annum)	**18332**
Overall Energy Saved(kWh/annum)	**98972**
Total Amount Saved due to replacement of lighting(Rs/annum)	**759629**
Total amount saved due to reduced TR load(Rs/annum)	**172689**
Overall amount saved(Rs/annum)	**932318**
Total Investment Amount(Rs)	**3600000**
Payback Period(Years)	**3.9**
Carbon Emission reduced(tCO2)	**79**

Conclusions:

Replacing energy inefficient halogen lamps via energy efficient LED lamps can lead to a cost saving of Rs 9.32 LPA with a payback period of 3.9 years and Return on Investment of 25.8%.