

Question 1

a.) Consumption according to present traditional grid system(monthly):

On an average a shopping centre annually consumes $250 \text{ kW/} m^2$ according to the present traditional grid system.

Average monthly electricity consumption = **20.83 kWh/ m^2**

Average area of a shopping centre(medium to large size) = **20,000 m^2**

Total monthly electricity consumption = **4,16,600 kWh**

Average cost of 1 kWh(1 unit) of power in India = **Rs 5.35**

(This can vary upon the demand of load so assuming an average value which costs on commercial purposes)

Total monthly bill on a shopping centre = **Rs 22,28,810**

Considering the air-conditioning system, lightning arrangement, elevator system and other miscellaneous arrangements consumption per month is given as:

Air conditioning system consumes 50% → **2,08,300 kWh → Rs 11,14,405**

Lightning + Elevator system consumes 30% → **1,24,980 kWh → Rs 6,68,643**

Other Miscellaneous consumes 20% → **83,320 kWh → Rs 4,45,762**

b.) Assumptions using smart grid technologies and reducing the electricity bill(monthly):

Assuming the average cost of 1 kWh(1 unit) is same as in the previous case → Rs 5.35

1.) Using rooftop solar panels:

Using rooftop solar panels and providing a switching or automation system between distribution grid and rooftop solar panels by observing the high peak and low peak demand instants can save **40%** of electricity usage.

Smart grid system = **4,16,600 - (40%*4,16,600) kWh = 2,49,960 kWh**

Cost according to smart grid system = **Rs 13,37,286**

Savings = **Rs 8,91,524**

2.) Using smart lightning system and fluorescent LED Lamps:

Using advanced and smart lightning systems i.e using LED lights which function according to the frequency of customers moving in that place(activated by some IoT sensors and monitored through the web) can reduce **30%** of electricity usage.

Smart grid system	=	1,24,980 - (30%*1,24,980) kWh = 87,486 kWh
Cost according to smart grid system	=	Rs 4,68,050
Savings	=	Rs 2,00,592

3.) Using smart building technology:

Using a HVAC(Heating, Ventilation and air-Conditioning) system with variable frequency drive technology or smart thermostat offers energy savings upto **25-30%** (approx).

Smart grid system	=	2,08,300 - (25%*2,08,300) kWh = 1,56,225 kWh
Cost according to smart grid system	=	Rs 8,35,000
Savings	=	Rs 2,78,000

Using a window shading system with switchable film technology or smart glass also offers energy savings upto **30%** (approx).

Smart grid system	=	4,16,600 - (30%*4,16,600) kWh = 2,91,620 kWh
Cost according to smart grid system	=	Rs 15,60,167
Savings	=	Rs 6,68,643

In this way many smart grid technologies have come up with possible solutions which can reduce around 30% of energy on an average approximately in shopping stores and centres. Out of these technologies usage solar energy is more efficient in working and also renewable(pollution free) to use.

Question 2:

References and web links used:

<https://openaccess.iyte.edu.tr/xmlui/bitstream/handle/11147/4753/4753.pdf?sequence=1&isAlloved=y>

<https://sites.ualberta.ca/~deyoung/myweb/mallenergy.pdf>

<https://electricityplans.com/12-ways-reduce-electricity-costs/>

<https://environmentamerica.org/sites/environment/files/reports/AME%20Solar%20Stores%20Feb16.pdf>

<https://www.aceee.org/sites/default/files/publications/researchreports/a1701.pdf>

<https://www.quora.com/In-India-what-was-the-price-of-1-unit-of-an-electric-bill>