International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Methodology to Calculate the Energy Consumption and Supply for One Family House in Buildings

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Abstract—*A case study of one house has taken for taking care energy demand, crisis and energy supply for one family or one house. It is one step to save environment climate in world, It is necessary for large population of world (especially India and China) is increasing with an alarming rate, there is an increase in the demand of conventional energy resources leading to its depletion, therefore emphasis is now given on the resources which will not only fulfil the demand of energy requirement but also provide eco-friendly environment for its inhabitant. This paper deals with the overall setup of solar PV system (including capacity required and cost incurred for its component) in order to meet the need of electrical energy requirement for a family of four people with their basic need of energy to run their basic household appliance without taking any energy from grid. As one family buildings become more energy efficient, small power equipment with all appliance are an increasingly significant source of energy end-use and consumption for one family and one apartment.*

Keywords— *Energy consumption, building lighting system, electric supply.*

I. INTRODUCTION

Energy demand in buildings has increased as a direct result of a population boom. Increase in time spent indoors have also impacted energy consumption patterns in tandem with progress in technology which has introduced automation. As power production has been cranked-up to meet today's growing energy demand, conventional sources are on the verge of getting exhausted. Not only does the depletion of resources pose serious concerns but also the usage of fossil fuels has a huge impact on the environment. Therefore, switching to off-grid or grid assisted self-powered sustainable solutions might prove profitable in the long run. Such a system can be powered by a robust solar photovoltaic system which has a low environmental impact. Depending on the metrological characteristics of the locality wind turbines can be proposed to help energy supply. Such self-powered buildings are independent of infrastructural support. Thus, costs incurred and energy losses associated with transmission and distribution of electricity is averted. For an off-grid setup, resource management is paramount from the point of effectiveness and cost. One of the chief causes of energy depletion in buildings is cooling. Therefore, passive cooling or cooling with minimum mechanical assistance should be implemented in such buildings.

In order to maintain comfortable condition indoors, the temperature should be maintained 4 degrees centigrade below the outside temperature and relative humidity should be low.

Chemical dehumidification along with earth-air tunnels can be used to cool the outside air and then supply it indoors through ducts. Separate ventilation ducts can be placed to set-up natural convection. As the population of world (especially India and China) is increasing with an alarming rate, there is an increase in the demand of conventional energy resources leading to its depletion, therefore emphasis is now given on the resources which will not only fulfill the demand of energy requirement but also provide eco-friendly environment for its inhabitant. This paper deals with the overall setup of solar PV system (including capacity required and cost incurred for its component) in order to meet the need of electrical energy requirement for a family of four people with their basic need of energy to run their basic household appliance without taking any energy from grid.

Self-Energy Building is an approach toward manage of energy required for building such as fan, cooler, tubelight, water pump etc. It is possible only energy obtained from natural resources includes wind energy, solar energy, by phase change material using by latent heat for building application with thermal storage etc. Our emphasis would be on solar energy. In Solar cell a photovoltaic cell is an electric device which convert light energy into electric energy. The main component include solar panel, battery. Size of panel and battery depend on energy requirement for building

Energy requirement depend on number of family member, number of appliances and energy consumed by each of them, wiring length and some amount of losses. But here we are interested ideal case mean ignore the all kind of losses.

To make building self-sufficient energy fulfillment we have to taken care of architecture point of view which embraces number of windows and angle at which window have to fix for proper ventilation, light, cooling or heating comfort as per weather in order to optimize energy requirement for fan, light. There should be material chosen for avoiding transfer of heat through wall from outside environment to inside building. Wall material should be insulating material. Now days generally thermocol is filled inside wall like sandwich. Wall should be made of phase change material to store thermal energy for some purpose like heating room, heating water etc. in form of latent heat.

Extra amount of energy after solar energy obtained by solar cell can be fulfilled by organic waste of building such biogas plant. Actually in biogas plant man excreted waste, organic waste such as vegetables skin and paper and other degradable product is mixed with water in proper ratio which produces mehane gas from which cooking gas requirement can be filled moreover light can also be glow. Other method that be used beyond solar energy is phase change material for storing thermal energy in form of latent heat which works on principle of a material which fuse when solar light falls on it and store thermal energy and become solid when energy is taken out of it for some purpose.

For proper fulfillment of building energy requirement we can optimize energy by changing some approach toward nature such as storing water on roof, called green roof. In fact storing water saves daily requirement for water pump to pump water in tank as well we saving ground water. Like green roof similar concept can be applied for wind energy. By installing wind turbine on roof will reduce the solar energy requirement. In wind energy a turbine blade rotates blade of turbine from which a dynamo is connected by which electricity is produced that used in daily building requirement. With the increase in awareness toward improving environmental condition by cutting down the hazardous gaseous emission of the coal based power plant, renewable source of energy has become the emerging trend in the developing as well as the developed countries. Self-powered house with modified building materials helps in achieving reducing dependency on the power grid to almost zero percentage by making use of solar panels, solar water heater etc.

Renewable source of energy such as wind power, hydropower, geothermal, solar power, etc. are the energy source which is available in abundance and are used to power cities by installing a suitable capacity plants. Such practice will not only cut down the cost of power consumption but also helps in keeping the environment clean by providing zero emission of harmful gases such as $NO_{x,}$ $SO_{x,}$ CO, etc. Conventional power plant such as coal based thermal power plant not only produce harmful gases but also pollute the water as they require large amount of water from the nearby reservoir for producing steam. According to a report of twenty countries along with two states of U.S. is planning to phase out coal and cut carbon emissions by 2030 in an effort to keep to the Paris Agreement target for lowering emissions.

Solar power is utilized by means of Photovoltaic technology that reliably converts solar radiation into electricity. There are different types of modules available in the market depending on power ratings and can be clubbed together to meet the ones power need. Every module has a number of solar cells which is fabricated by means of semiconductors such as silicon. Photovoltaic cells generate electricity in clean and reliable manner and whose efficiency can be improved by providing proper inclination, periodic cleaning of panels, etc., which is the prime concern for today's environmental wellbeing. The main components of a rooftop solar system consists of:-

1. Solar Panel (In India generally rating of 40W is used)
2. Solar charge controller
3. Inverter
4. Batteries

Solar panels captures the sun's radiation and convert it into electricity by making use of fabricated semiconductor thereafter, the electricity thus generated is sent to solar charge controller which access the quantity of electricity that needs to be used for charging the batteries and the quantity that should be used for real time power need of the house. The inverter and battery capacity is decided by taking into account the losses that occur while converting electrical energy from AC to DC and vice-versa, wire loss, type of motor or likewise heavy electrical equipment for starting surge current for few seconds.

Total energy consumption by a family of 5 living in a 3BHK with 2 bathroom. 1125sq.ft house

Appliance	Qty	Power(W)	Hrs./day	Energy/day(MJ)	Model
Fan	5	28	84	8.4672	general
Tubelight	7	20	38	2.736	general
LED lights	8	6	68	1.4688	10 w
TV	1	40	10	1.44	general
Set-top box	1	10	10	0.36	general
Exhaust	3	8	18	0.5184	0.5 w
Refrigerator	1		24	9	200 litre
Mixer	1	500	1	1.8	Small
Motor	1	372.85	1	1.34226	0.5 hp
Geyser	2	2000	3	21.6	10 litre
Phone	1	3	24	0.26	general
Desktop	1	200	5	3.6	General
RO	1	60	2	0.432	
Water purifier	1	10	22	0.792	
Mobile	3			0.1296	
Laptop	1	70	10	2.52	
TOTAL				**56.47**	

Energy demand in buildings has increased as a direct result of a population boom. Increase in time spent indoors have also impacted energy consumption patterns in tandem with progress in technology which has introduced automation. for one family house total predicted power demand has calculated. The presence of plug loads not included in the like so many equipment such as mobile phone chargers, desk fans and task lighting, etc., It can may add total for the underestimation of power demand. The energy consumption also includes the profile used in equipment for compliance with Building. This is under Regulations in electricity boards National Calculation

Methodology (NCM). In this case, the NCM profile and calculation pattern would slightly overestimate the operational demand when the office is occupied, especially around the beginning and end of the working day, whilst significantly underestimating overnight heat gains.

As power production has been cranked-up to meet today's growing energy demand, conventional sources are on the verge of getting exhausted. Not only does the depletion of resources pose serious concerns but also the usage of fossil fuels has a huge impact on the environment. Therefore, switching to off-grid or grid assisted self-powered sustainable solutions might prove profitable in the long run. Such a system can be powered by a robust solar photovoltaic system which has a low environmental impact. Depending on the metrological characteristics of the locality wind turbines can be juxtaposed to solar PV systems. Such self-powered buildings are independent of infrastructural support. Thus, costs incurred and energy losses associated with transmission and distribution of electricity is averted. For an off-grid setup, resource management is paramount from the point of effectiveness and cost. One of the chief causes of energy depletion in buildings is cooling. Therefore, passive cooling or cooling with minimum mechanical assistance should be implemented in such buildings. In order to maintain comfortable condition indoors, the temperature should be maintained 4 degrees centigrade below the outside temperature and relative humidity should be low. Chemical dehumidification along with earth-air tunnels can be used to cool the outside air and then supply it indoors through ducts. Separate ventilation ducts can be placed to set-up natural convection.

II. Conclusion

This paper has described detailed the energy consumption and energy supply for one family building for development for predicting electricity consumption and power demand profiles. Calculation have demonstrated a good manner metered data and monthly predictions of energy consumption. Prediction ranges for power demand profiles were also observed to be representative of metered data with minor exceptions. Model 1 provides a more robust methodology for predicting the variability in power demand throughout a given day, being of particular use to building services design that are very sensitive to changes in internal heat gains. However, appropriate monitored data for individual appliances must be acquired to suitably represent the office space under investigation, and these might not be available at the design stage. Currently, self-powered power consumption and demand are often estimated based on the use of benchmarks in one family building. This calculation has its limitations, mostly due to the variability of small power as an end-use, which might not be directly related to current benchmark classifications. This study showed the significant /and improvement to predictions of one small building performance. In near future it help in design of an energy consumption perspective but also from a thermal comfort for house holders, by ensuring that internal heat gains and heat extraction due to small power like light/fan etc. equipment are accurately accounted for in the design of building systems.

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