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# Sustainable energy efficiency lighting in Green buildings: An approach with DC based lighting systems

**Sujit Kumar Patro[1], G.R.K.D. Satya Prasad[2], Deepak kumar dash[3], Sanket bhoi [4], Jyotiranjan nayak[5], Biswa ranjan rautray [6]**

[1] *Assistant Professor, Department of Electrical Engineering, GIET, Gunupur, Orissa, INDIA*
[2] *Associate Professor, Department of Electrical Engineering, GIET, Gunupur, Orissa, INDIA*
[3,4,5,6]*Final Year UG student, Dept. of Electrical Engineering, GIET, Gunupur, Orissa, INDIA*

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**Abstract:**

With energy costs expected to increase significantly in the next decade, options to reduce or eliminate these expenses are growing. In a typical college or university classroom building, lighting represents 31 percent of total energy use, making this the best target for energy savings. New technologies and changes in philosophical approaches have dramatically decreased costs associated with lighting. Several major colleges and universities have installed different lighting systems to limit raising energy costs. With many available options currently on the market, one must consider the potential costs for implantation as well as which system is right for their institution. Day lighting and lighting controls are two such options that work together to optimize light throughout a building while being energy efficient.

In this paper the main focus is on the efficient energy consumption in green building in GIET campus. As it is a green building we will take care of each and every load including the lighting load. We have to consider the consumption of light in day time so we can utilize the penetration of sunlight which will give the proper ventilation, light and health consideration.

We have considered the loads of a single room and start optimizing by simulation. By doing this project we can reach our optimum level to do efficient light consumption by dc based lighting system in green building

**Keywords: DC lighting, green-building, Homer**

## I. INTRODUCTION:

Electricity is the important parameter for developing for day today life and socioeconomics of a country.

India largely depends on fossil fuel and hydro power station to generate major portion of the power and still it lack behind the production capacity. High demand and increasing need of power challenge for the power station by using thing challenge the research on renewable energy source such as solar energy and wind energy is highly demanding. Again the load which we are using 60% is lighting load if we use that 60% load in the renewable energy source than we can save on grid production and save electricity. In this paper we have taken a ac load and dc load and compare in a green building with homer software. Here in this paper we compare AC load (with grid and renewable energy) and DC load and check the economics consideration

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

## II.GREEN-BUILDING:

Green building are called as sustainable building. It is the right combination of house building and existing environment. Green building is the result of equal contribution of design team, engineers, and the client in the projects. The main objective of green building is to minimize the overall impact of existing environment on human beings. Green building helps proper use of water, solar energy, wind energy and other resources. It also helps in betterment of health and improves productivity with minimizing the pollution and degradation of environment. Green building may also be referred as getting the requirement of present generation without affecting the needs of future generation. There are 10 energy building technologies such a zero energy home, Smart-appliance, electro chromic smart glass, solar power, Geothermal heating, waste water management, bricks, Biodegradable materials, Green insulation, Cool roofs. Green building will cost more at the starting because the materials which are used are costly but the payback period is very less. We can save money on energy cost because the energy consumption is very less. The advantages of Green building start from environmental issue to economic condition of society. Green building helps to minimize the operating cost and also make the market for green services. It helps to improve the quality of life and comfortless. The prime goal of green building is not to disturb the natural habitats around the building. The other environmental benefits of green building are emission, water conservation, storm management, temperature management.

## III.LIGHTING

Lighting is the process of proper use of light to get the practical desirable and cosmetic effects. Lighting is the combine use of both artificial light sources (like lamps, LEDS, CFLS) and the natural light source that is day lighting. The main sources of day lighting are windows ,skylights or light

shelves which can save the energy of artificial lighting in day time. Proper lighting improves the productivity, appearance of area. Indoor lighting is the most important parameter for the interior designing with the help of lighting fixtures. The functions of lighting fixtures include, for getting direct lighting and avoid very high brightness we can use holders. The main property of lighting fixture is luminous efficacy which is the measure of how well a light source produces visible light. It is defined as the ratio of luminous flux to power.

Measurement of lighting is generally related to the amount of lighting falls on the earth and the amount of lighting comes out from a lamp or other lighting resources along with the colors of light which absorbs by the light. The basic SI unit of measurement of lighting system is candela (cd).Luminance is the density of luminous intensity in a given direction. The SI unit of luminance is candela per square meter (cd/m2).Luminance is measured by Lux.

Lux is the SI unit of luminance measuring the luminous flux per unit area. It is equal to one lumen per square meter.

Lux = 10.76391 × watts × (lumens per watt) / (square feet)

It is very important to provide the correct light intensity and color spectrum for each environment .Otherwise not only energy will be wasted but also it can be resulted to negative effects to health and psychological effects. Health problems like headache, increased blood pressure which ultimately decrease the work efficiency of employee with bad lighting design.

There are many energy consumption strategies are available to minimize the energy requirements for lighting a building. Such as analysis of quality of light, integration of space planning and interior architecture, design of time of use that does not waste energy, maintenance, selection of lighting fixtures, proper use of natural lights, load shedding. Lighting control systems reduce the consumption and cost of the energy. It also provides light only where and when it is needed.

Day lighting is the most common and old method of lighting. construction of building should be done to get the proper light is such that the site for the green building is, where we will get the proper ventilation, proper penetration of light and indoor space. Day lighting have the positive effects on the patients in the hospitals as well as work and school performance. Basically we are using the major lighting load such as incandescent lamp, CFL, LED.

**IV.THEORETICAL ASPECTS OF DC DISTRIBUTION:**

Electricity flows in two ways either in Alternating current (AC) or in Direct current (DC) .In order to transport the electricity from generation to the user by the distribution system .An electrical distribution system is two types one is Ac distribution and another is Dc distribution .for dc distribution network is the dc grid, which is connects the PV elements and battery system to the household load, but in ac distribution network the ac grid is direct connecting to the household load. Theoretical difference between AC and DC has explained in the following section.

**AC vs DC:**

The main difference between AC and dc lies in the direction in which the electrons flow. In dc the electrons flow in single direction and in Ac, electrons both directions like something going to forward and then going backward. In other word Alternating current is the flow of charge that is change in direction periodically and the voltage level is reverses along with the current Ac is used to deliver power to houses, office buildings etc. And direct current provides a constant voltage and current.

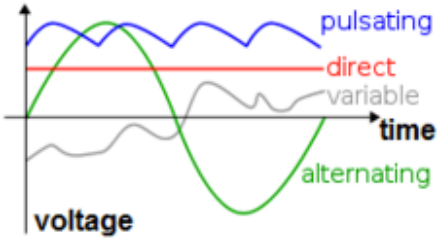


Fig.1 comparison between AC and DC

The frequency of alternating current is 50 t0 60 Hz depending upon the country and the current magnitude is varying with time and safe to transfer over longer city distances and can provides more power, its power factor lies between 0 & 1 with sinusoidal, trapezoidal, Triangular .But in direct current the frequency is zero and the current magnitude is constant and also voltages of dc cannot travel very far until begins with lose energy, its power factor is always 1 with pure and pulsating.

**B.AC vs. DC Lighting:**

Almost all on grid electrical systems use 120 volts Ac lighting. Ac lighting widely used in hardware stores and even many department and grocery stores. The accessories of ac lighting are easily obtained at lower prices and for the installing new wiring system, ac power can flow on much small gauge wiring with low costs. But two major disadvantages to using ac lighting in an alternative energy system. Firstly in order to flow 120 volt ac power from a storage battery bank and a inverter needed for convert dc battery power to ac. This can increase the overall cost of electricity. second one is Ac lighting is much less energy efficient than a dc system, that means the renewable energy generators need to be capable of producing more power to run the same number of lighting.

But DC lighting has most advantage of being for energy efficient lighting in building. A small panel or wind turbine or any resource can be used to run a dc lighting system than would be required for an AC lighting. So dc can be powered directly from the battery bank and for installing an inverter is not required. Although DC lighting fixture is the standard incandescent and halogen light can easily connected to the 12 dc power.

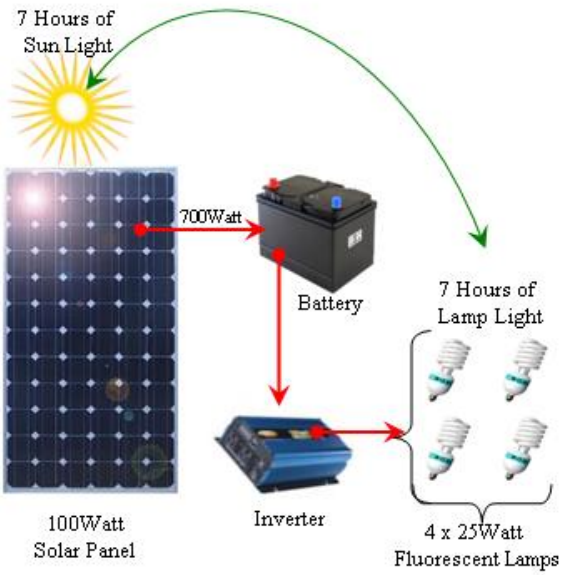


FIG2. PV based DC LED lighting

So now days we use dc lighting in every household appearances and any building like green building. In green building the main resources are renewable energy sources which produces dc power .so this dc power can used in green building by dc lighting system for saving the cost and energy loss in green building so we focus on dc lighting over ac lighting.

**V.DC lighting fixtures:**

**A. Market Analysis:**

The dc lighting market includes more companies and lager diversity of products than ac lighting and its products and also represents an insignificant role of the mainstream market as a outside emergency lighting. Dc light sources for dc most product company markets are Ablamp, nextek power system ,phocos, steca.thin light, sunwize etc. the table no.1 shows the different dc light used in dc based lighting system.

| Lighting type | Bulb type | Fixture type |
|---|---|---|
| Incandescent | Special 12v DC bulb | Regular fixture |
| Halogen | Special 12 v DC bulb | Regular fixture |

TABLE.1 comparison between different DC lighting loads

**Energy Savings Analysis:**

The dc technologies have high efficient than their ac counterparts. In CFLs, the DC power efficiency is almost 10 % than ac power with the same power consumption. For LEDs, the dc power efficiency is lager and depends upon the lamp power. But for incandescent lighting sources should have same efficiency in both dc and ac power operation. More and more devices, like LEDS are native users dc power, and therefore can be easier to build and smaller when directly connected to dc power and LEDs are saving the energy than other used dc light like dc CFL and incandescent.

**VI. Feasibility of dc lighting in green building:**

By providing energy efficient and direct access to safe power and cost so dc lighting system could:

1. Dc lighting makes to easier and less expensive to install lighting fixtures, sensors and other devices and also simple to re purpose.

2. By dc lighting technology can reduces the cost of power by using LED lighting and also reducing energy consumption via state of the art device control and digitally load and that can enable higher resolution control.

3. This system can promote sustainability and that have fewer materials without ac to dc conversion components and for use and reuse of the system it is mobility and simplicity

4. Very easy to direct connection and efficient use of energy from solar and wind.

5. This dc lighting is also allowed to facility technicians to quickly and safely move or reinstall the system at any time at any place. No any interrupt area occupants in this technology.

**VII.SIMULATION USING HOMER SOFTWARE**

The HOMER energy modelling software is a powerful tool for designing and analysing hybrid power systems, which contain a mix of conventional generators, combined heat and power, wind turbines, solar photovoltaic, batteries, fuel cells, hydropower, biomass and other inputs. For either grid-tied or off-grid environments, HOMER helps determine how variable resources such as wind and solar can be optimally integrated into hybrid systems. HOMER determines the economic feasibility of a hybrid energy system optimizes the system design and allows users to really understand how hybrid renewable systems work [14]. For our project homer showed the economic feasibility of using both panel and grid connection at the same time.In the following unit first all components that were required were entered. Such as total led load power,

total dc fan power, panel, grid power and controller which is represented as converter in Homer software. Then the specifications were mentioned in each of the components, such like panel wattage and total cost. Load wattage, cost, and time slot of the load distributions. Controller specification and cost and grid off peak and peak costs were also included. The next following figures will show the screen shots of how things were obtained in homer software.

## VIII.SIMULATION RESULTS

### INPUT:

We have connected the DC load to the renewable energy source. Here we only considers the dc light load of a particular building

### A.Setup using homer software with dc loads

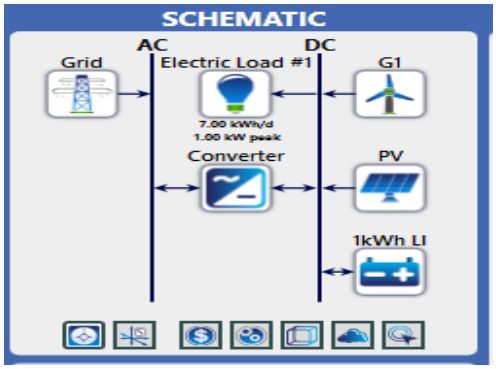


Fig. schematic diagram of dc lighting

| Load | Consumption (kWh/yr.) | Fraction (%) |
|---|---|---|
| AC primary load | 0 | 0 |
| DC primary load | 2,555 | 83 |
| Grid Sales | 517 | 17 |
| Total | 3,072 | 100 |

The lighting load is set in between 6pm to 12 am and in other time it will use natural lighting


Fig,D.C light load

### B. Setting of PV-cell:

Here we have taken 1kw PV solar cell with cost of RS.100000

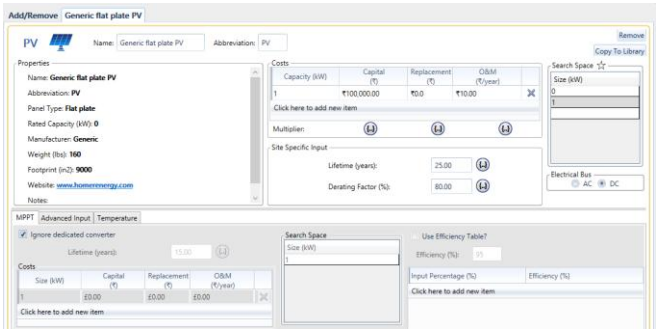


Fig. PV cell setting

### C. Setting of wind turbine:

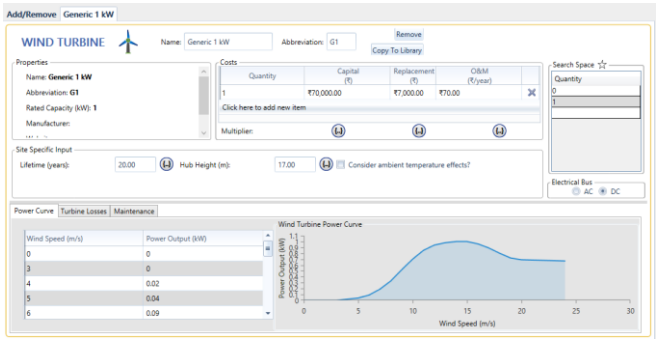


Fig. wind turbine cell setting

**D. Production of Different Resources**

| COMPONENT | Production (kWh/yr.) | Fraction (%) |
|---|---|---|
| PV | 1,741 | 52 |
| Wind Turbine | 371 | 11 |
| Grid Purchases | 1,234 | 37 |
| Total | 3,345 | 100 |

**F. Cost Comparison between Ac and Dc Lighting**

| Net Cost | A.C Lighting (In Rs.) | DC Lighting (In Rs.) |
|---|---|---|
| **Grid Electricity Cost** | 25,580 | 21,991 |
| **System Cost** | 254,428 | 252,344 |
| **Battery** | 16,507 | 18,012 |

**IX.CONCLUSION:**

The proposed model of Dc lighting save energy cost compared with Ac lighting. Operating lamps and other devices with a residential DC grid offers two major benefits: Overall power losses can be reduced. However, for a supply of the residential DC grid from a public AC grid, this effect is partly compensated by losses in the central rectifier. But energy savings become especially visible with the integration of additional local power sources. As a further benefit, complexity can be reduced in the powered devices by shifting it into the infrastructure. This can make the devices more durable and reliable. Especially for mass products like lamp drivers and consumer devices, which are manufactured and used in a huge number, this will reduce the overall cost. From a system point of view, it is advantageous to make those devices, which are needed in large numbers as simply and cheaply as possible and to allow a few central devices to be more complex. This cost advantage should be considered as the main benefit of the DC system. The specification of a DC system should take these benefits into account: To reduce losses in the distribution system and the voltage should be as high as possible

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