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THE SOLAR COLLEGE: REDUCING CARBON FOOT PRINT WITH GREEN TECHNOLOGIES-CASE STUDY

V.V. Prabhakar Rao

Department of S & H, Andhra Loyola Institute of Engineering & Technology, Vijayawada-8. (India)

ABSTRACT

College campuses are large energy consumers and have a continuous need for electricity, in increasing amounts, all day, every day. The engineering education sector owns and operates of buildings, owns acres of land and spends a lot of money each year on energy. In recent years, it has come to light about the impact global warming has had on the environment and what causes global warming. Nonrenewable energy resources release greenhouse gases while drilling and this is one the leading causes of global warming. To combat this, renewable energy sources have been a major investment. One such source is solar energy. This captures energy from the sun and converts it into power and electricity. Since the college campus runs on nonrenewable energy sources, it is contributing to global warming. The benefits associated with the development of on-site, "green" energy systems--solar photovoltaic systems in college campus, include reduced energy costs, enhanced service reliability, and a smaller carbon footprint. By switching over to green technologies like solar energy in this college campus, not only it is beneficial to the environment by reducing 98,550 pounds of carbon annually, giving excess power generated by solar panels in campus to government power grid and therefore reducing 78,840 pounds of carbon emission from the power grid, which reduces global warming, dependency on unreliable sources of fossil fuels but also proven to be cost effective.

Keywords: College Campus, Carbon Emissions, Green Technology, Nonrenewable Energy Resources, Power Grid, Renewable Energy Resources,

I. INTRODUCTION

In our world today, people rely on oil, natural gas, and coal to provide energy .Nonrenewable energy sources are those that cannot be replaced as fast as they are being used or have limited quantities (Barry, 2012, Para. 1) [1]. Nonrenewable energy sources also pose many threats to the environment. The potential danger of collecting fossil fuels is extensive (Eriksson, 2012, Para. 12)[2]. These are nonrenewable energy sources that create toxic emissions into the atmosphere, called greenhouse gases. With the depletion of nonrenewable energy sources and the problems that greenhouse gases cause to the environment, people have started to look towards alternative energy sources.

Alternative energy refers to any way of producing energy that does not require fossil or nuclear fuels. This has led to the discovery of renewable energy sources. These resources are available infinitely. The most appealing sources of energy are wind, water, and sun (Eriksson, 2012, Para. 18)[3]. Solar energy is the conversion of sunlight into usable energy (Power Source Solar, 2008, para. 2)[4]. The reason solar energy has become a leading

alternative energy source is because more energy from the sun falls on the Earth in one hour than is used by everyone in the world in one year (National Renewable Energy Laboratory, 2009, Para. 1)[5] and is proven to be more cost effective in the long run and help the state of the environment. The first and foremost advantage of solar energy is that it does not emit any greenhouse gases (Whitburn, 2012, para. 3)[6].

Solar panels have been invented which captures this energy and allows it to be transformed into electricity and other energies.

II. OBJECTIVE OF THE STUDY

The purpose of this analytical research paper is to provide information about nonrenewable energy resources and the effects of greenhouse gases to the environment. It also presents ideas about alternative energy sources, focusing specifically on solar energy and how it helps to reduce global warming by reducing releasing of green house gases(especially carbon gas). There will also be information about installing solar panels on the roofs of buildings around campus and their benefits for the entire college campus.

III. STUDY AREA

Andhra Loyola College was established in 9 December 1953 by the Society of Jesus (Jesuits), an international religious order of Catholic priests and brothers founded by Ignatius of Loyola, who run over 200 colleges and universities worldwide. The college is situated on 98 acres of land in which 12 acres of land is occupied with Andhra Loyola institute of engineering and technology offering 6 undergrad and 3 postgraduate programs. Facilities include 70 classrooms, 22 labs, digital library, 8 seminar halls, 2drawing halls, 1workshop, 3 guest rooms 2 boys hostels, an auditorium with capacity for 2500 students, 450 computers with LAN connectivity.

Solar panels are installed on four stored building in three directions in north building (120 panels), south building (120 panels) and west building (194 panels).Total 434 solar panel are installed to produce 100 kw.

Fig.1: Photo voltaic cells on west side of Andhra Loyola Institute of Engineering and Technology (ALIET)

Fig.2: Photo voltaic cells on North side of Andhra Loyola Institute of Engineering and Technology (ALIET)

Fig.3: Photo voltaic cells on South side of Andhra Loyola Institute of Engineering and Technology (ALIET)

IV. MATERIAL AND METHODS

4.1Solar Cell

Silicon—used to make some the earliest photovoltaic (PV) devices—is still the most popular material for solar cells. Silicon is also the second-most abundant element in the Earth's crust (after oxygen). However, to be useful as a semiconductor material in solar cells, silicon must be refined to a purity of 99.9999%. A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Solar cells are the building blocks of photovoltaic modules, otherwise known as solar panels.

Assemblies of solar cells are used to make solar modules which generate electrical power from sunlight. Multiple solar cells in an integrated group, all oriented in one plane, constitute a solar photovoltaic panel or solar photovoltaic module.

Photovoltaic modules often have a sheet of glass on the sun-facing side, allowing light to pass while protecting the semiconductor wafers. Solar cells are usually connected in series in modules, creating an additive voltage. Connecting cells in parallel yields a higher current.

4.2 How Photons are Converted to Electricity

The photovoltaic effect is the creation of voltage or electric current in a material upon exposure to light and is a physical and chemical phenomenon. The term *photon* (meaning "visible-light particle").When the sunlight or any other light is incident upon a material surface, the electrons present in the valence band absorb energy and, being excited, jump to the conduction band and become free. The chemical bonds of the material are vital for the process to work, as crystallized atoms are ionized and create a chemical electric imbalance, driving the electrons. These highly excited, non-thermal electrons diffuse, and some reach a junction where they are accelerated into a different material by a built-in potential (Galvani potential). This generates an electromotive force, and thus some of the light energy is converted into electric energy[7].

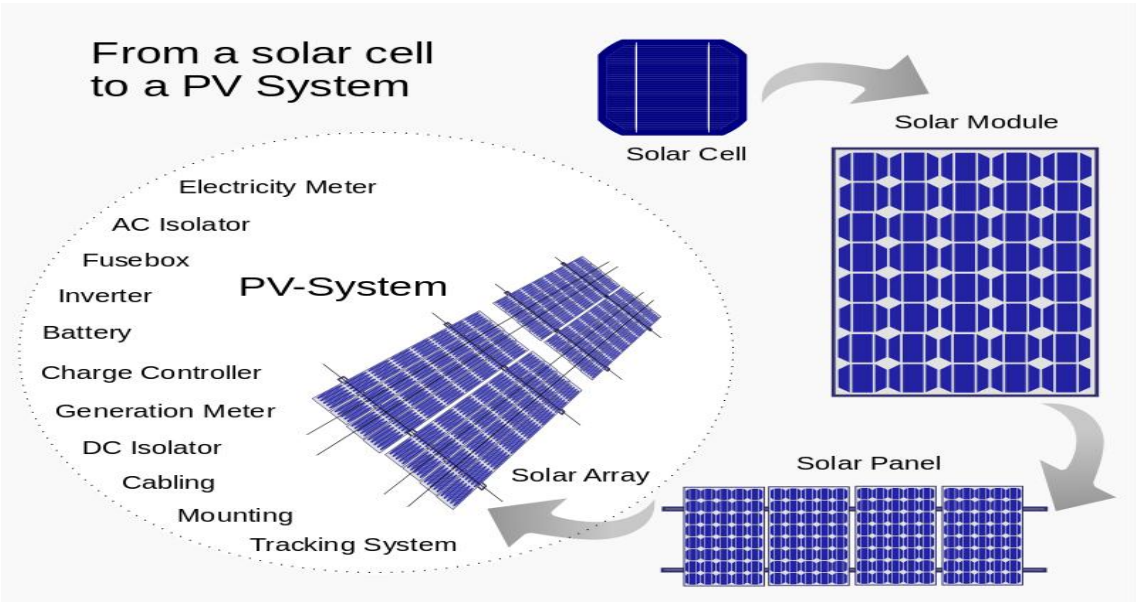

Fig 4: Cell to PV System

4.3 Modelling of A Solar Cell

A sunlight based cell is the key working unit of a daylight based board. A photovoltaic display is surrounded by making a relationship of various PV cells in course of action and parallel. Considering simply a lone PV cell; it could be shown by using a current source, a diode and resistors. This model is the single diode model of PV cell. Two diode models are similarly used however simply single diode model is considered[8].

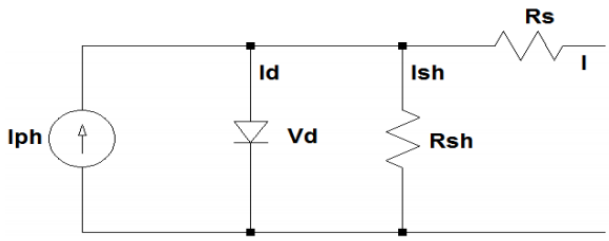

Fig 5. Single Diode Model of a Solar Cell

The characteristic equation for a photovoltaic cell is given by,

$$Iph = Iscr + ki(T - 298)*\eta \ (2.1) \qquad \ldots\ldots\ldots(1)$$

where k:Boltzmann's constant, 1.38 *10-23 J/K; q: Electron charge, 1.6*10-19 C;

Ki: Short circuit current temperature coefficient at Iscr; Lambda: Solar irradiation in W/m2 ;

Iscr : Short circuit current at 25 degree Celsius; Iph : Light-generated current;

Ego : Band gap for silicon; Tr : Reference temperature; Ior : Cell saturation current at Tr;

Rsh : Shunt resistance; Rs : Series resistance

V. RESULTS

No. of panels on the roof=434

434 panels produces=80-100kw

*To produce 1kw coal required is 1.5 pounds that releases 2.7 pounds of carbon

*To produce 100kw coal required is 150 pounds that releases 270 pounds of carbon

Annual calculation:

100kw*365 days=36500kw.

100kw requires 150 pounds of coal*365days=54,750 pounds of coal.

Combustion of 54,750 pounds of coal releases 98,550 pounds of carbon.

Table1. Carbon Emission reduction in College Campus & by Power grid in 2015.

MONTH	POWER GENERATED BY SOLAR PANELS (In kw)	POWER USAGE IN CAMPUS	CARBON EMISSION REDUCED BY (CAMPUS in pounds)	POWER GIVEN TO GOVERNMENT (POWER GRID) In kw	CARBON EMISSIONS REDUCED BY (POWER GRID) In pounds
January	84	10	27	74	199.8
February	86	10	27	76	205.2

March	90	11	29.7	79	213.3
April	94	11	29.7	83	224.1
May	96	12	32.4	84	226.8
June	92	12	32.4	80	216
July	90	10	27	80	216
August	90	10	27	80	216
September	88	11	29.7	77	207.9
October	84	10	27	74	199.8
November	82	11	29.7	71	191.7
December	82	12	32.4	70	189

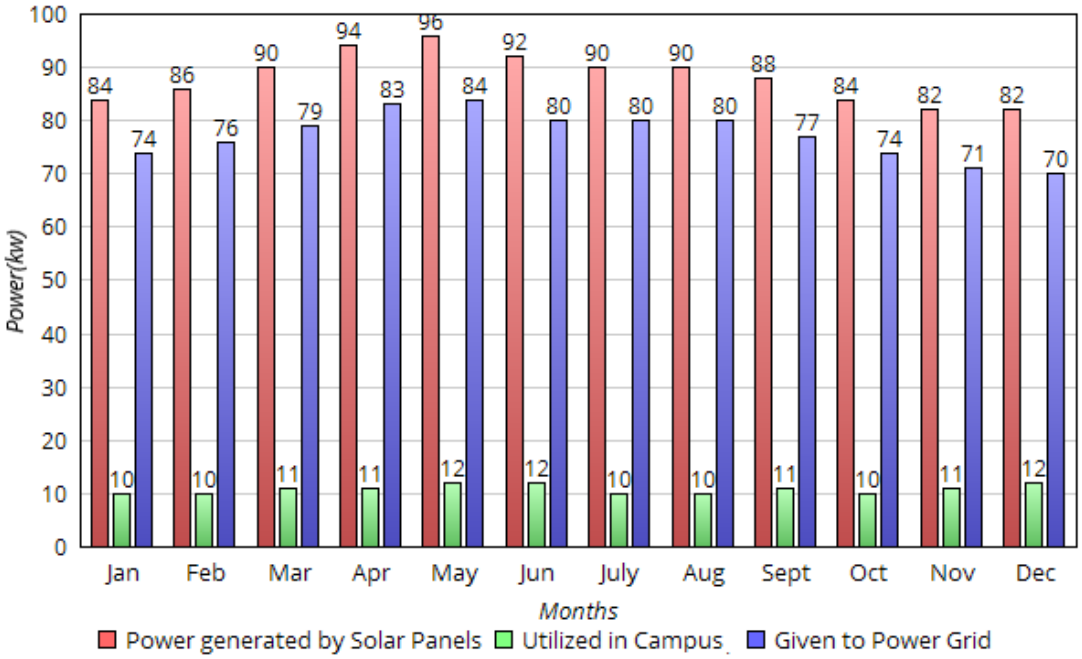

Fig 6.Power Generated by Solar panels, Utilized in Campus & given to Power grid (2015)

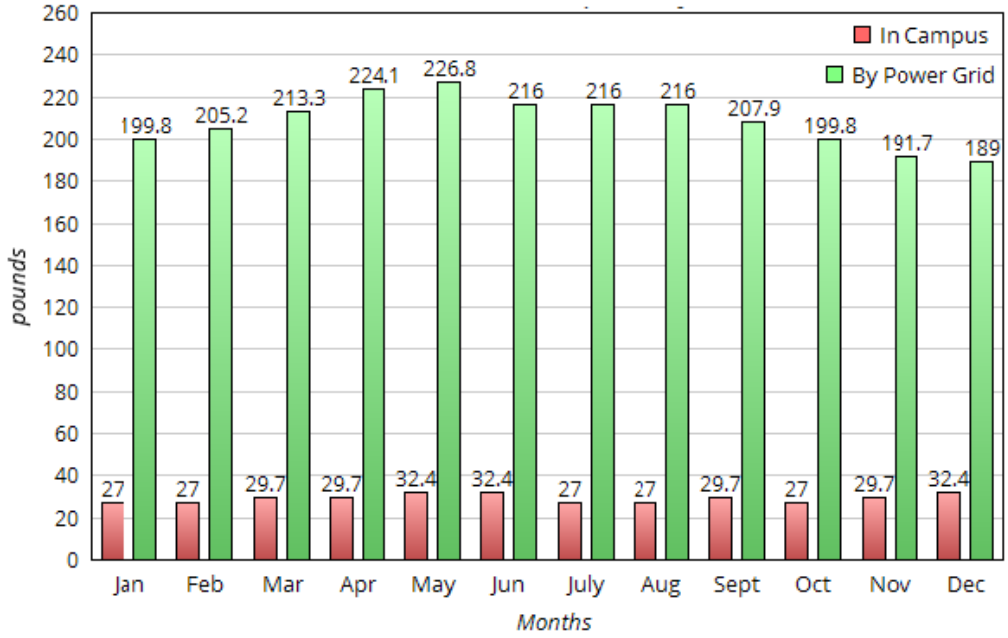

Fig 7.Carbon Emission Reduced in Campus & by power grid (2015)

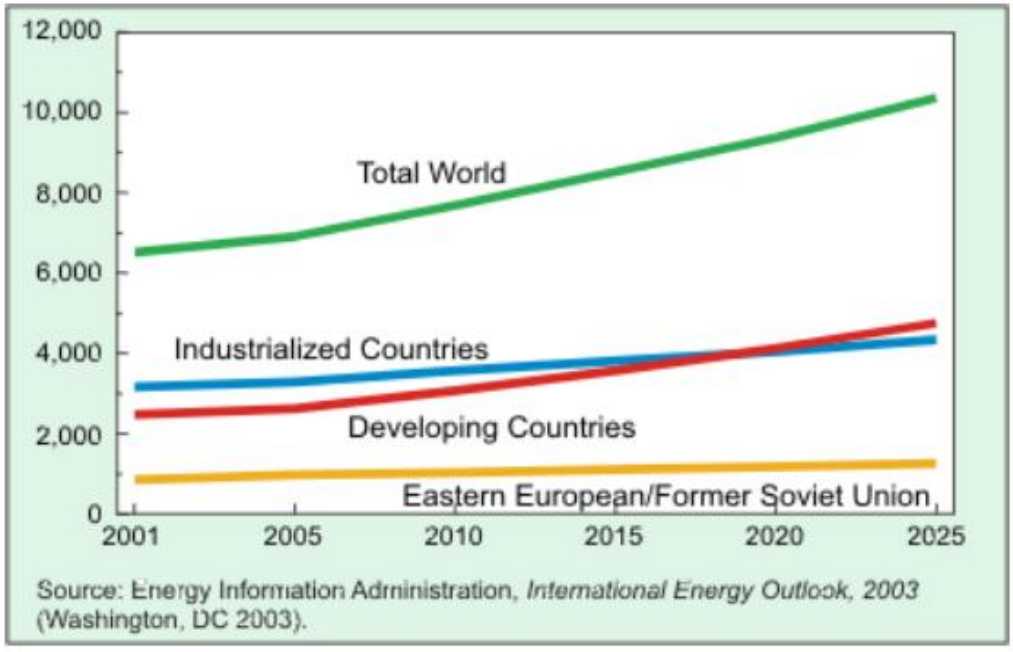

Fig 8.World carbon dioxide emission by region, 2001-2025

VI. DISCUSSION

The college is producing 80-100kw of electricity per day and only less than 20kw was used for campus needs, rest of the produced nearly 80kw was given to power grid in turn government is paying for the80kw electricity that is given to them which was produced in campus by solar panels. This generates the revenue to college, which is helping to reduce carbon emission from government electricity generation through thermal power

plants and also maintenance cost of college campus. Taking this as example if people don't start paying attention to the seriousness of greenhouse gases then it will pose a bigger issue for the future. Converting to alternative energy is what people need to start looking into to combat this concern. If the colleges don't begin to convert to some sort of renewable energy source, then in the years to come it'll become more expensive to use nonrenewable energy sources.[9] The colleges will also be contributing to global warming and harming the environment, which is compromising the future of Earth. Colleges now claim to be 100 percent carbon neutral. Even with these types of improvements, colleges and universities continue to be large users of electricity, natural gas, and other fuels. To claim to be carbon neutral while saving costs in energy purchases altogether--and truly lessen their carbon footprint and dependence on the local power grid--colleges and universities need to produce electricity on site through use of distributed generation. The use of solar photovoltaic systems has the potential to generate substantial cost savings.[10]

VII. CONCLUSION

This campus is the only college campus which installed 434 solar panels and is generating 100kw electricity in entire state of Andhra Pradesh, outstanding as an example for other colleges in India. College is reducing about 98,550 pounds of Carbon every year and by giving excess power generated by solar panels in campus to government power grid and therefore reducing 78,840 pounds of carbon emission from the power grid. Given the large energy needs of our college campuses, combined with the social conscience of today's faculties and students, it is not surprising that such institutions are beginning to take a leading role in the development and implementation of renewable energy projects across the country.

VIII. ACKNOWLEGEMENT

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