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Solar Energy in India – a Motivation for Engineering Undergraduates

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Abstract *: This paper describes the need for India to switch towards using renewable energy. Being the nation having over 18% of its total population in the 15-24 age groups, there is a very high potential of acquiring a man-power which can help achieve the projected targets in developing and establishing renewable energy sources. A brief status and statistical analysis of the rising need of power generation is given. The employment scenario of Indian engineers in the Information Technology (IT) sector irrespective of their specialization is discussed. To use the full potential of Indian engineers, solar photovoltaic is portrayed to be the next major area. There is a discussion on the need for inclusion of solar photo-voltaic coursework in the Undergraduate curriculum. A brief introduction and conceptual discussion of solar photo-voltaic is given as a motivation to the undergraduate students.*

Keywords: *Employment, India, Renewable Energy, Solar, Undergraduate curriculum*

I. Introduction

India is committed towards establishing renewable energy sources to account for about 15% of its total power generation by the year 2020.

Table 1. Present distribution of power generation

Total Installed Capacity (TIC) as on March 2012	Thermal Power Generation	Hydroelectric Power Generation	Wind Power Generation	Others (small hydro-plants, biomass, waste-to-electricity plants, and nuclear energy)
236.38 GW	66% of TIC = 156.01GW	19% of TIC = 44.91GW	24.9GW	10.56GW

Source: Energy Statistics 2013 [1]

The total energy consumption in India was estimated to be 879 kWh as on March 2012. As shown in Table 1, a major portion of the power generation is thermal based. Due to its adverse effects on the environment and depleting nature of this kind of raw material there is a rising need to switch to renewable sources of energy. Solar, unlike other sources of energy, is available in abundance all over India. India is fortunate enough to have 350 sunny days, a fact, which can be used to extract the solar energy to fulfill its energy demands. [2] states the energy demand prospects of India. India has launched the Jawaharlal Nehru National Solar Mission which aims on 20GW of grid connected solar power and 2GW of off-grid capacity including 20 million solar lighting systems and a solar thermal collector area of 20 million square meters by the year 2022.

To achieve such a big goal in a short time, India needs huge man-power both for the design and implementation of solar projects. Almost none of the universities/technical institutions in the vast ocean of about 5672 engineering institutions across the country impart solar based courses in the undergraduate curriculum unlike the graduate and doctoral programs. As the undergraduate enrollment is way bigger in number vis-à-vis the graduate and the doctoral enrollment, incorporating solar power based courses in the undergraduate curriculum would increase skilled man-power in this developing area. Section II discusses the engineering employment-unemployment scenario in India. Section III provides a brief overview of the solar statistics and curriculum.

II. (Un)Employment Scenario - India

Around 14 lac students write the engineering entrance exams in India to enter into engineering streams every year. Approximately 7 lac students join engineering courses. According to a survey conducted all over India (Fig 1) with 450 survey takers in August 2013 by the authors, around 54% had taken engineering willingly. Around 20% had based their choice on the basis of good job prospects after finishing their engineering.

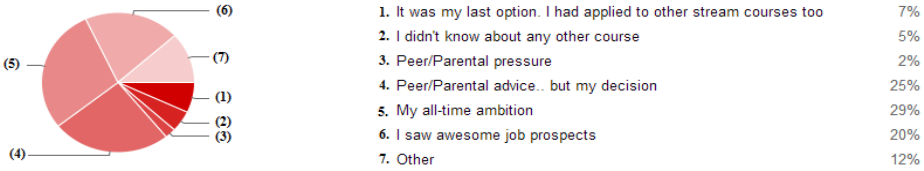

Fig 1. Reason for students to choose engineering: survey results

With over 50% of the undergraduate population in India searching for a job after fulfilling their degree requirements, there is a huge resource and potential for man-power. As there are very less amount of jobs available in the non-IT sectors presently, a major population tends to opt for IT based jobs. This may be considered as a major disappointment for the young engineering graduates.

The engineering unemployment rate in India was 9.4% according to the 2011 statistics. According to NASSCOM survey in 2012, only about 25% of the Indian engineering graduates are employable. The industry constantly complaints about the students not having the required entry level skills. All these problems can be faced by introducing good quality training to the students related to the industry requirements. The solar power industry requires a huge man power which, again, requires quality education to be imparted in the colleges.

III. A Motivation To The Undergraduates

There is a need to motivate the undergraduate students to take up courses based on solar power. The engineering disciplines which can be involved in this domain are innumerous. Students from both circuit branches and the non-circuit branches can participate in this domain and have equally good opportunities to flourish. Here, as an example, the authors have rendered a general motivation to pursue undergraduate courses in the solar domain.

Solar power is free and it is feasible to extract power out of the solar energy falling on the earth. Hence, a Solar PV System has become the order of the day. The solar panels installed on the roof of ETAS building at University of Arkansas at Little Rock (UALR), USA are shown in Fig 2.

Fig 2. Solar panels on the roof of ETAS building, UALR, USA

The average solar insolation at full sun is considered to be 1000W/m^2 all over the globe. Solar insolation is defined as the solar radiation received on a given surface area at a given time. The solar insolation changes according to the time of the day. Therefore, the power output is not constant throughout the day. Hence, it is important to extract the maximum power from a solar module at any point of time. To perform this operation, various Maximum Power Point Trackers are used. Various maximum power point trackers have been discussed in [3].

Equivalent Circuit:

The solar PV system can be modeled as shown in Fig. 3. The photovoltaic (PV) panel/cell acts as a current source. The ideal Current (I) – Voltage (V) and Power (P) – Voltage (V) characteristics are shown in Fig 4 and 5 respectively.

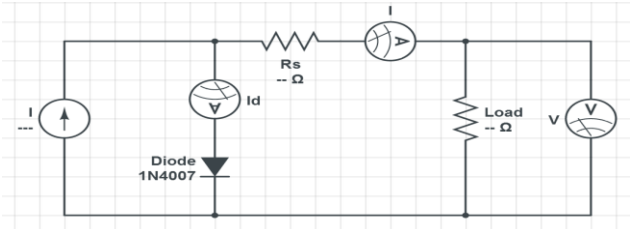

Fig. 3 Simplified general equivalent circuit for a solar cell

The current flowing through the diode (Id) is very small when compared to the short circuit current (I). Hence, it is assumed that almost all of the current I is available at the output. Now, the power delivered at the load is

$$P = V*I$$

I-V and P-V characteristics:

The I-V characteristics of the rooftop panel modules installed in the ETAS building of UALR is shown in Fig. 4.

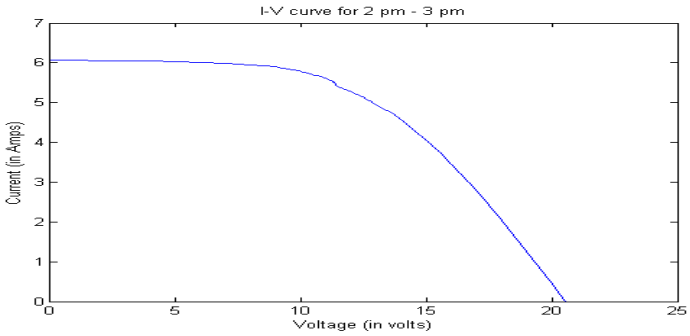

Fig. 4 V-I characteristics of a PV System

It can be seen that for small output voltages, the current is almost constant. As the output voltage starts increasing toward the open circuit voltage, there is a drop in the output current. Due to this unavoidable change in the voltage-current characteristics, there is a shift in the Maximum Power Point (MPP) as the load changes.
The P-V characteristics for the I-V graph in Fig 4 are shown in Fig 5.

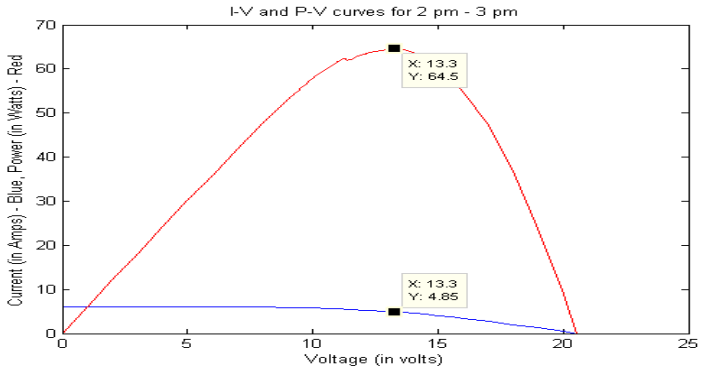

Fig. 5 P-V characteristics of a PV system

The MPP for the module at the time span 2-3 pm recorded on a sunny day at Little Rock, USA, is shown in the above figure. Usually the MPP is reached at a voltage in the range of 0.6-0.8 times the open circuit voltage of the PV module.

The above given brief on solar photovoltaics could be further dealt in great detail and can be extended to a semester long course. Material on Battery technology and hands-on installation could be included in the coursework.

IV. Conclusion

In this paper, the authors infer that solar energy has a great potential in the future of India in both energy as well as employment sectors. The solar segment needs an immediate attention and harnessing of this energy may lead to revolutions in power sector of the nation and give the nation, ability not only to meet its needs but also export sufficient amount of energy to other nations. This will resolve a large amount of unemployment issues faced by the bright engineers of the nation to a great extent. Inclusion of solar energy in engineering, as it is applicable in all sectors of engineering, would prove to be fruitful in motivating the youngsters for choosing a career in solar sciences, which itself is a course large enough to be employed as a separate program in education. Government should implement more domestic projects that promote solar energy to increase the awareness and interests in this field. Lighting up streets and houses with solar power could lead to great deal of reduction in power-cuts and provide a vast area of employment for efficient engineers (Indian

state of Gujarat proves to be an apposite example). Government should undertake more projects and recruit more engineers to create more opportunities in this field. There are innumerous number of small scale private industries coming up in solar which needs motivation and encouragement. This could lessen the employment burden on government and provide more motivation for engineers to be solar entrepreneurs.

Acknowledgements

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