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Alternate way of electricity generation from solar power

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ABSTRACT

Energy in the form of electricity is the prime need of any field. The need for power is indispensible. Most research is being carried on producing electricity from any energy source available. The growth in energy requirement increases gradually due to the technological and industrial development. To fulfill the requirements, it is necessary to harness the very renewable resource which is present in excess. Solar energy is the one which is non-exhaustible at any point. The efficiency of generation techniques of energy from solar power so far been developed still in the quarter path. Hence, alternate way of utilizing solar power for power generation would bring out a revolution. This paper aims to innovate a new methodology for electricity generation from solar energy. The method is based on the well known greenhouse phenomenon.

Keywords: solar energy, enhanced greenhouse effect, seebeck effect, thermoelectric generation.

1. INTRODUCTION

Solar Energy is the non-exhaustible power available at every corner and at all the time. Every requirement on the sides of domestic, industrial, manufacturing, technology, electronics and literally any field can be fulfilled (Sadiq et al. 2016a). If surplus energy can be given to all these fields then, human power could do wonders. For supplying this quantity, it can only be done by harnessing a source like solar power, which continuously pours out energy of tremendous amount that could be a super-surplus value comparing whole world consumption (Javaria Manzoor Shaikh, 2015; Rajan YS, 2016). There exists techniques to generate electricity from solar energy (Hemant Kumar Singh, et al. 2015), but still there is much of research to increase its efficiency. Thus, new ideas and innovation has to be done in field of harnessing solar energy (Maheshwari RC, 2015; Akinnubi et al. 2016). Solar spectrum consists of 90% visible and near infrared radiation. So, a technique which is sensitive to this particular wavelength and capable of converting it to electrical energy directly or indirectly by converting it to other kind as intermediate has to be employed.

2. GENERAL DESCRIPTION

This paper is based on the very fact that Earth's average surface is 32°C warmer than it would be if it had no atmosphere. A planet the size of earth at earth's distance from the sun, and in thermodynamic equilibrium with solar energy, would have an average surface temperature of -18°C. This deviation in temperature from that of radiative balance is solely due to the green house gases which is present in few parts per million, gives an unimpeded way for incoming solar spectrum but impedes the outgoing spectrum which consists of long infrared radiation. If extra amounts of greenhouse gases are added to the atmosphere, then they will absorb more of the infra-red radiation. The Earth's surface and the lower atmosphere will warm further until a balance of incoming and outgoing radiation is reached again. Therefore, the emission of infra-red radiation increases as the temperature of the emitting body rises, which thereby increases the surrounding temperature. This extra warming is called enhanced greenhouse effect. The conversion to electricity is by the thermoelectric generation, utilising this temperature difference.

3. EXISTING METHOD

Existing method for solar energy conversion to electrical power is primarily of two ways. One way is by using the photoelectric effect which says that when light falls on the junction between two charged layers, electric current flows breaking the potential barrier i.e. by use of solar cells whose practical efficiency is about 25-30 percent (Suresh Babu et al. 2015). This is utilized for domestic power requirement and much research has been undergoing.

Another method is to have solar heat collectors based on the fact that solar spectrum comes with infrared radiation. When solar spectrum falls on a body, it heats up, making temperature to increase to a great extent, which then made to boil the water making it to rotate turbine, whose mechanical energy is then converted to electrical energy. This technique is been utilized in solar power plants generating megawatts of power. This requires high maintenance and high initial costs.

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4. PROPOSED METHOD

4.1. Methodology

This paper aims to bring out an alternative technique for electricity generation from solar energy. The main objective is to utilize most solar spectrum both IR and visible, rather than as in existing methods which solemnly depends on any one radiation of the spectrum i.e. visible in case of solar cells and IR in case of thermal plants, which promises to give out maximum utilization and yields comparatively high output. Here, the main process is to convert solar energy to heat energy to the maximum possible amount. Then to utilize the heat converting it to electrical energy by thermoelectric effect i.e. when there is a difference in temperature between two junctions of dissimilar material, electrons pass from one end to another creating electric potential. For conversion to heat to maximum, comes utilizing the enhanced greenhouse effect, wherein the greenhouse gases are put in at very high concentration inside a chamber which is of glass allowing the solar radiation in. This is primarily will be a product for domestic purpose satisfying the needs of every home individually. It is similar to solar cells, but the difference being, in this method infrared spectrum is made to increase and indirect generation whereas solar cells use the visible spectrum and direct generation of electrical energy. This method differs from the solar thermal power generation as we use heat retaining by gas rather than heat buildup by absorption through a heat collector.

4.2. Greenhouse effect

Most of solar radiation is between wavelengths of 0.1 and 3 µm. This range of wavelengths includes infrared radiation, visible light and ultraviolet light. Over 90% of the solar radiation reaching the Earth's atmosphere is visible light and near-infrared radiation, with a wavelength range of 0.7 and 1.5 µm. The amount of heat received by the surface is actually much larger which is three times than the amount the surface receives in solar radiation, due to the natural greenhouse effect (Sadiq et al. 2016b). When electromagnetic rays reach the bottom of the setup, it heats up. It is known, any object above absolute temperature emits at a wavelength proportional to the fourth power of its temperature hence, emits a longer infrared radiation. This radiation is prevented to go out of the setup by the greenhouse gases. These gases are capable of absorbing these long wavelength radiations. Molecules which could absorb can also emit at same wavelength and will radiate in all directions, approximately half back inside the setup. By the same time, solar energy is being poured into, along with the re-emitted heat radiation, increasing the net heat to increase, which means there is a net heat accumulated inside the setup. This is been taken as the hot junction while electricity is generated through heat difference.

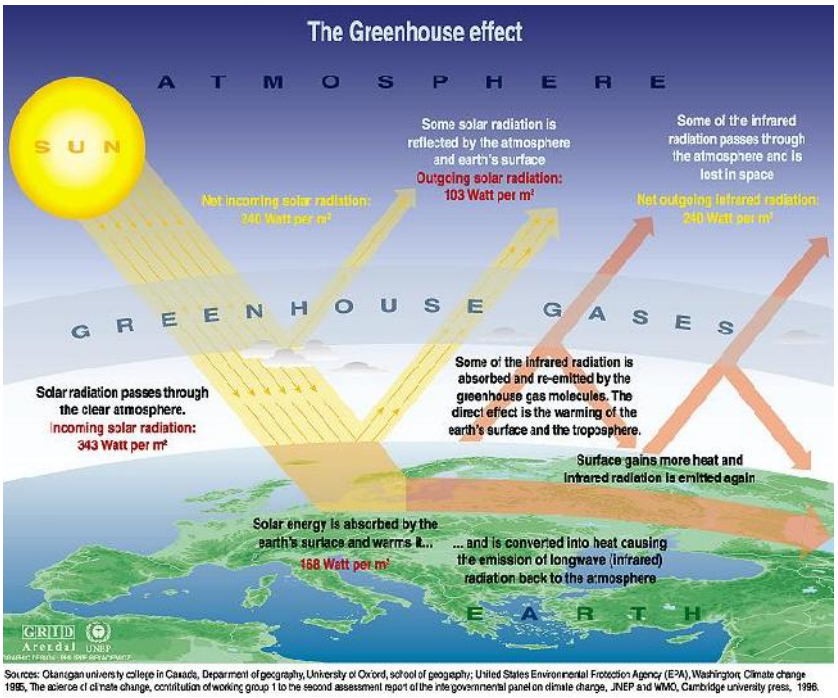

Figure 1 Natural Greenhouse Effect

4.3. Thermoelectric Generator

Thermoelectric generator is based on the thermoelectric law Seebeck effect. When there is a temperature gradient between the two junctions formed by dissimilar conductors, it results in heat flow, which then results in the diffusion of charge carriers. This in turn creates a potential difference. Thermoelectric efficiency is around 7-8% maximum. Hence, higher power output can be made by connecting thermocouples in series to increase the voltage capability and in parallel to increase the current capacity. Such an array of thermocouples is called a thermopile. The voltage is proportional to the number of thermocouples that is connected together. It Thermoelectric material should have high seebeck co-efficient to have high output voltage per Kelvin difference, high electrical conductivity to improve efficiency by reducing joules heating, low thermal conductivity to maintain high temperature gradient. Thermoelectric generators can be used in much the same way as photovoltaic devices and the same electrical ancillary circuits can be used. The open circuit output voltage of thermoelectric generator can be given as follows

$$V = \int_{Tc}^{Th} (S_b(T) - S_a(T))\, dT$$

5. HARDWARE SETUP

The hardware setup consists of a closed container which on incoming side has a material that is capable of being translucent to visible and near infrared radiation. The other side has to be made up of a material that has a very low thermal conductivity so as to retain heat increasing temperature and also it must be totally reflecting else, energy can be lost through the other end. In between is the place where greenhouse gas were been filled up to high concentrations. So this setup would build up heat in the sandwiched area and here, a thermoelectric circuit's hot junction is placed and a cold junction may be held at atmospheric temperature. Thermoelectric material should have low thermal conductivity and high electrical conductivity and also it should capable of withstanding high temperature. As thermoelectric generators are a series of thermocouples, the resistance is very high hence power can be efficiently transferred only by high resistance auxiliary circuit and then stored in a rechargeable battery.

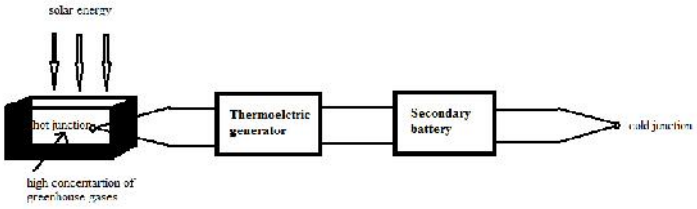

Figure 2 Schematic Diagram

6. SIGNIFICANCE

This idea can be witnessed from the understanding of presence of carbon-dioxide, a greenhouse gas in the planet Venus. The planet's atmosphere consists of 96.5% carbon-dioxide and virtually no water has a temperature of about 730K. And the surface pressure is about 90 times than that of earth. At this pressure, CO_2 is highly absorbing both at 15 and near 5 microns. By Wein's law, emission peak is close to 5000nm.[1] This high temperature by the principle of seebeck effect can produce electricity.

The advantage other than electricity generation would be that, it acts as a carbon Sequenstration. In this industrial development, emission of carbon which is not desirable could not be completely ridden off, even though many steps are being taken. The above technique could act as a method to store or trap carbon and hence a boon to environmental safety.

7. CONCLUSION

This proposal is primarily for meeting every energy crisis by harnessing electrical energy from an ever reliable energy by converting it to heat. Any heat can't be made to electricity at all times as the thermoelectric generators are quite good thermal conductors too. Hence, for power generation this heat used must be from a source which continuously has energy in it. If the increase in temperature is of such a large magnitude and efficient thermo-electric conversion is possible, then the above strategy could make a

great impact in the field of energy, thereby in every named field.

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