Research proposal on renewable energy solar panels

Environment, Electricity

Abstract

The research proposal outlines the significance and need for adopting alternate sources of energy. The most abundantly available and inexhaustible source of energy is the solar energy. Sun provides 100, 000 TW of energy to the earth which is much greater than the present amount of energy consumption which is 13 TW (Gratzel, 2007). A lot of research has been carried out to trap the solar energy and convert it to other usable forms. Though it is quite a difficult task, advancements in technology have enabled trapping of this natural resource possible. Our present energy needs could be met if approximately 0. 1% of Earth’s surface can be covered with Photovoltaic installations that have an efficiency rate of 10% (Gratzel, 2007). Photovoltaic cell or the Solar Cell is an effective devices used for trapping in sunlight and converting it into electricity. These Solar Cells are stacked together to form Solar Panels. The paper presents the different types of solar cells available and their properties. It consists of elaborate calculations of the present energy needs and consumptions that are based on the conventional sources of electricity. The design parameters and the implementation techniques of solar panels, especially for domestic purposes have been provided.

Introduction

Conventional sources of energy such as fossil fuels have limited reserves on earth. These are precious sources of energy that have multifarious uses and applications. Due to this fact their demand and usage has been growing recklessly. However, fossil fuels are the greatest emitters of carbon. This has

become a serious cause of concern since large amounts of carbon emissions have resulted in the unpredictable change in climate. This in turn gives rise to several environmental concerns such as pollution, global warming, rise in sea level etc. It also poses threat to the wildlife since the animals will face extreme difficulty in adapting to such fast changes in the climate and may thus get endangered or even extinct. Thus, it is a primary requirement to take into consideration every feasible sustainability solutions and to successfully take them to completion. According to Sun (2010), " Sustainability involves balancing a growing economy, protection for the environment and social responsibilities, so they together lead to an improved quality of life for ourselves and future generations." It has become imperative for us to adopt alternative sources of energy for device ways to maintain the existing lifestyle without causing any further harm to the environment. It is highly required to strategize for the long term use of " land use, food production, soil, health, water quality and quantity, human habitation, ecosystem health, evolution and robustness, biodiversity, waste disposal (particularly hazardous waste), climate change, resource use and even technological direction" (Boyle, 2004b, p. 2).

One of the most wonderful sources of energy on earth is the sunlight. It is a natural source of energy and is available abundantly on earth's surface. Sun is a vast energy reservoir due to the continuous fusion reactions taking place for over four billion years. Sun provides 100, 000 TW of energy to the earth which is much greater than the present amount of energy consumption which is 13 TW (Gratzel, 2007). Solar radiation falling on earth's surface for a period of just three days is equivalent in amount to the energy stored in all

fossil energy sources. Despite the fact that sun is an inexhaustible and incredible source of energy it is a challenge to harness the energy obtained and is a subject of continuous research. There are many devices that function solely on the solar energy such as solar cars, solar water heaters, solar water collectors, solar cookers, etc. Our present energy needs could be met if approximately 0. 1% of Earth’s surface can be covered with Photovoltaic installations that have an efficiency rate of 10% (Gratzel, 2007).

Fig. 1: Figure showing solar panels used for domestic purposes (solarpanelinfo. com)

An extremely useful invention was that of the photovoltaic cells by Edmund Becquerel in the year 1939. These cells could generate electricity through solar energy. When the photovoltaic cells are stacked together in the form of panels, they acquire the sufficient power to generate electricity adequate enough to run devices. These panels containing photovoltaic cells are known as solar panels (see fig. 1).

The efficiency of a solar cell is determined by the percentage of available sunlight that it can successfully convert to electricity. In the 1880s selenium photovoltaic cells were used to generate electricity from sunlight. It had an efficiency of 1-2% and paved the way for several significant developments. It was in the year 1908 when the design of the present day solar technology began to take shape. William J. Bailey of the Carnegie Steel Company developed a solar entrapment cell comprising of a collector with an insulated box and copper coils. The Bell Telephone Labs could achieve 4% efficiency by the mid 1950s followed by an efficiency level of 11%. However, the

expense incurred in their manufacture and installation was the major hindrance and rendered it unsuitable for use on earth. Nevertheless owing to their ruggedness, light-weight and low power requirements, these PV Cells served quite well as sources of electric power for satellites. Thus, space scientists played active role in the development and advancement of the solar cells.

Solar cells will enable us to reduce our dependency on the conventional energy sources. It is necessary to take active steps towards adopting renewable energy sources even at the basic household or the domestic level.

Literature Reviews

Solar panels can be used to harness solar energy in many ways and for several applications. Depending upon the specific conditions and requirements solar panels can be for a range of functions such as providing a renewable source of electricity or supplying hot water. The initial cost of installation of solar panels incurred is quite high but in the long term it proves to be a cost-effective and resource-efficient measure. The amount of energy that can be produced from the present generation solar panels is sufficient to support the household requirements. Therefore, it is highly recommended to make use of these efficient measures for the domestic usage. This can remarkably reduce the consumption rates thereby cutting down on costs.

Solar panels can be divided into three categories, mono-crystalline, poly-crystalline and amorphous silicon. The life-span of these panels is approximately 25 years thereafter these panels will lose 20% efficiency.

Mono-crystalline silicon is the earliest form of silicon used to produce solar panels. It has high efficiency curve and is still widely in use. It comprises of a single, unbroken and extremely pure silicon sample from which the cells are manufactured. Solar panels consisting of poly-crystalline silicon are relatively cheaper but less efficient. Amorphous silicon is made up of poly-crystalline silicon. It is quite cheap and comparatively less efficient. However, due to their versatility they find applications in numerous areas.

The recently developed cells known as ‘ bulk’ junctions that are based on mesoscopic organic and inorganic semiconductors are a promising prospect for the future due to their low installation costs. They have three-dimensional structures, hence the name. An example of cells belonging to this family includes the dye-sensitizer solar cell (DSC). It consists of a light absorbing material i. e. the dye-sensitizer with a wide gap semiconductor of mesoporous or and the nano-crystalline morphology. Research is being carried out in the area of third generation PV Cells. These shall comprise of multiple-junction devices. Another advancement concerning multiple carrier generation in quantum dot absorbers are other such research areas that claim importance (Gratzel, 2007).

Design

For the purpose of usage in the household, solar cells must possess the following features and procedures.

(a) Solar panels which can easily be maintained on the roof and produce 1000W of power. The total cost for the 1000WP solar panel kit is £7000.

(b) The installation cost will be the price of the panel kit itself, which is

£7000. As it was mentioned earlier it will produce 1000W which gives us an approximate number of 7000Wh per day and 1400kWh per year. This means that every year I will save 1400kWh or £252 (with 18 pence per kWh rate).

(c) Then the PBT for the solar panel will be:

£7000£252= 27. 8 years

Analysis

Economics

At present the electricity generation at the household is primarily dependent on the burning of fossil fuels. The Energy Usage of the appliances can be calculated using the following equation:-

Wattage×Hours used1000×number of days used per year= Annual kWh consumption

I am an international student in UK and my annual electricity usage can be put into three different categories namely electricity, gas and transportation. According to the reports, the average per capita consumption in UK is approximately 4TOE/annum. Estimation of my personal Annual Energy Usage for all the energy consuming equipments at home is shown as follows.

Annual Gas Consumption

In order to calculate my annual gas consumption I have checked my gas bills from 20/01/2012 to 20/01/2013 which gave me a total of 14130kWh of energy used for space heating and cooking.

Energy spent on Transportation

In order to calculate annual energy consumption for bus I have checked the energy used by UK electric bus per km, which is about 0. 8kWh/km.

The distance between my flat and Heriot Watt University is 4. 8 miles = 7. 8 kilometres. Therefore, the energy used for return travel is:

0. 8 (kWhkm)×7. 8(km)×2 = 12. 48 kWh

200(days in total)7(days in a week)*5working days in a week= 140

Then, the annual bus energy consumption:

12. 48 kWh×140days= 1747. 2 kWh

The distance covered through air travel between Edinburgh Airport and Kuwait National Airport is3094. 81 miles / 4980. 62 km. Then using data for international flight from Carbon Trust Fact Sheet CTL018, the amount of CO2 per distance travelled by one passenger equals to 0. 1206 (kg/ (p*km)) multiply by distance travelled the times number of passengers times number of flights. we can calculate the kg CO2 emission per passenger kilometres travelled for a return flight:

0. 1206kg/pkm×4980. 62km×1p×2= 1201. 33 kg

Now we can convert kg CO2 into kWh:

1201. 33kg0. 266kg/kWh= 4516. 3 kWh

Now multiply to the number of travels over the year:

4516. 3kWh×2= 9032. 52 kWh

The total amount of kWh:

9032. 52kWh+1747. 2kWh+14130kWh+3029. 925(kWh)= 27939. 645(kWh)

Overall, my personal Annual Energy Usage (AEU) is - 27939. 645kWhor in kg of CO2:

27939. 645kWh×0. 537kgkWh= 15003. 59 kg

And in tonnes of burning oil (TOE):

27939. 645(kWh)1. 163×104= 2. 402 TOE

Being a student this much amount of energy consumption can be considered high and the corresponding monetary equivalent feels heavily on my pocket. It makes me look for other alternatives. Apart from this, it is a well known fact that fossil fuels are scare and their burning leads to large amounts of CO2 emission resulting in environmental pollution. Devices that are environmentally sensitive and function with minimum usage of energy are the key elements to sustainable living. Renewable energy resources offer solutions to the present problems by introducing new and innovative technologies, techniques and patterns of thinking. Technologies such as the solar panels that make sole usage of the renewable energy resources must be stressed upon.

Conclusion

The recent times have seen many concerns revolving around the fossil fuels and other exhaustible sources of energy regarding their scarcity and adverse impacts on the environment. The average consumption of electricity even at the domestic level touches very high values. However, owing to complexities involved in the trapping of this abundantly available natural resource it has demanded ample time and attention from the scientific and engineering communities to research and develop feasible techniques. It is in the general

interest of everybody to embrace the alternative techniques of energy generation such as the solar panels. Solar panels provide commendable opportunities for using the incredible natural renewable energy source i. e. sunlight. Solar panels have the ability to directly convert solar energy into electricity. Therefore, they find multiple uses and applications.

Bibliography

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