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A REVIEW PAPER ON RECENT USAGE OF SOLAR ENERGY AND ITS ECONOMIC AND ENVIRONMENTAL IMPACT

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Abstract: Solar Power is a prime resource of all kinds of energy generation in the world .Even though we require oxygen for breathing which comes out from green plants which they release during the process of photosynthesis and is not possible without solar energy. An attempt is made in this paper to focus on the past and future prospective of solar energy and to calculate and calibrate its effective utilization so that dependency on conventional sources should be minimized as these resources are scare and depleting.

Keywords energy resources, renewable energy, energy use efficiency, generation technology, carbon emission, Organization for Economic Co-operation and Development (OECD) ,ppm-parts per million

INTRODUCTION

Electricity consumption will comprise an increasing share of global energy demand during the next two decades. In recent years, the increasing prices of fossil fuels and concerns about the environmental consequences of greenhouse gas emissions have renewed the interest in the development of alternative energy resources. Considering that the major component of greenhouse gases is carbon dioxide, there is a global concern about reducing carbon emissions. In this regard, different policies could be applied to reducing carbon emissions, such as enhancing renewable energy deployment and encouraging technological innovations. Two main solutions may be implemented to reduce CO2 emissions and overcome the problem of climate change: replacing fossil fuels with renewable energy sources as much as possible and enhancing energy efficiency.

During the two last decades, the economic feasibility of solar power for residential, commercial and industrial consumption has been investigated by researchers. Industrial countries like Japan and Germany are looking for alternative sources of energy such as solar power due to the limited availability of natural primary energy sources. In early 1990s, Japan started to take advantage of large-scale electricity generation by solar photovoltaic (PV), and was soon followed by Germany. More recently, China has developed an extensive solar power capacity due to cheap labor and government subsidies, in turn, decreasing the cost of solar power generation. On the other hand, there are also negative effects caused by solar technologies, such as impacts on buildings' aesthetics, routine and accidental releases of chemicals, land use, etc.

The solar photovoltaic market has experienced extraordinary growth over the last five years. The market has increased from 9,564 MW in 2007 to 69,371 MW in 2011. Similar to wind energy, solar energy is dependent on weather conditions. Variation in weather, including clouds and pollution, could affect solar power generation. Many technologies are used to deploy solar radiation including thermal solar energy, concentrated solar power plants (CSP), solar chimneys or towers and photovoltaic systems. Photovoltaic technology allows the integration of PV collectors into the building and can turn external walls, windows and roofs into PV collectors. However, some environmental and health concerns can arise from the use of materials in the PV systems . Frankl et al. (1997) evaluated the benefits of building-integrated PV systems, comparing them to conventional PV power plants through the aspects of a life cycle analysis, maximizing energy efficiency and CO2 reduction potential. The results show favorable effects for building-integrated PV systems in terms of the energy production and reduction in CO2 emissions. They estimated CO2 yields of 2.6 and 5.4 for conventional PV power plants and building-integrated systems, respectively. These benefits are estimated to increase in the future with the advancement of PV technologies. Market interests to expand renewable energy use, including solar power, has increased globally. A number of potential problems were identified. Kolhe et al. (2002) analyzed the economic feasibility of a stand-alone solar photovoltaic (SAPV) system, comparing it to diesel power plants, in India. The results show that PV systems have the lowest cost up to 15 kWh of energy use, but that it could be increased to 68 kWh/day under more favorable economic conditions. The break-even point increases if the cost of PVs decrease and diesel costs increase.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute sunlight. Active solar techniques include the use of photovoltaic panels, solar thermal collectors, with electrical or mechanical equipment, to convert sunlight into useful outputs. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

GREEN HOUSE EFFECT

Visible sunlight is absorbed on the ground, at a temperature of 20ºC. Glass easily transmits short wavelength radiation, which means that it poses little interference to incoming solar energy, but it is a very poor through transmitter of long-wave radiation. Once the sun‘s energy has passed through the glass windows and has been absorbed by some material inside, the heat will not be reradiated back outside. Glass therefore act as a heat trap, Emission increases with temperature, following T^4 law. The sun emits radiation like a black body whose surface temperature is about 5700ºC; this corresponds to maximum emission of 0.5 m. A black body at a room temperature emits radiation with a maximum at about 10 m, which is within the spectrum of invisible infra-red light. The infra-red light absorbed by the glass is remitted in all directions; half of it is emitted to the outside and lost, the other half re-emitted towards the black plate which absorbs it again. More and more heat is accumulated in the way in the black plate, whose temperature thus increases. Equilibrium is reached when the energy gain by absorption of visible light is exactly balanced by the loss of energy through infra-red emission of the glass plate. With rising temperature, the wavelength of the infra-red emission becomes shorter. At 200ºC (473ºK) the maximum radiation is emitted at about 6 m, at which wavelength, glass is partially transparent for infra-red light.

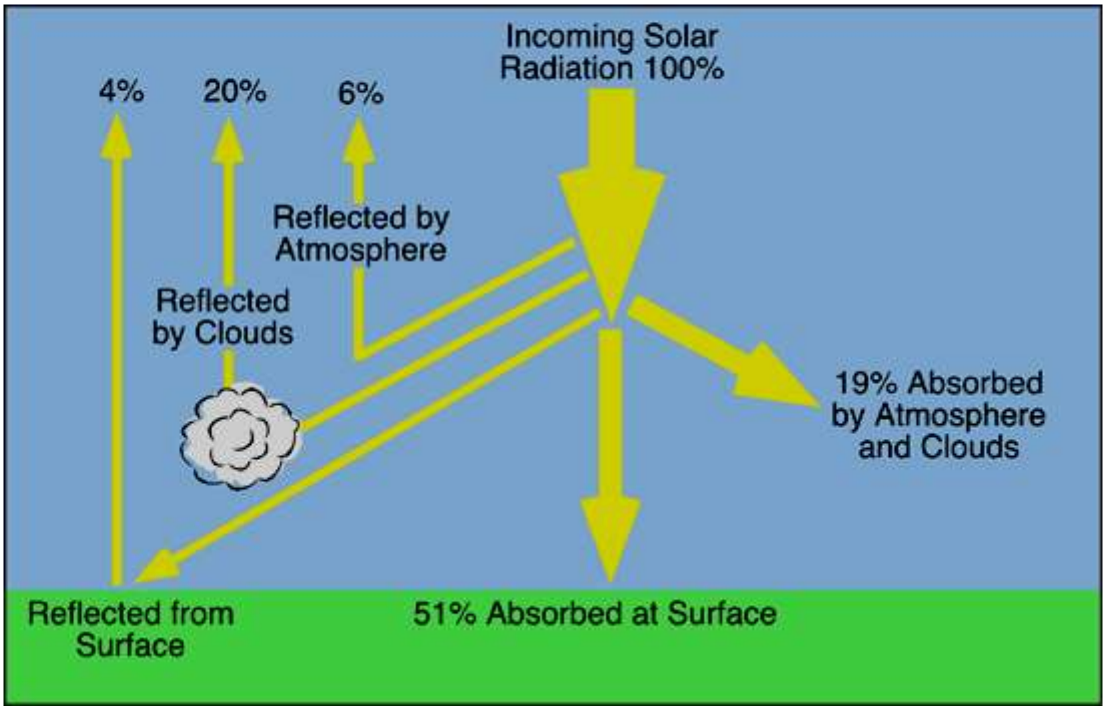

Fig-Green house effect

DEVELOPMENT OF SOLAR ENERGY TECHNOLOGIES

Solar energy technologies have a long history and can be divided into, what are today, at least three distinct markets viz. solar thermal heating, solar thermal electric and most recently, photovoltaic. Photovoltaic cells were invented at Bell Labs in 1954 and the earliest applications of PV, in the late 1950‘s, were onboard space satellites to generate electricity .Indeed, the world remains dominated by fossil fuels, which account for over 79% of global final energy consumption, and are supplemented by renewable such as traditional biomass and large hydro, which along with nuclear supply about 13%, 3% and 3% respectively. The remaining current market share of about 2.4% of total global final energy consumption, for new renewable energy technologies, is the result of a sustained dramatic growth trend over the past decade

Solar power in India is a fast-growing industry and as of 31 December 2016, the country's solar grid had a cumulative capacity of 9,012.66 MW. In January 2015, the Indian government expanded its solar plans, targeting US$100 billion of investment and 100 GW of solar capacity, including 40 GW's directly from rooftop solar, by 2022.The rapid growth in deployment of solar power is recorded and updated monthly on the Indian Government's Ministry of New and Renewable Energy website. Large scale solar power deployment began only as recently as 2010, yet the ambitious targets would see India installing more than double that achieved by world leaders China or Germany in all of the period up to 2015 year end.

In addition to the large-scale grid connected solar PV initiative, India is continuing to develop the use of off-grid solar power for localized energy needs. India has a poor electrification rate in rural areas. In 2015, only 55% of all rural households had access to electricity, and 85% of rural households depended on solid fuel for cooking. Solar products have increasingly helped to meet rural needs, and by the end of 2015, a cumulative total of just under 1 million solar lanterns had been sold in the country, reducing the need for expensive kerosene. In addition, a cumulative total of 30,256 solar powered water pumps for agriculture and drinking water had been installed. During 2015 alone, 118,700 solar home lighting systems were installed, and 46,655 solar street lighting installations were provided under a national program.The same year saw just over 1.4 million solar cookers distributed or sold in India.

In January 2016, the Prime Minister of India, Narendra Modi, and the President of France, Mr. François Hollande laid the foundation stone for the headquarters of the International Solar Alliance (ISA) in Gwalpahari, Gurgaon. The ISA will focus on promoting and developing solar energy and solar products for countries lying wholly or partially between the Tropic of Cancer and the Tropic of Capricorn. The alliance of over 120 countries was announced at the Paris COP21 climate summit. One of the hopes of the ISA is that wider deployment will reduce production and development costs, and thus facilitate increased deployment of solar technologies, including in poor and remote regions.

India is ranked number one in solar electricity production per watt installed, with an insolation of 1700 to 1900 kilowatt hours per kilowatt peak (kWh/KWp). On 16 May 2011, India’s first solar power project (with a capacity of 5 MW) was registered under the Clean Development Mechanism. The project is in Sivagangai Village, Sivaganga district, Tamil Nadu. India saw a sudden rise in use of solar electricity in 2010, when 25.1 MW was added to the grid, and the trend accelerated when 468.3 MW was added in 2011.Recent growth has been over 3,000 MW per year and is set to increase yet further. Government-funded solar electricity in India was just 6.4 MW per year in 2005.

Economic impacts

The emphases for economic impacts are job creation, industrial innovation and balance of payment. Renewable energy technologies could enable countries with good solar resources to employ this energy source to meet their domestic demand. Also, solar energy technology may even enable these countries to utilize solar energy source with long-term export potential. Moreover, the cost of importing fuels can affect economic growth. If these countries could reduce their balance of payment by producing their own renewable energy to replace their dependence on fossil fuels, it could raise the capacity for investment in the other sectors. A main economic driver to the enhancement of renewable energy technologies is their job creation potential. It’s estimated that 5 million people work in solar energy industries. Although, total employment in these industries has continued to increase, the recent global recession, coupled with policy changes, has caused the employment. It is the outcome of some report that 8,20,000 jobs will be created in solar pv panel sector . From their point of view, the economic advantages of renewable energy could be even higher if external costs were included in calculations.

CO2 emission reduction

Renewable energy technologies could reduce carbon dioxide emissions by replacing fossil fuels in the power generation industry and transportation sector. Life-cycle CO2 emissions for renewable energy technologies are much lower than fossil fuels. The life-cycle balance is also considered to be an important factor in the heat and transportation sectors. Based on an analysis performed by the IEA, renewable power generation enabled countries to save 1.7 Gt of CO2 emissions in 2008, a figure that is more than the total power sector's CO2 emissions in the European region (1.4 Gt).

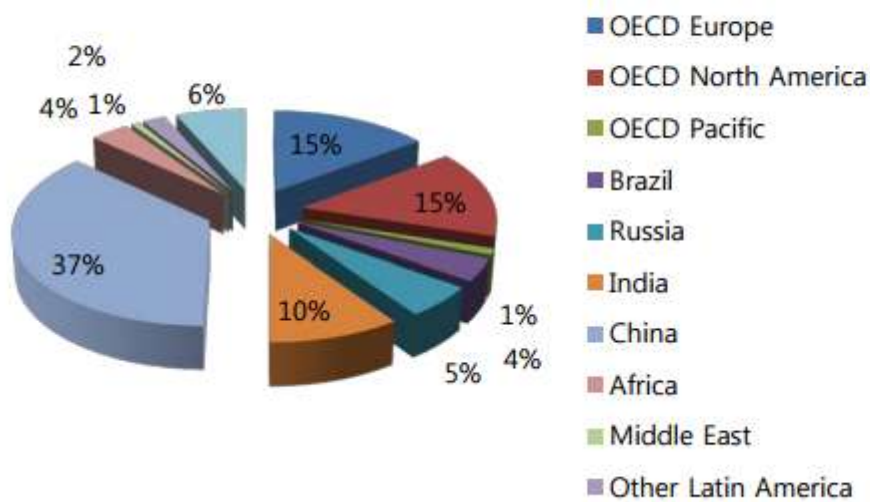

Fig - Saving in CO2 emissions in 2030

Figure shows Saving in CO2 emissions in 2030 The key point is that most CO2 savings are concentrated in the OECD countries and China. According to the IEA report, CO2 savings in China on a 450 ppm scenario would be 2.2 Gt, constituting 64 percent of the BRICS countries' total saving. Edenhofer et al. (2010) examined the technological feasibility and economic consequences of achieving greenhouse gas targets and found that these targets are low enough to be feasible, both technically and economically. They stated that this crucially depends on the particular technology. For example, the availability of carbon capture storage technology is very important in the removal of CO2 from the atmosphere. Also, they argued that additional political and institutional prerequisites are required to achieve the targets.

Conclusion

Ongoing concerns about climate change have made solar energy source an important component of the world energy consumption portfolio. Solar energy technology could reduce carbon dioxide emissions by replacing fossil fuels in the power generation industry and the transportation sector. Due to negative and irreversible externalities in conventional energy production, it is necessary to develop and promote solar energy supply technology. Power generation using solar energy source should be increased in order to decrease the unit cost of energy and to make them compatible with a competitive alternative to the conventional energy sources. Two main solutions may be implemented to reduce CO2 emissions and to overcome the problem of climate change: replacing fossil fuels with renewable energy sources as much as possible and enhancing energy efficiency regardless of type.

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