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Implementation of renewable energy (solar) for rural development

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ABSTRACT

Fuels are the major sources of energy with the help of fuels we done our manufacturing part in chemical, food, pharmaceuticals, beverages industries etc. Fuels are depleting day by day so we can try to generate the energy with the help of renewable energy in low cost. Energy is of generally two types Renewable and Non renewable energy. Renewable energy are hydropower, biomass, solar energy, wind, geothermal, and ocean energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat where as non renewable energy (fossil fuels) are coal, crude oil, natural gas, nuclear fuel etc. While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas and developing countries, where energy is often crucial in human development. Our aim is towards the development of energy or electricity from solar energy by using photovoltaic cells, solar panel, solar heating, solar cooker, solar electric generation.

Key words: Photovoltaic cells (PVC), Renewable energy, solar energy etc.

INTRODUCTION

Renewable Sources of Energy:
India is endowed with abundant natural and renewable resources of energy viz., sun, wind and biomass. The country has been able to achieve significant capacity addition of 1,367 MW through wind farms. India now ranks fifth in the world after Germany, United States, Spain and Denmark in the generation of wind energy. Available renewable resources need to be exploited by giving a commercial orientation, wherever possible. It may be necessary to continue with subsidies in the case of socially oriented programmes to meet the energy requirements of rural areas, particularly remote villages, which may be difficult to service through the conventional power grids in the near future. Apart from these resources, the country has significant potential for ocean thermal, sea wave power, solar and tidal power.

Renewable energy comes from natural resources and is naturally replenished.
Major renewable energy sources are:

i. Hydroelectric
ii. Solar energy
iii. Biomass
iv. Wind
v. Geothermal heat
vi. Ocean

1.1. Hydro energy:
Hydro energy is derived from the force or energy of moving water. Most hydroelectric energy comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the volume and on the difference in height between the source and the water's outflow. This height difference is called the head. The amount of potential energy in water is proportional to the head. To deliver water to

a turbine while maintaining pressure arising from the head, a large pipe called a penstock may be used. In 1878, the world's first house to be powered with hydroelectricity was in Northumberland, England. The old Schoelkopf Power Station near Niagara Falls in the US began to produce electricity in 1881.

One of the major advantages of hydroelectricity is the elimination of fuel. Because there is no fuel combustion, there is little air pollution in comparison with fossil fuel plants and limited thermal pollution compared with nuclear plants. Hydroelectric plants also tend to have longer economic lives than fuel-fired power generation, with some plants now in service which were built 50–100 years ago. Operating labour cost is also usually low, as plants are automated and need few personnel on site during normal operation. The sale of electricity from the station may cover the construction costs after 5–8 years of full operation. Hydroelectric usually refers to large-scale hydroelectric dams. Micro hydro systems typically produce up to 100 kW of power. Hydro systems without dam derive kinetic energy from rivers and oceans. Ocean energy includes marine current power, ocean thermal energy conversion, and tidal power. The present installed capacity as on September 30, 2013 is approximately 39,788.40 MW which is 17.39% of total electricity generation in India.[1] The public sector has a predominant share of 97% in this sector.[2] National Hydroelectric Power Corporation (NHPC), Northeast Electric Power Company (NEEPCO), Satluj Jal Vidyut Nigam (SJVNL), THDC, NTPC-Hydro are a few public sector companies engaged in development of Hydroelectric Power in India.

Bhakra Beas Management Board (BBMB), an illustrative state owned enterprise in north India, has an installed capacity of 2.9 GW and generates 12,000-14,000 million units per year. The cost of generation of energy after four decades of operation is about 20 paise/kWh.

1.2. Solar Energy

Solar energy is derived from the sun through the form of solar radiation. Solar powered electrical generation relies on photovoltaic and heat engines. Other solar applications includes space heating and cooling through solar architecture, day lighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes. Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy:

• Active solar techniques include the use of solar thermal collectors to harness the energy. Some active solar techniques include solar process heat by commercial and industrial buildings, space heating/cooling, and water heating. A typical water heating system includes solar collectors that work along with a pump, heat exchanger, and one or more large heat storage tanks. The most common collector is called a flat-plate collector. Mounted on a roof, it consists of a thin, flat, rectangular box with a transparent cover that faces the sun. Small tubes run through the box and carry the heat transfer fluid mainly water or air to be heated. The tubes are attached to an absorber plate, which is painted black to absorb the heat. As heat builds up in the collector, it heats the fluid passing through the tubes. The storage tank then holds the hot liquid. It can be just a modified water heater, but it is usually larger and very well-insulated. Systems that use fluids other than water usually heat the water by passing it through a coil of tubing in the storage tank, which is full of hot fluid.

• Passive solar systems rely on gravity and the tendency for water to naturally circulate as it is heated. Passive solar techniques orient buildings to the Sun, select materials with favourable thermal mass or light dispersing properties, and design spaces that naturally circulate air.

In the solar energy sector, some large projects have been proposed, and a 35,000 km^2 (14,000 sq mi) area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 to 2,100 GW. In January 2015, the Indian government significantly expanded its solar plans, targeting US$100 billion of investment and 100 GW of solar capacity by 2022.[17]

1.3. Biomass and Bio energy

Biomass is organic material made from plants including microorganisms and animals. Plants absorb the sun's energy in photosynthesis and store the energy as biomass. Therefore, biomass is a renewable energy source based on the carbon cycle. Some examples of biomass fuels include wood, crops, and algae. When burned, the chemical energy in biomass is released as heat. Biomass can be converted to other biofuels, such as ethanol and biodiesel. Biomass grown for bio fuel includes corn, soybeans, willow switch grass, rapeseed, sugar beet, palm oil, and sorghum[15]. Cellulosic biomass, such as corn stover, straw, timber, rice husks can also be used for bio fuel production. Anaerobic digestion of biomass produces biogas, while gasification produces synthesis gas, which is the mixture of hydrogen and carbon dioxide to be converted to liquid fuels. Cellulosic ethanol can also be created by a thermo-chemical process, which uses various combinations of temperature, pressure, water, oxygen or air, and catalysts to convert biomass to cellulosic ethanol.

By 2010, there was 35 GW (47,000,000 hp) of globally installed bio energy capacity for electricity generation, of which 7 GW (9,400,000 hp) was in the United States.[11]

1.4. Wind Energy

The Earth is unevenly heated by the sun and the differential heating drives a global atmospheric convection system reaching from the earth's surface to the stratosphere. Most of the energy stored in these wind movements can be found at high altitudes where continuous wind speeds of over 160 km/h (99 mph) generally occur. To assess the frequency of wind speeds at a particular location, a probability distribution function is often fitted to the observed data. Wind power is a totally renewable energy source with no greenhouse gas emissions, but due to its unpredictability, has problems integrating with national grids. At the end of 2009, worldwide wind farm capacity was 157,900 MW, representing an increase of 31% during the year, and wind power supplied some 1.3% of global electricity consumption. Installed US wind power capacity reached 25,170 MW at the end of 2008 and still growing (15% in cumulative wind power capacity in 2010). The potential for wind to supply a significant quantity of energy is considerable. Availability of transmission capacity helps large-scale deployment by reducing the cost of delivered wind energy.

India has the fifth largest installed wind power capacity in the world.[3] In 2009-10 India's growth rate was highest among the other top four countries. As of 31 March 2014 the installed capacity of wind power in India was 21136.3 MW,[4][5] mainly spread across Tamil Nadu (7253 MW),[6] Gujarat (3,093 MW), Maharashtra (2976 MW), Karnataka (2113 MW), Rajasthan (2355 MW), Madhya Pradesh (386 MW), Andhra Pradesh (435 MW), Kerala (35.1 MW), Orissa (2MW),[7][8] West Bengal (1.1 MW) and other states (3.20 MW).[9] It is estimated that 6,000 MW of additional wind power capacity will be installed in India by 2014.[10] Wind power accounts for 8.5% of India's total installed power capacity, and it generates 1.6% of the country's power.

1.5. Geothermal Energy

Geothermal energy is the heat originating from the original formation of the planet, from radioactive decay of minerals, from volcanic activity, and from solar energy continuous conduction of thermal energy in the form of heat from the core to the surface absorbed at the surface. The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface. Geothermal power is cost effective, reliable, sustainable, and environmentally friendly. The world's largest geothermal power installation is The Geysers in California, with a rated capacity of 750 MW. Worldwide about 11,700 megawatts (MW) of geothermal power is produced in 2013.[12] An additional 28 giga watts of direct geothermal heating capacity is installed for district heating, space heating, spas, industrial processes, desalination and agricultural applications in 2010.[13]

1.6. Ocean Energy

Systems to harvest electrical power from ocean waves have recently been gaining momentum as a viable technology. The potential for this technology is considered promising. The world's first commercial tidal power station was installed in 2007 in the narrows of Strangford Lough in Ireland. Although the generator is powerful enough to power a thousand homes, the turbine has minimal environmental impact, as it is almost entirely submerged, and the rotors pose no danger to wildlife as they turn quite slowly. Ocean thermal energy conversion uses the temperature difference that exists between deep and shallow waters to run a heat engine. Among ocean energy sources, OTEC is one of the continuously available renewable energy resources that could contribute to base-load power supply.[14] The resource potential for OTEC is considered to be much larger than for other ocean energy forms [World Energy Council, 2000]. Up to 88,000 TWh/yr of power could be generated from OTEC without affecting the ocean's thermal structure.

EXPERIMENTAL SECTION

There are so many methods in renewable energy but we are focusing in solar energy. In solar energy there are numbers of way by which we can generate and use the energy. We can produce or generate energy by photovoltaic cell, solar heating, solar cooking etc.

Current sources available for cooking are firewood, crop residues and animal dung in rural areas Promoted by the Government of India are: Parabolic Dish Solar Cookers, Solar Box Cooker, Community Solar Cooker, Solar Steam Cooking System etc.

2.1. Material:

Materials which are used for the production of energy are photovoltaic cell, semiconductors materials like silicon etc. Natural resources like sunlight etc.

2.2 Methods:

2.2.1. Solar Photovoltaic cell:

Solar photovoltaic (SPV) convert light into electricity using semiconductor materials. Photovoltaic cell is a solar cell, which is a solid state electrical device that converts the energy of light directly into electricity. Assemblies of cells are known as solar modules or solar panels. Solar modules are typically deployed as an array of individual modules on rooftops, building facades, or in large-scale ground based arrays. A module consists of many jointly connected solar cells. Most crystalline modules usually consist of 60–72 cells. Photovoltaic cell and modules use various semiconductors; they have three types (1) crystalline silicon, (2) thin-film, and (3) concentrator. Photovoltaic systems produce direct current, which must be converted to alternating current via an inverter if the output from the system is to be used in the grid.

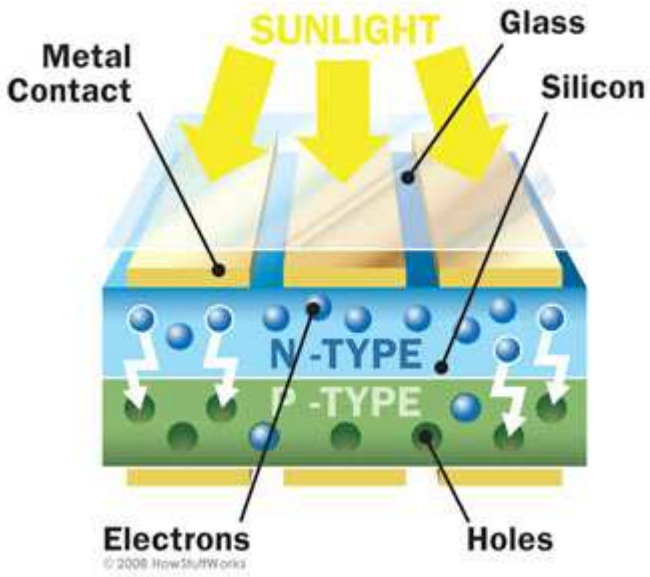

Fig. 1. Photo electric effect

The solar cell works in several steps:

- Photons in sunlight hit the solar panel and are absorbed by semiconducting materials, such as silicon.
- Electrons are excited from their current molecular/atomic orbital. When light energy hits the cell, electrons are knocked loose from the atoms in the semiconductor material.

If electrical conductors are attached to the positive and negative sides, forming an electrical circuit, the electrons can be captured in the form of an electric current.

- Once excited an electron can either dissipate the energy as heat and return to its orbital or travel through the cell until it reaches an electrode. Current flows through the material to cancel the potential and this electricity is captured.
- An array of solar cells converts solar energy into a usable amount of direct current (DC) electricity.
- An inverter can convert the power to alternating current (AC).

The most commonly known solar cell is configured as a large-area p-n junction made from silicon shown in (Fig.1.).

2.2.2. Solar water heater:

Solar water heaters have proved to be the most popular so far and solar photovoltaic (PV) for decentralized power supply are fast becoming popular in rural and remote areas. More than 7,00,000 PV systems generating 44 MW have pumping program more than 3,000 systems have been installed so far, and the market for solar lighting and solar pumping is far from saturated. A conservative estimate of solar water heating systems installed in the country is estimated at over 4,75,000 sq mt of the conventional flat plate collectors. Noticeable beneficiaries of the so far have been cooperative solar drying is one area, which offers very good prospects in food, agricultural and chemical products drying, guest houses, hotels, charitable institutions, chemical and process units, hostels, hospitals, textile mills, process houses and individuals. In fact in India solar water heaters are the most popular of all renewable energy devices.

2.2.3. Solar Electric Generation Systems

Solar electric generation system use parabolic trough collectors to collect the sun's energy shown in (fig. 2) to generate steam to drive a conventional steam turbine [16]. The parabolic mirrors automatically track the sun

throughout the day. The sun light is directed to central tube carrying synthetic oil, which heats around 400^0C. The heat is used to convert water to steam to drive a steam turbine and produce electricity. The largest solar thermal power station is in the Mojave Desert in the US with a power output of 354 MW.

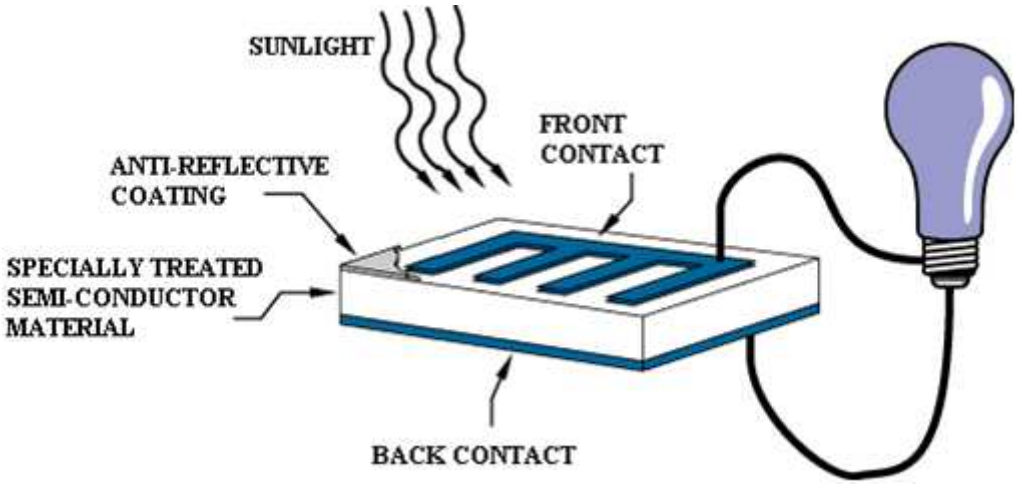

Fig.2. Generation of electricity by the help of sunlight when it incident on the semiconductor material

2.2.4. Solar Cookers

Government has been promoting box type solar cookers with subsidies since long time in the hope of saving fuel and meeting the needs of rural and urban populace. There are community cookers and large parabolic reflector based systems in operation in some places but solar cookers, as a whole, have not found the widespread acceptance and popularity. A lot of educating and pushing will have to be put in before solar cookers are made an indispensable part of each household at least in rural and semi-urban areas. Solar cookers using parabolic reflectors or multiple mirrors which result in faster cooking of food would be more welcome than the single reflector box design is. This is how some observers and users of the box cookers feel.

RESULTS AND DISCUSSION

3.1. Result:

From this review paper it is clear that although we are having lots of natural occurring renewable energies which are used for various purpose using technologies but the energy which is available very easily and in abundance present in our surroundings is the sunlight or solar energy. The technique to utilise the solar energy is also very simple and the material used for this is easily available by using this technology we can generate lots of energy for various purpose like in rural area as well as in industries.

3.2. Discussion:

Why is Solar so easy for rural India?

Rural needs are simple, fuel for cooking, water for drinking, light for studying, television and telephone for entertainment and connectivity. In these areas as tall buildings are not present so there will be more open space hence the solar panel will take less amount of time to energies.

India has a lot of sunlight on the surface of earth is the radiation received from sun. India has adequate sunshine available for most parts of the year; including rural areas. The amount of solar energy impacting the surface of earth is 1000 watts per square meter, which is about 32.8 million MW every second on the Indian land mass. A large part of the incident heat is reflected to the outer space or radiated back to space.

In India “Indian Renewable Energy Development Agency Ltd” is working in the field of energy. Similarly all the states are having their own organization for the development of renewable energy by using new methods or technology. Some of the organizations running in various states are; In Maharashtra: Maharashtra energy development agency (MEDA) in pune, Gujarat: Gujarat energy development agency (GEDA) in gandhinagar, Uttar Pradesh: Uttar Pradesh new and renewable energy development agency (UPNEDA) in lucknow, Madhya Pradesh: Madhya Pradesh urja vikas nigam limited in Bhopal, Chhattisgarh: Chhattisgarh renewable energy development agency (CREDA) in Raipur.

CONCLUSION

Every state is running their own organisation depending upon their availability to increase the efficiency of energy in energy sector. So, in upcoming years we can develop simpler ways or techniques to utilize this energy in industries as well as in rural areas. Some programs must be run in our country so that people may aware of these technique and use it.

Some awareness program like: Education on Energy, Public Awareness and Participation, Research and Development, Work in Rural Areas, Problem of Implementation and Ignorance towards Indigenous Lifestyle should be given to the people.

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