HIGH EFFICIENCY HARNESSING SOLAR ENERGY ON A DOMESTIC LEVEL

[1]S. MALAVIKA, [2]P. ABIRAMI, [3]S. VISHAL

[1,2,3]Dept of Electrical and Electronics, Thiagarajar College of Engineering,
Email: rmalavika94@gmail.com, abirami.sugashini@gmail.com, krpadmakumar94@gmail.com

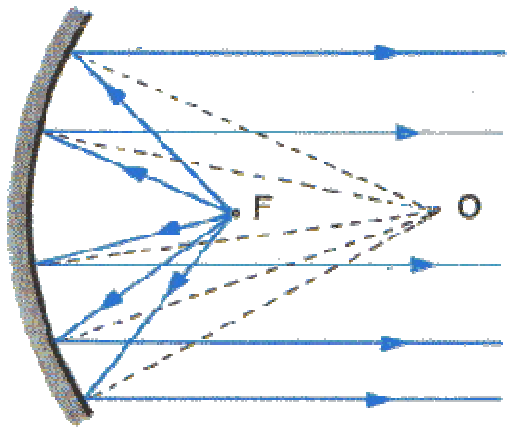
Abstract: This paper focusses on harnessing solar energy on a domestic basis. What we propose is using bits of reflecting material which has high reflective index fixed on a concave parabolic dish available in homes. When sunrays fall on this reflecting surface the rays are converged to a particular point. This is then passed through a borosilicate glass film which absorbs the heat energy and allows only the photons. This is done so that the excess temperature does not affect the solar panel. The photons emitted after convergence and heat removal are focussed on the solar panel and the equivalent power is generated which are exponentially greater than the normal power obtained from a solar panel. Thus more power can be generated. This can be adopted in areas where light intensity is higher. This model can also be modified in areas of high temperature where we use steam turbines and boilers in place of solar panels. Thus efficiency is increased, cost is reduced, size of panel is reduced and further the method can be implemented everywhere on a domestic basis as parabolic dishes are commonly available in all homes.

I. INTRODUCTION

The main crisis of today is the depletion of fossil fuels. Research has proved that in another 40 years there will be complete depletion of fossils, petroleum products, etc. moreover the continuous and unchecked use of fuels has affected the environment on a world level as global warming has scaled new heights. Melting of glaciers, mountain slides are all a result of global warming. Now is the ripe time to move toward renewable sources of energy. However wind energy and tidal energy have been proved to be inefficient in tackling the global demands. The only viable alternative is solar energy which could be trusted for a minimum of a million years. The only disadvantage is the cost and efficiency of solar panel. This paper aims to tackle this issue and promote use at domestic level at improved efficiency.

II. THEORY

Concentrating Solar Power (CSP) systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. The concentrated heat is then used as a heat source for a conventional power plant. A wide range of concentrating technologies exists: the most developed is the parabolic trough. Various techniques are used to track the sun and focus light. In all of these systems a working fluid is heated by the concentrated sunlight, and is then used for power generation or energy storage. Thermal storage efficiently allows up to 24 hour electricity generation.



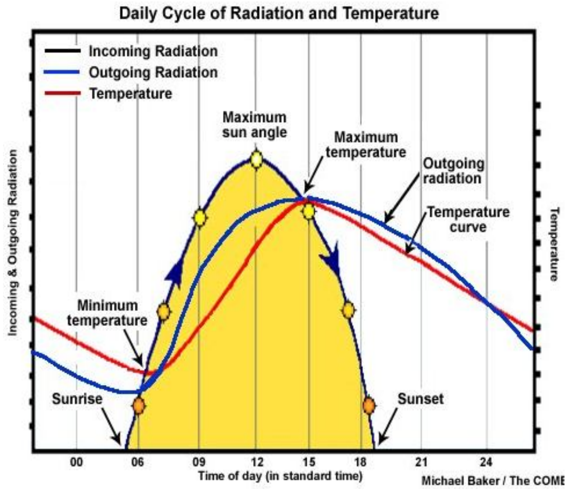
Concentrated photovoltaics (CPV) systems employ sunlight concentrated onto photovoltaic surfaces for the purpose of electrical power production. Solar concentrators of all varieties may be used, and these are often mounted on a solar tracker in order to keep the focal point upon the cell as the sun moves across the sky. Luminescent solar concentrators (when combined with a PV-solar cell) can also be regarded as a CPV system. Concentrated photovoltaics are useful as they can improve efficiency of PV-solar panels drastically.

Solar cells produce direct current (DC) power which fluctuates with the sunlight's intensity. For practical use this usually requires conversion to certain desired voltages or alternating current (AC), through the use of inverters. Multiple solar cells are connected inside modules. Modules are wired together to form arrays, then tied to an inverter, which produces power at the desired voltage, and for AC, the desired frequency/phase.

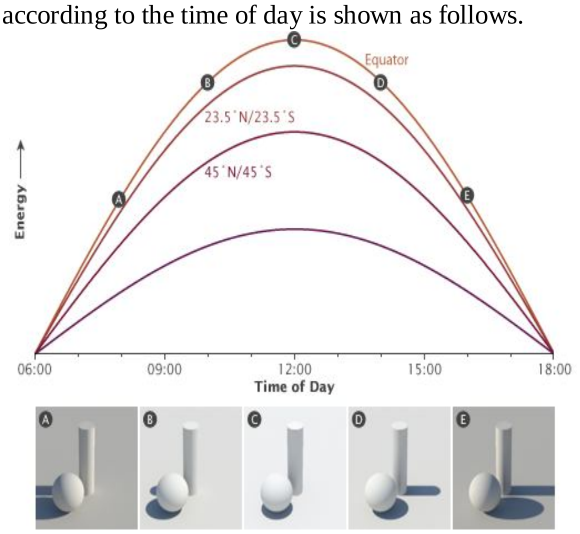
Panels can be mounted at an angle based on latitude, or solar tracking can be utilized to access even more perpendicular sunlight, thereby raising the total energy output. The calculated values in the table reflect the total cost in cents per kilowatt-hour produced. They assume a 5%/year total capital cost (for instance 4% interest rate, 1% operating and maintenance cost, and depreciation of the capital outlay over 20 years).

Thermo-electric, or "thermo-voltaic" devices convert a temperature difference between dissimilar materials into an electric current. First proposed as a method to store solar energy by solar pioneer, thermo electrics remerged in the Soviet Union during the 1930s. Under the direction of Soviet scientist Abram Loffe a concentrating system was used to thermoelectrically generate power for a 1 hp engine. Research in this area of thermo generators, which can use any heat source, is focused on raising the efficiency of these devices from 7–8% to 15–20%.

Physicists have claimed that recent technological developments bring the cost of solar energy more in parity with that of fossil fuels. In testing, the concentrated solar technology proved to be up to five times more cost effective than standard flat photovoltaic silicon panels, which would make it almost the same cost as oil and natural gas.



Another graph showing the variation in solar energy according to the time of day is shown as follows.



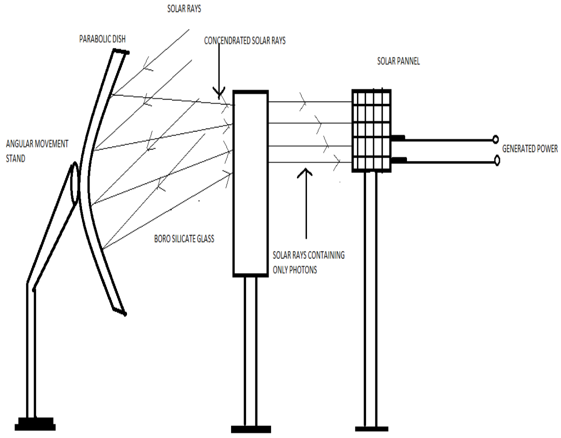
Based on the equation of the sun's position in the sky throughout the year, the maximum amount of solar in solution on a surface at a particular tilt angle can be calculated as a function of latitude and day of the year. These calculations are also essential in using experimental data from sunshine hour recorders.

Proposal 1: Increasing efficiency of solar panel

Components:

i. Parabolic dish with angular rotation equipment
ii. Reflecting material
iii. Borosilicate glass
iv. Small sized solar panel

Circuit diagram:



III. METHOD

A parabolic dish whose angle can be changed is used. The parabolic dish is coated with a reflecting material having high reflective index. When sunrays fall on this surface the rays get converged to a particular point. Just before this point a borosilicate glass is used. The main purpose of this glass is to absorb the heat energy and allowing the photons. This is used here because due to converging the temperature rises to a high level (approximately 500-600 degree Celsius for 1m diameter parabolic dish). Now the converged solar rays having high photon intensity are made to fall on a solar panel and power is generated. This power can be stored in a battery for further use. Since converged rays are used in place of normal rays the efficiency is increased exponentially. By increasing the size of the parabolic dish, the number of photons falling on the panel gets increased which in turn increases the efficiency. For a required amount of power to be produced, using this method, the size of solar panel can be reduced to a great extent when compared to the normal operation. Thus cost can be reduced at a reduced size of panel however with increased power production.

Advantages:

i. Small sized panels for greater power generation
ii. Reduced cost (small panels)
iii. Easily implementable as only common domestic equipment are used

Disadvantages:

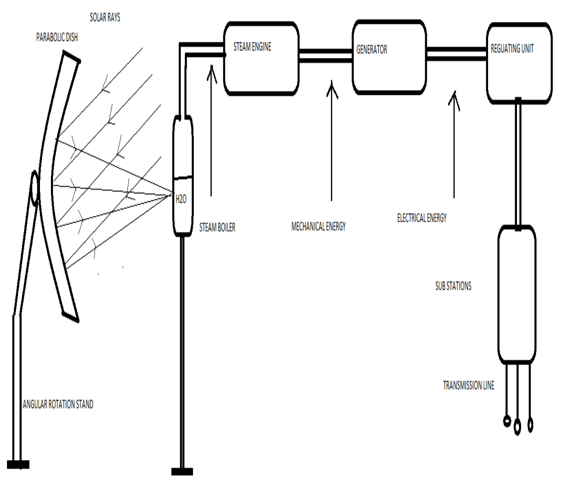
i. Proper thermal insulation and care should be taken in case of borosilicate glass as any damage in the glass focusses high temperature on the solar panel and damages it.

Proposal 2: Harnessing solar energy without solar panels

Components:

i. A parabolic dish with angular rotation
ii. Reflective material having high reflective index
iii. Boiler
iv. Steam engine
v. Gear box
vi. Generator

Circuit diagram:



IV. METHOD:

A parabolic dish with angular rotation equipment is taken. This is coated with a reflecting material with high reflecting index. When solar radiations fall on the concave surface it gets converged to a particular point. At this point the temperature is about 500-600 degree Celsius. When this converged radiation is made to fall on a steam boiler, the water which is present inside boils, and gets converted to pressurised steam. This is then fed into a steam engine. The steam engine is coupled with a gear box which is further connected to a generator.

Thus the mechanical rotation is converted to an equivalent electrical energy. The output of the generator can be used for the required purposes. Thus in this model, solar energy is converted to heat energy, heat energy is used in producing pressurised steam, this steam produces mechanical energy, the mechanical energy is converted to electrical energy.

Advantage:

i. Solar energy can be harnessed without use of solar panels
ii. Reduced cost and increased power production

Disadvantage:

i. Big setup and wide area is needed

Derivation:

Solar radiation=Area of parabolic dish* Permeability of free space* Stefan's constant* (Temperature^4)
Focal length= Radius of the parabolic dish/ 2
Since radius= diameter/2,
Focal length= Diameter/4
Focal length= 1/ Solar radiation
Therefore,
Temperature= {4/ Diameter* Area* Permeability*Stefan's constant} ^ (1/4)
Now let us assume the following values for the different parameters

Diameter = 1 meter
Area of dish = 3.14*1*1/ 4
=0.785 meter square
Stefan's constant= 5.67*(10^-8)
Temperature ={4/ 1*0.785*1*5.67*10^-8} ^ (1/4)
=97.36 degrees.

Thus using this proposal, we are able to generate a temperature of about 100 degree Celsius, using a setup from which the normal temperature obtained would be 50 to 60 degrees. Thus efficiency is increased for the same size of solar panel. Thus at the same cost, we get increased temperature and consequently increased cost.

CONCLUSION

Thus two methods have been proposed to harness electrical energy on a domestic level. The plus involved is that we can improve the output using the same level of input and other conditions.

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