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# A Review Paper on Solar Charging Station for E-Rickshaw

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***Abstract:*** ***Now a day's there is crises for energy and energy products. All over the world there is a great concern regarding the cost and supply of petroleum products. Purchase of fuels for automobile or power plants we have to spend a lot of money causing a bad effect on economy. Burning of fossil fuel causes environmental pollution and bad effect on the health of human being as well as animals and nature too. This paper is a little effort to keep safe guard the human being by development, design and cost estimation for the power supply to the battery operated Rickshaw from environment friendly and renewable solar photo voltaic power. The energy generated for this on small scale but in billions of station would be helpful to reduce the petrol and diesel consumption on national level.***

***Keyword: Solar energy, Photovoltaic cell, E-Rickshaw, Solar Charging Station, Renewable Energy.***

## I. INTRODUCTION

Now a day's due to economic progress and increasing population of the country there is huge demand of energy for automobile, power plant and development activities. There is consumption of hydrocarbons fuel which required supply of oxygen and releases various pollutants .These pollutants may be in the form of gas, liquid, solids and noise rendering the very bad effect on humans, animals and vegetation due to emissions of CO, $NO_x$ , $SO_2$ ,$CO_2$, unburned oxides, $H_2S$, Smoke, suspended particulate matters and soot. There are reports that in Delhi even the children are affected by pollution very badly and are patients of asthma. NGT and Honorable Supreme Court are very clear that any vehicle and industry causing the pollution and threatening the environment are not allowed to function in NCR. Actually Government of India and political leadership is not taking the action properly. Even the use of CNG in Delhi could be implemented by the Supreme Court order after various harsh strictures to the Government of India.
It is observed that a Solar charging station for E-rickshaws not only meet the requirement of electricity but also saves the environment and can earn the carbon credit for the investor. It is meeting the international obligation too. There are four parts which are Solar Energy, Environment and Pollution, E-Rickshaw, and Solar Charging Station.

## II. SOLAR ENERGY

Solar energy is available on earth as free gift from sun so called Suryadev. Without this the existence of living things is not possible and it is a source of renewable energy. Earth receives it in the form of solar radiation which has a large size of wavelength. Solar energy is available free but collection is not free.

### *A. Solar Radiation*

Due to high temperature of sun it emits energy in the form of electromagnetic waves which is called radiation energy. The energy from the sun is transferred to the earth in the form of photons moving at the speed of $3x10^8$ m/s. When photon falls on solar cells, their energy is converted into electrical energy.

### *B. Solar spectrum*

Electromagnetic waves are characterized by their wavelength .The sun emits energy in wide range of wavelengths, between 0.15 and 120 microns.

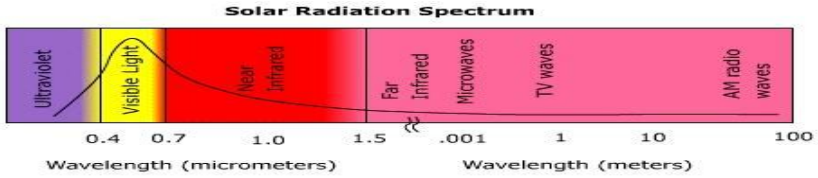



**Figure 1:- wavelength and types of radiation**

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*C. Radiation on the earth surface*

The thickness earth's atmosphere of is referred to as Air Mass (AM). Solar radiation is subjected to scattering and absorption and reduced amount of radiation reaches the surface of earth.

Table 1:- Radiation wavelength and energy distribution

| Name | Range of wavelength | Energy carried % |
|---|---|---|
| Ultraviolet radiation | 0.15 to 0.38 | 7.6 |
| Visible radiation | 0.38 to 0.78 | 48.4 |
| Infrared radiation | 0.72 to 4.0 | 43 |
| Other radiations | >4.0 | 1 |

*D. Benefits of solar energy*

It is a clean source of energy. These do not violate any of the natural proportions in the nature. It does not modify the internal balance of the earth and does not have polluting effect on rivers and sea water. It is free and available in adequate quantities in almost all parts of the world where people live.

*E. Limitations*

1) *Dilute source of energy*: Even in the hottest regions on earth the solar radiation flux available rarely exceeds1 KW/$m^2$ and total radiation flux available over a day is at best 7 kWh/$m^2$. So it requires large collection area.
2) *Availability:* It varies widely with time. Due to cycle of day and night there is daily variation of solar energy. Seasonally because of earth's orbit around the sun. Due to local weather conditions there is variation of radiation at a specific location.
3) *Storage:* Energy collected when the sun is shining must be stored for use during periods when it is not available. Generally energy demand is constant and the source of energy supplied by solar radiation is variable. Energy is stored when excess energy is available than demand. Stored energy is used when energy supply is less than energy demand. Energy storage reduces the mismatch between the energy supply and energy demand. It also improves the performance of energy system by smoothing the output and thus increasing the reliability of the system.
4) *Economy:* Collection of energy and storage result in increase of cost. We can design various systems for different capacity, duration and cost.

*F. Solar Photovoltaic System*

Photo-voltaic is a solar power technology that uses solar cells to convert incident sunlight directly into electricity with zero emissions. Silicon is purified, melted, and crystallized into ingots. The ingots are then sliced into wafers to make individual cells. Solar photo-voltaic application takes energy from solar radiation emitted due to high temperature of the sun. Radiation of sun has very wide range of solar spectrum. Visible range has the highest energy density useful for P V application. DC is given by solar module and this energy is transferred to E-rickshaw which is used for silent and green transportation in the city. PV systems are of two types first Power generated used directly and second Stored and utilized when required

*G. Solar cells*

When sunlight falls on solar cells, a voltage is generated across its terminals and the solar cell acts like a charged battery. (Reference from Sun light to Electricity of TERI Publication) Types of solar cells:-

1) Single crystal silicon
2) Polycrystalline silicon
3) Ribbon silicon
4) Amorphous silicon.

Table 2: Types of cells and conversion efficiency

| S N | Technology | Efficiency % | Remarks |
|---|---|---|---|
| 1. | Single crystal silicon | 13-15 | Highest efficiency, more expensive |
| 2. | Polycrystalline silicon | 12-14 | Slightly less efficient, no distinct cost difference |
| 3. | Amorphous silicon | 6-7 | Very low efficiency cheaper |
| 4. | Cadmium telluride | 8-10 | Low market penetration |
| 5. | Copper indium disulfide | 10-11 | Negligible share |

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*H. Balance of System*

All system components other than the PV module is called balance of system. It consists of battery, charge controller, inverter, support structure and wiring and cabling.

1) *Batteries:* It stores electrical energy generated by the modules during the day and delivers during the non -sunshine hours. For solar applications a battery need to be capable of being discharged thousands of times. A cycle is described as an interval that includes one period of charging and discharging.

Types of Battery: - 1. Lead acid battery 2. Nickel-cadmium battery

Lead acid battery is commonly used and types of it are dry cell and flooded. Dry cells are used in portable system and of 1-10 Ah while Lead acid is used for large size applications and its maintenance is easy.

2) *Charge Controller:* It is a device used to control the amount of charge flowing into and out of the battery. It is used for avoiding the excessive load and charging of the battery. Solar charge controller is specified by the system voltage they are designed to operate the maximum electrical charge they can handle.
3) *Inverters:* Inverters are electronic components which convert DC power generated by a solar array into AC compatible with the local distribution network.
4) *Blocking Diode:* This acts as a check valve to prevent discharge of batteries (reverse flow of current to the solar cells) through PV module during night or during insufficient sunlight.
5) *Other Component:* Electrical connecting equipment consists of wire and cables and physical mounting components consist of metallic frames, bolt and clamps.

*I. Solar Electrical System*

The figure 2 shows a general arrangement of solar panel, battery, charge controller and electrical load. In case of charging station inverter and AC load is not there.

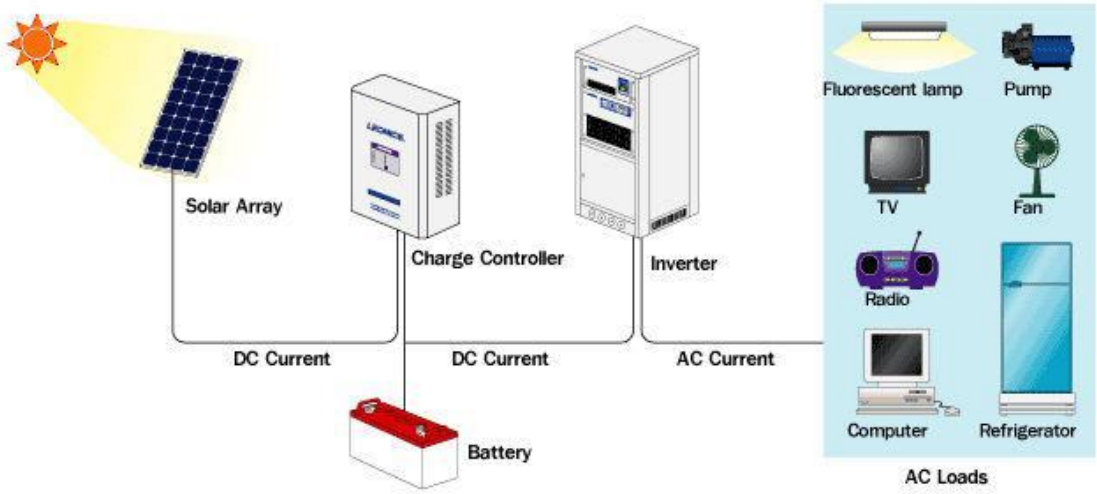



Figure 2: Solar photovoltaic system and electrical load.

## III. ENVIRONMENT, POLLUTANTS AND EFFECTS

There is a deep concern in society and looking for clean and green alternative sources. It is a matter of great concern that neither water nor air is fit for living things and environment is polluted to such a degree that it is beyond limit of standard; result is even children became patient of asthma reducing the working capacity of their lungs. For quality of air to improve in Delhi, Supreme Court gave many times order and instruction to government of India to take steps like introduction of CNG buses closing and throwing out industries from Delhi a world's largest polluted city.

Automobile creates pollution of air and noise too. E-Vehicle gives a sign of relief. Though E-vehicles is sharing the market but there is lack of infrastructure facility and faith of people. E-vehicles use electric power from power plant causing pollution and it is shifting the place of pollution only and from national and global point of view renewable energy must be used for their operation. This work is related to design of a solar charging station for E–rickshaw.

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*A. Pollution due to Hydrocarbons*

Air pollution is presence of, dust, fumes, gas, mist, smoke, and odor in atmosphere which are injurious to the health of human, vegetation and marine life. The table (2.5.1) shows various pollutants developed from coal and diesel power plant.

Table 3: Pollutants from power plants

| S. N. | Pollutant | Coal power plants | Diesel power plants |
|---|---|---|---|
| 1. | Carbon dioxide | Yes | Yes |
| 2. | Oxides of nitrogen | Yes | Yes |
| 3. | Sulfur dioxide | Yes | Yes |
| 4. | Hydrogen sulphide | Yes | Yes |
| 5. | carbon monoxide | No | Yes |
| 6. | Aldehyde | No | Yes |
| 7. | Particulate matter | Yes | Yes |
| 8. | Unburned hydro carbons | No | Yes |
| 9. | Soot | Yes | Yes |

Table 4: Pollutant cause and effect

| S.N. | Pollutant | Cause | Effect |
|---|---|---|---|
| 1. | CO | Incomplete combustion of fuel | Headache, nausea, breathlessness, reduced $O_2$ carrying capacity to lungs |
| 2. | HC | Un-burn HC in lean and rich mixture | Irritation in respiratory system |
| 3. | $NO_x$ | Combustion at temperature more than $1000^0$ C | Irritation to eyes ,nose and throat, damage to lungs, smog formation |
| 4. | Soot | Un-burnt solid carbon | Lung cancer |
| 5. | SPM | Burning of fossil fuel | Respiratory system soiling and corrosion of metal parts |
| 6. | $SO_2$ and $CO_2$ | Burning of sulfur in fuel | Suffocation, irritation of throat and eyes, lung cancer. destruction of crops, Reduced vegetation |
| 7. | $CO_2$ | Combustion of fuel | Global warming, flooding of coastal area |

*B. Benefits of Solar power plant*

Energy produced by these plants is environment friendly and have some more benefits like zero cost of fuel, no acid rain no thermal pollution and no noise pollution.

## IV. E-RICKSHAW

It is very interesting that E-rickshaw market is growing while two wheeler battery vehicles could not develop. E-Rickshaw market has gone various problems like ban on it by the court when a very painful accident takes place. Because people had found it was a convenient mode of transport. E-rickshaw business model is giving good returns. Invention is result of needs. In the market a new kind of transport has emerged and is promising so called E-Rickshaw It has some advantages and disadvantages. It has become very popular in economic class of people who are between the manual rickshaw and Auto / Vikram. E-rickshaws earning good money and has problem too.

*A. Advantages of E-rickshaw*

*1)* It is environment friendly releasing no air pollutants.
*2)* It is silent in operation and does not create noise.
*3)* It is saving hydrocarbon fuels a source of pollution.
*4)* As India is importing 80% of fuel it is making saving of foreign exchange.
*5)* Foreign exchange is required to import fuel. For this we are exporting meat products. Production of meat is itself a highly polluting industry causing air and water pollution is not happens in E-rickshaws.

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*6)* We are creating pollution to purchase pollution creating products which can be reduced by use of solar charging station.
*7)* It is low cost and in the range of purchasing capacity of young people.
*8)* Owner feels self- respect and pride to have it.

*B. Disadvantages of E-Rickshaw*

*1)* It slows down in the loading condition when passenger is going to destination and operator has to go back to home to charge the batteries while there are passenger available causing financial loss as well as reliability.
*2)* It has problem of battery maintenance and warranty and guarantee. Initially gives 1 year battery guarantee after it they give for six months and then three months and now no guarantee for E-Rickshaw operation.
*3)* In some area of the city and villages there is no pattern of power supply and it becomes very trouble-sum that a battery already discharge to a more than recommended depth of discharge level requiring a loner charging period is again on the road with partly charged condition making it a worse situation for life as well as livelihood loss of operator.
*4)* When operator gives high acceleration motor withdraws very high current against the operation practice of battery causing reduction of battery life cycles.
*5)* Charge controller is also creating maintenance trouble and has to replace causing livelihood loss due to non plying time as well as cost of purchase.
*6)* There is no regulator of design and transport authority.
*7)* Early E-car technology was very costly and government had to give subsidy but E - rickshaw is taking momentum itself.

*C. Case Study of SIKCO Brand E –Rickshaw*

It consists of design parameter, operating parameter motor specification and various parts.

Table 5: Specification of E-rickshaw

| Technical Basic Specifications of Electric Rickshaw (SIKCO BRAND) | | |
|---|---|---|
| S.N. | Particulars | Specifications |
| 1 | Max Load Bearing | 400 to 500 Kg |
| 2 | Passengers | 4 to 6 |
| 3 | Speed | 25 to 35 Km /hr |
| 4 | Motor Efficiency | 60 % |
| 5 | Battery Utilization Factor | 80 % |

Table 6: Technical specification of E-Rickshaw motor



| Technical Specification For E-Rickshaw Motor | |
|---|---|
| **Power** | 650w / 850w / 1000w |
| **RPM / Speed** | 3000 |
| **Voltage** | 48Vdc |
| **Type** | Brushless Motor |
| **Shaft** | Yes |
| **Gear on shaft** | Yes |
| **Efficiency** | > 92% |
| **Sensors** | PT 100 Temperature Sensors and Hall Effect Speed Sensors |
| **Output Type** | 3 phase |
| **Controller** | Under Development |
| **Speed Type** | Variable Speed |
| **Poles** | 8 |
| **Length** | 136.5mm |
| **Height** | 210mm |
| **Weight** | 5kgs |
| **Protection Type** | IP 55 ( Can be modified as per customer requirement) |
| **Insulation Type** | Class H |

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## V. SOLAR CHARGING STATION

Schnider Electric had a PPT of battery charging station by solar energy and grid power charging station for lighting and mobile charging station. PPT throws light how this model can be a business model though solving the problem of electricity at local level. This study is related to solving the battery charging problem with solar energy as off grid stand alone system and design and costing and proposal of a business model.

### *A. Cost and Economics of Solar Charging Station*

There is two types of solar system from economic viability point of view .It may be stand alone or working in conjunction with conventional system

*1)* Cost of the system.
*2)* Economic analysis of the system.
*3)* Financial model
*4)* Model of operatio



Figure 3 shows a photograph of solar charging station cum shade in a Europeean country

## VI. CONCLUSION

Due to reduced fuel consumption environment will become clean by using source of green and clean energy as renewable solar energy. This plant can be installed in schools of villages and can earn a financial assistance to them from its rent for space used of school as well as silent power would be available. It has more benefits as compared to fossil fuel and petroleum products. It is an alternative which is promise and consistent to meet the high eco-friendly transport demand. Research on solar energy E-Rickshaw is promise has a future worldwide.

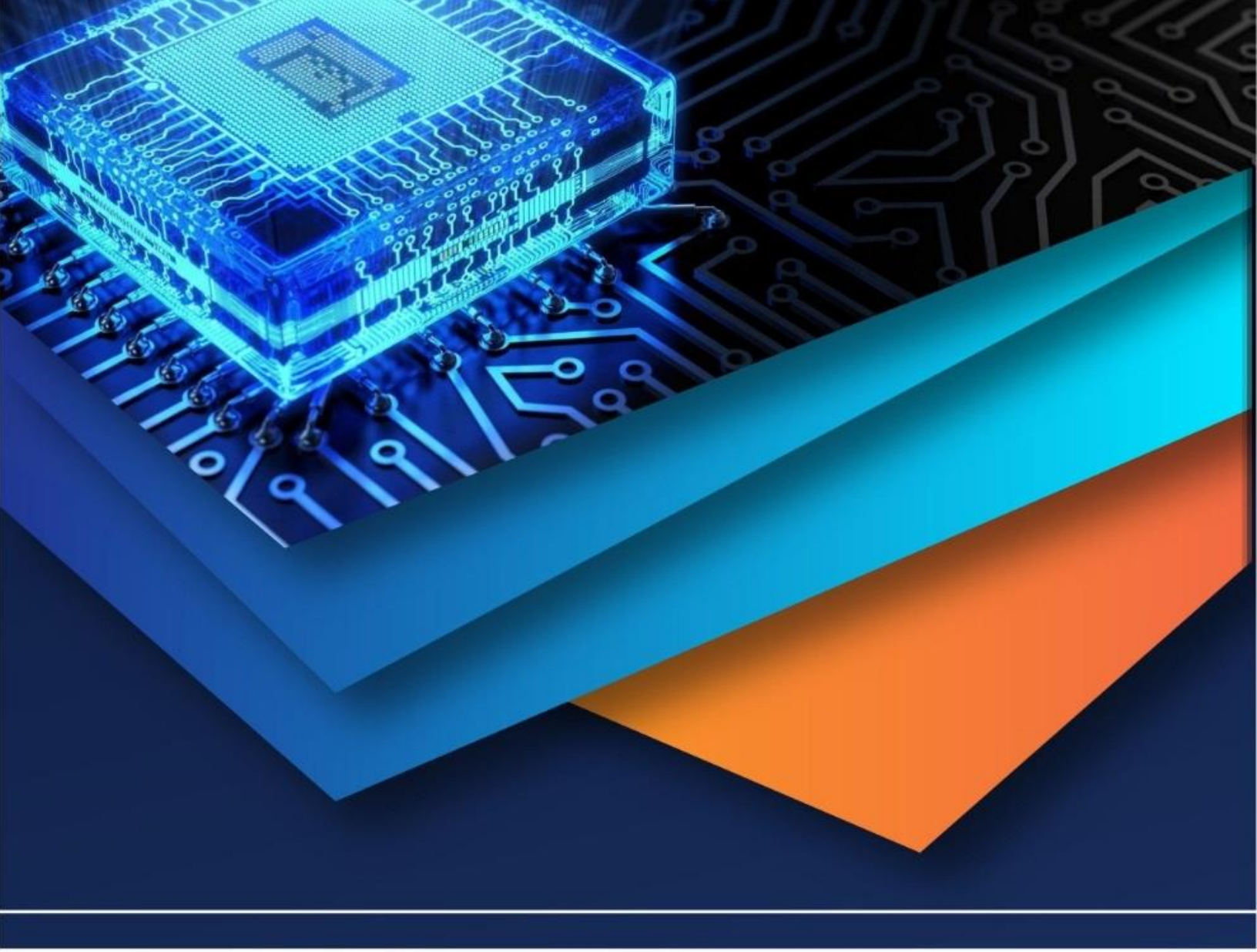
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