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Design of Solar Charging Station for E - Rickshaw

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Abstract: Now a day's there is a crisis for energy and energy product's. All over the world there is a great concern regarding the cost and supply of petroleum products. Purchases 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 animal's and nature too. This thesis presents 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 scale back the petrol and diesel consumption on national level. There is another factor of transportation of fuels causing another point of consumption and unnecessary loss of fuel. It would be helpful in totally for the development of a station and in development of solar energy and the poor section but hardworking small entrepreneur people. survey by meeting with rickshaw owner it had found that due to discharging of battery they have to go back to their home for charging. If this is available to them as commercially in their present root they would be able to drive more and earn more as well as a proof of sustainable eco-friendly technology.

Keywords: Type of methods of use, Radiation wavelength and energy distribution Table , Types of cells and conversion efficiency, Trouble shooting of solar panel, Relative performance of various types of batteries, Specification of E-rickshaw , Distance covered and battery capacity ,Technical specification of E-Rickshaw motor, System Set Up.

I. BLUEPRINT OF SOLAR CHARGING STATION

A solar station is designed to charge the battery of E-Rickshaw. System consists of solar panel 13KWp and a set of batteries consist of 4 pieces making a 48V supply system for the motor of E-Rickshaw. This system can charge at peak times 6 E-Rickshaws at a time with 20Ah in an hour. It consists of assessment of solar energy required for battery and how to supply it and manage. E rickshaw has 4 batteries of 80 -100Ah in general system consist of 48V 100 Ah. To work efficiently and considering the life of battery the depth of discharge of battery should be up to 70%.

A. Assessment of Energy for Battery Charging

Let the battery have discharging and charging efficiency of 90%. The charge of one time is claimed to run the rickshaw about 70Km. Simple analysis is that battery can deliver only $(70 \times 90 = 63)$ 63Ah in a single charge, and required of 70 Ah supply of energy at 48V equal to $(70 \times 48 = 3360)$ Wh. As this energy will be supplied from solar panel to cover losses of system for electric energy panel should be of capacity $(3360 \times 1.3 = 4368)$. This is the energy supplied in whole day. As these rickshaw's are commercially used so battery is always discharged more than the 50% of depth of discharge. In this situation battery can be charged in bulk mode. In this case you can give a charging rate of 40% of battery capacity meaning 40A charging. This station is design to charge 10 rickshaws. In the experiment it is found that system of 12V and 125W_p panels (number 4) in parallel delivers up to 28A in the peak noon periods of May.

II. METHODOLOGY

For charging 10 rickshaws in the whole day a rickshaw can be given 1 hour charging as these have their alternative arrangement too. As their route is hardly 5-8 Km, let we are charging 2 rickshaws from 8 to 10 AM. As in the morning charging is low so we need to attach 3 strings in a rickshaw.

A table is shown for time of the day and the ampere of charging the battery. First average is taken for half an hour and then for one hour it shows the average amount of ampere deliver to the battery. As from 8.0 AM to 9.0AM ampere developed is 6.3. Therefore 3 strings in parallel are required to deliver above 20Ah. As ampere is lower than 20 so time required would be more than 1 hour. During time period of 8-9AM only 2 rickshaws can be charged. After 11 AM to 3 PM One E-Rickshaw can be charged by a string in totality 6 rickshaw can be charged.

III. MATERIALS AND METHODS

The electric power is required but in interiors the electric power is not available properly. The operator cannot charge it anywhere except his place of charging. Therefore battery is not fully charged so E-rickshaw has to come back for charging the batteries. A solar system is proposed to charge battery in the day to overcome this problem. This charging station would supply electrical fuel like petroleum from petrol pumps. E-Rickshaw is a silent, green and clean transport medium in the congested cities and interior areas. Following points considered here.

- 1) Supply of electric energy requirement to E-rickshaw
- 2) Development of solar charging station.
- 3) Effect of pollution on environment
- 4) Solar energy

S No	Item	Parameter
1	System consist of 4 panel in parallel	12V and 125Wp
2	Battery rating	12v 150 Ah
3	Ampere meter	40A
4	Watch	1 piece
5	Wire diameter	4mm ²
6	Wire length	10 m

A. Identification Of Problems

In the survey it is found that battery is not fully charged so during the operation it goes to deep discharge state. This state harms the battery life therefore a battery is supposed to work one year is working only three months. This problem can be rectified by charging the batteries at the start and end point of their route travelled. To find the solution of problem two experiments conducted. First to measure how much ampere is withdrawn by the motor of E-Rickshaw and second experiment is to know the size of panel required to deliver 20 Ah supply in one hour in a day.

B. Operational Problem of E-Rickshaw

It is a matter of great concern that battery is running hardly 3 months while it should work more than 1 year and duration of working distance covered also not as per claimed that is lower coverage per charge. It is causing a loss to rickshaw operator as well as battery manufacturer. Charge controller is also having short life due to high ampere used than the rated 40A.

C. Assessment of Energy To Charge Battery

For charging this battery with the help of solar energy experiments are performed as.

IV. EXPERIMENTS

In this section there are two experiments. First experiment is for finding the actual data of current developed due to solar radiation at Meerut. Second experiment is for current delivered by battery of E-Rickshaw and voltage of battery in working condition.

A. Experiment: 1

It consists of conversion from solar radiation and developed ampere for charging the batteries with solar panels and measurement of current in a day. It depends upon the geographical situation as well as month of the year. It is observed that if there are clouds at the peak time less energy develops. In winter season as day is short, no lower radiation period and peak remains available though peak is itself lower than summer season.

B. Battery and Solar Panel

The setup had 12V 150 Ah batteries and data was taken between the time and ampere developed .To supply 48 V and 20-25A array should consist of such 4 sets in series. Though voltage also changes but for a practical and simple analysis it was taken constant as solar PV charges nearly at 13.5V. A sample calculation is shown for average ampere supplied during 30 min and then for 60 minutes supposed to deliver for battery charging.



Battery and Solar Panel

1) *Observation:* Observation for how much current is developed at a certain period of time to calculate an average of energy supplied .It gives a rough idea that in a particular period how many panel you are required and how long to supply power. It delivers maximum current in the peak noon periods of 28A.

C. Average Radiation At Meerut

The average radiation received by Meerut city on monthly basis as recorded by the metrology department depicted in table (3.2) .Monthly average radiation data of Indian solar resource This table shows that in the month of December and January available radiation at Meerut is very low. This period is winter season accompanied by fog will lower the working capacity and effect would be lower time available for charging. Effect would be less number of charging E-rickshaw with lower Ah than the designed 20 Ah.



D. Costing Of Solar Charging Station

Price of solar charging station consists of plant installation

1) **Fixed Cost:** This onetime cost includes plant machinery, transportation, installation etc.

Table of Fixed cost

S.N.	Item	Specification	Pieces/number	Rate	Cost
1	Panel	250W _p	52 (13kW _p)	45per watt	585000
2	Battery	12v150A 24M	4	12500	50000
3	Structure	MS 35x35x4	7	10000	70000
4	Wiring	4mm	70/m	70/m	5000
5	Cable	6mm		100/m	7500
6	Cable	10mm		180/m	10000
7	Charge controller	48V40A	6	11000	66000
8	Inverter	3KVA48V40A	1	57500	57500
9	Transport		Lot		25000
10	Installation		Lot	5000/KW _p	65000
11	Total				941000

2) **Running Cost:** Expected running cost of system for a year under various head

Table of Running cost

S no	Item	Rate	Amount /month	Yearly
1	Operator (1)	6000/month	6000	72000
2	Security (1)	3500	3500	42000
3	Land rent	4000	4000	48000
4	Maintenance	1000	1000	12000
5	Total		18500	174000

V. RESULT AND CONCLUSION

- A. Due to reduced fuel consumption environment will become clean by using source of green and clean energy as renewable solar energy.
- B. Rickshaw motor is withdrawing more than 40A and in experiment measured up to 42A causing extra high current withdrawal of the order of more than 225Ah capacity battery.
- C. If such a large battery bank is used it will increase the battery weight and more consumption of power as well as initial and maintenance cost defeating the purpose. But charging station at the starting and end point will solve the problem and they can earn more money without loosening their livelihood Though operator has to use low acceleration to keep current withdrawal lower up to 35A.
- D. A theoretical estimate is that total panel wattage (52x250=13KW_p) would generate 13x4.5 =58.5KWh (units) of electrical energy reducing 58.5/4=14.6 liter of diesel per day by a gen-set. If considered grid supply and transmission losses the energy consumption of 58.5 units may go up to 70units generation considering 20% transmission losses.
- E. It is found that 40 E-Rickshaw can be charged for 1 hour by 20Ah. The cost of charging by 20Ah is Rs 15 and rickshaw moves 20 Km @ of Rs 0.75 per km. This system can be made more viable by increasing the number of rickshaws and differently able person and ladies by increasing the capacity of station to charge more rickshaws.
- F. It is a fact that E-rickshaw is using domestic electrical connection.
- G. The rate of an electrical unit is less than commercial electrical connection and amount roughly half Rs.6. Therefore operator feels cost is very low of full charge Rs.25. Cost of full charge would be Rs.45.



H. A bench mark is also required to do this job. There is I. C. Engine free zone, which produced power itself. This model can be a bench mark working in TERI, Gurgoan. Eight such plants can be run by 100KW_p plant. A 100KW_p plant saves a carbon foot print of 125 tones. (Source TATA Solar).ROI is low from economic point but environment concern fulfills. Investor can earn carbon credit of 100KW_p too. A new concept of business model and investment also considered for finding the ways for clean and green earth to hand over the next generation.

VI. FUTURE SCOPE

- A. A diesel generator set or electric power supply from utility can be added as a hybrid system and dependability on sun can be reduced or larger size solar system may be used. It would help to make successful.
- B. A new style rickshaw may be developed which will have battery in a separate trolley with wheel and added to rickshaw. When battery got full charged and there would be no time involvement in charging battery of 8 to 10 hours.
- C. To make a system as come and take away charged battery as petrol at petrol pump. A number of such trolley say 5 would made arrangement user friendly.
- D. To increase power of rickshaw 60V system can be used as in Bangladesh.
- E. The system can be upgraded from E-rickshaw to a big E-Car or E-Van.
- F. This system can be used to develop a silent gen-set like diesel generator set used for various occasion like in marriages behind a Baghi of a groom.
- G. 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.

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