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SOLAR VEHICLES

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ABSTRACT

A solar vehicle is an electric vehicle powered completely or significantly by direct solar energy. Usually, photovoltaic (PV) cells contained in solar panels convert the sun's energy directly into electric energy. The term "solar vehicle" usually implies that solar energy is used to power all or part of a vehicle's propulsion. Solar power may be also used to provide power for communications or controls or other auxiliary functions. Solar vehicles are not sold as practical day to day transportation devices at present, but are primarily demonstration vehicles and engineering exercises, often sponsored by government agencies. However, indirectly solar charged vehicles are widespread and solar boats are available commercially. Research and development is continuously going on to increase the efficiency of solar vehicles and trying to make it commercially viable.

KEYWORDS: PVTRAIN, Single track vehicles, Solar buses, Solar cars, Solar powered spacecraft.

INTRODUCTION

There are limits to using photovoltaic (PV) cells for vehicles:

- Power density – Power from a solar array is limited by the size of the vehicle and area that can be exposed to sunlight. This can also be overcome by adding a flatbed and connecting it to the car and this gives more area for panels for powering the car. While energy can be accumulated in batteries to lower peak demand on the array and provide operation in sunless conditions, the battery adds weight and cost to the vehicle. The power limit can be mitigated by use of conventional electric cars supplied by solar (or other) power, recharging from the electrical grid.
- Cost – While sunlight is free, the creation of PV cells to capture that sunlight is expensive. Costs for solar panels are steadily declining (22% cost reduction per doubling of production volume).
- Design considerations – Even though sunlight has no lifespan, PV cells do. The lifetime of a solar module is approximately 30 years. Standard photovoltaics often come with a warranty of 90% (from nominal power) after 10 years and 80% after 25 years. Mobile applications are unlikely to require lifetimes as long as building integrated PV and solar parks. Current PV panels are mostly designed for stationary installations. However, to be successful in mobile applications, PV panels need to be designed to withstand vibrations. Also, solar panels, especially those incorporating glass, have significant weight. In order for its addition to be of value, a solar panel must provide energy equivalent to or greater than the energy consumed to propel its weight.
- Sometimes efficiency is very lesser.

METHODOLOGY

- Solar cars: Solar cars depend on PV cells to convert sunlight into electricity to drive electric motors. Unlike solar thermal energy which converts solar energy to heat, PV cells directly convert sunlight into electricity. Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar car is severely limited by the amount of energy input into the car. Solar cars are built for solar car races. Even the best solar cells can only collect limited power and energy over the area of a car's surface. This limits solar cars to ultra light composite bodies to save weight. Solar cars lack the safety and convenience features of conventional vehicles. Solar cars are often fitted with gauges and/or wireless telemetry, to carefully monitor the car's energy consumption, solar energy capture and other parameters. Wireless telemetry is typically preferred as it frees the driver to concentrate on driving, which can be dangerous in such a small, lightweight car. The solar electric vehicle system was designed and engineered as an easy to install (2 to 3 hours) integrated accessory system with a custom molded low profile solar module, supplemental battery pack and a proven charge controlling system. As an alternative, a battery

powered electric vehicle may use a solar array to recharge, the array may be connected to the general electrical distribution grid.

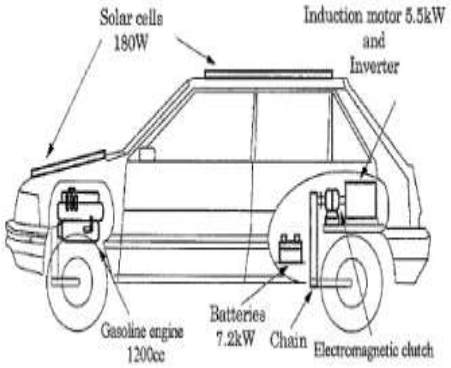

Figure 1: Solar car

- Solar buses: Solar buses are propulsed by solar energy, all or part of which is collected from stationary solar panel installations. The Tindo bus is a 100% solar bus that operates as free public transport service in Adelaide City as an initiative of the City Council. Bus services which use electric buses that are partially powered by solar panels installed on the bus roof, intended to reduce energy consumption and to prolong the life cycle of the rechargeable battery of the electric bus, have been put in place in China.

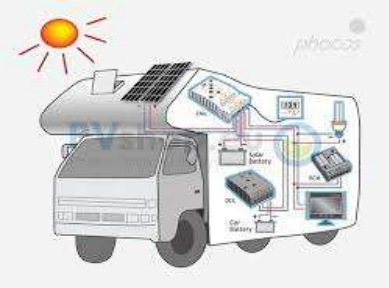

Figure 2: Solar bus

- Single track vehicles: The first solar "cars" were actually tricycles or quadra cycles built with bicycle technology. These were called solar mobiles at the first solar race, the Tour de Sol in Switzerland in 1985. With 72 participants, half used solar power exclusively while the other half used solar human powered hybrids. A few true solar bicycles were built, either with a large solar roof, a small rear panel, or a trailer with a solar panel. Later more practical solar bicycles were built with foldable panels to be set up only during parking. Even later the panels were left at home, feeding into the electric mains, and the bicycles charged from the mains. Today highly developed electric bicycles are available and these use so little power that it costs little to buy the equivalent amount of solar electricity. The "solar" has evolved from actual hardware to an indirect accounting system. The same system also works for electric motorcycles, which were also first developed for the Tour de Sol.

RESULTS

- The Venturi Astrolab in 2006 was the world's first commercial electro-solar hybrid car, and was originally due to be released in January 2008. An inventor from Michigan, USA built a street legal, licensed, insured solar charged electric scooter in 2005. It had a top speed controlled at a bit over 30 mph and used fold-out solar panels to charge the batteries while parked.
- Auxiliary power: Photovoltaic modules are used commercially as auxiliary power units on passenger cars in order to ventilate the car, reducing the temperature of the passenger compartment while it is parked in the sun. Vehicles such as the 2010 Prius, Aptera 2, Audi A8, and Mazda 929 have had solar sunroof options for ventilation purposes.
- Rail: Railway presents a low rolling resistance option that would be beneficial of planned journeys and stops. PV panels were tested as APUs on Italian rolling stock under EU project PVTRAIN. PVTRAIN concluded

that the most interest for PV in rail transport was on freight cars where on board electrical power would allow new functionality –

- ✓ GPS or other positioning devices, so as to improve its use in fleet management and efficiency.
- ✓ Electric locks, a video monitor and remote control system for cars with sliding doors, so as to reduce the risk of robbery for valuable goods.
- ✓ ABS brakers, which would raise the maximum velocity of freight cars to 160 km/h, improving productivity.

Indian railways announced their intention to use on board PV to run air conditioning systems in railway coaches.

- Water: Solar powered boats have mainly been limited to rivers and canals, but in 2007 an experimental 14m catamaran, the Sun21 sailed the Atlantic from Seville to Miami, and from there to New York. It was the first crossing of the Atlantic powered only by solar. Japan's biggest shipping line Nippon Yusen KK and Nippon Oil Corporation said solar panels capable of generating 40 kilowatts of electricity would be placed on top of a 60,213 ton car carrier ship to be used by Toyota Motor Corporation. The low power density of current solar panels limits the use of solar propelled vessels, however boats that use sails (which do not generate electricity unlike combustion engines) rely on battery power for electrical appliances (such as refrigeration, lighting and communications). Here solar panels have become popular for recharging batteries as they do not create noise, require fuel and often can be seamlessly added to existing deck space.
- Air: Solar ships can refer to solar powered airships or hybrid airships. There is considerable military interest in unmanned aerial vehicles. Many demonstration solar aircraft have been built, some of the best known by Aero Vironment.
- Solar powered spacecraft: Solar energy is often used to supply power for satellites and spacecraft operating in the inner solar system since it can supply energy for a long time without excess fuel mass. A communications satellite contains multiple radio transmitters which operate continually during its life. Solar power is not generally used to adjust the satellites position, however, and the useful life of a communications satellite will be limited by the on board station keeping fuel supply.

CONCLUSION

Efficiency of solar vehicle is typically 15%-18%. Since the solar energy is free of cost hence no operational cost. Solar vehicles are eco friendly since they do not pollute the environment.

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