

Solar Cars

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What are Solar Cars?

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What are Solar Cars?

- Solar cars are cars powered by a type of renewable energy -- in this case solar power
- This solar energy is obtained by solar panels attached to the car
- Presently, solar cars are not used much for day to day transportation, but for demonstrations and engineering exercises

Overview

- Solar cars use the solar array to collect energy from the sun.
- This energy is then stored by batteries in the electrical system for the car to run on.
- The mechanical design of the car allows for maximum utility of the electric energy gathered from the sun.

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How Do Solar Cars Work?

- Solar Array
 - Solar cells
 - Positioning
- Electrical System
- Mechanical System

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Solar Array

- The Solar array is made up of hundreds of photovoltaic (PV) solar cells that convert sunlight to electricity using the “photovoltaic effect.”

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Photovoltaic Effect

- Sunlight is composed of photons, or "packets" of energy. These photons contain various amounts of energy corresponding to the different wavelengths of light.
- When photons strike a solar cell, they are absorbed and when a photon is absorbed, the energy of the photon is transferred to an electron in an atom of the solar cell.
- With its newfound energy, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit.

Solar Cells

- A device that captures sunlight directly and converts it into electricity using the “photovoltaic effect”
- Assemblies of these cells are used to make solar panels, solar modules, or photovoltaic arrays
- These panels can be mounted in different ways

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Ways to position Solar Panels

- There are six ways to position Solar Panels:
 - Horizontal
 - Vertical
 - Adjustable
 - Integrated
 - Trailer
 - Remote

Position 1 of 6

- Horizontal
 - Most common; gives most overall power during the day in low latitudes or higher latitude summers and offers interaction with the wind

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Position 2 of 6

- Vertical- This can be found in free standing or integrated sails to harness energy- this is most useful in mornings, evenings or winters and when the car is pointing in the right direction

Position 3 of 6

- Adjustable- These solar panels can be tilted around the axis of travel in order to increase power when the sun is low and well to the side

Position 4 of 6

- Integrated- This is where a car's surface area is covered with solar cells. Some of these cells will be at optimal angles while others will be shaded depending on the angle of the sun

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Position 5 of 6

- Trailer- Solar trailers are useful for retrofitting existing cars with little stability (e.g. bicycles). Some trailers include batteries, while some also include the drive motor

Position 6 of 6

- Remote- In this option, the solar array can be mounted at a stationary location instead of on the car itself. Power can be maximized and the resistance is limited.
- This grid connection does involve more electrical losses however, than with true solar vehicles and the battery must be larger

Electrical System (1)

- The Electrical System stores all the energy gathered by the Solar Cells and turns it into “fuel” for the solar car to run on
- Aside from the Solar Array, the electrical system is the most important part because it controls all of the power that comes into and exits the vehicle

Electrical System (2)

- Battery pack- stores power gathered from PV cells
- Batteries- lead-acid, nickel metal hydride, nickel cadmium, lithium ion, lithium polymer

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Electrical System (3)

- Pros
 - Easy to replace, flexibility of design and implementation allows for use of cheaper batteries to be combined
 - Can recycle old batteries

Electrical System (4)

- Cons
 - When using a battery pack there are dangers -- chemical, electrical and fire risks

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Electric Pick-up Truck by
Phoenix Motorcars

Mechanical System (1)

- The Mechanical System of a Solar car is the way in which the body of the car is designed in order to use the electric energy and make the car move.

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Mechanical system (2)

- The Mechanical System is designed to keep the weight and space at minimum amounts while maintaining strength of the vehicle
- Normally use titanium and composites - this ensures a good weight to strength ratio
- Usually contain 3 wheels-2 front and 1 rear, front steers
- 4 wheelers are set up like normal cars

Plug-In Hybrid Solar Vehicles (1)

- Triple hybrid vehicle “PHEV”
- Hybrid car with batteries that can be recharged by connecting to an electric power source
- This has the option to have solar panels installed on the roof as well
- May use some gasoline

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Plug-In Hybrid Solar Vehicles (2)

- In 2010 the Toyota Prius will have an option to mount solar panels on its roof making it a triple hybrid vehicle (PHEV)

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Solar Electrical Vehicles Company

- A company founded in mid 2005 by Greg Johanson
- Created to provide an increased electric driving range and improve fuel economy for PHEV's

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Solar Electrical Vehicles (2)

- The system collects clean renewable solar energy to charge the supplemental and HV battery pack
- Energy output = 1200 watt hrs per day

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Solar Electrical Vehicles (3)

- Electric mode driving range = up to 20 miles/day depending on driving habits, speed & conditions
- Fuel economy improvement range between 17-29%
- Solar modules last up to 30 yrs

Solar Vehicle Ventilators

- Also called a “solar car vent” or “solar car fan”
- The SVV takes the sun’s energy and converts it into low-voltage electricity used to run a small fan
- This fan blows hot air out of the car and draws in fresh air lowering car interior temp by 15 degrees

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Photovoltaic cells

Solar Vehicle Ventilators

- Pros -
 - less work required for air conditioner to perform because cooled by clean energy
 - smells better
 - increases airflow and can help head off bad smells and the humidity that creates them
 - most models will fit any car

Solar Vehicle Ventilators

- Cons -->
 - Need direct sunlight to function, so may not work on cloudy days
 - May not work when mounted on tinted windows
 - Require windows to be opened a crack -- this could lead to break-ins

Solar Car Races

- World Solar Challenge
 - Competitors from around the world race across Australia - over 3,000 km
- North American Solar Challenge (NASC)
 - Features mostly college teams racing in timed intervals in the U.S. and Canada
- Photo - U of Michigan and U of Minnesota cars in '05 NASC



Obstacles to widespread usage

- 100% solar cars are still not around for commercial use because it's difficult for the solar array to get enough power to move the car
- The way solar cars gather and store power is an issue
- High cost of solar panels

Beyond Solar Cars

The same technology applied to solar cars has been applied to boats and airplanes.

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However, thus far there has not been commercial widespread use -- perhaps in the near future.

Any Questions?

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