



Energy solutions for the Next generation

TODAY

Hydrogen fueling station

Penn State is the home of the first commercial hydrogen production and fueling station in Pennsylvania. This station is operated through Penn State's Hybrid and Hydrogen Vehicle Research Laboratory. www.vss.psu.edu/GATE/gate_h2vrc.htm



Penn State's hydrogen fueling station is used for experimental fleet vehicles and buses

TOMORROW

Hybrid Car-Home Energy System

A hybrid energy system combining wind, solar, and hydrogen fuel cell technologies is planned for an experimental residence built at Penn State's Center for Sustainability. www.engr.psu.edu/cfs

- **Solar powered hydrogen production**
- **Smart metered grid connection**
- **Predictive energy demand and production controls**



The MorningStar Home planned at Penn State will feature a hybrid solar-wind energy system and car-home hydrogen interface

Current Sponsors

U.S. Department of Energy (NREL)
 National Electrical Contracting Association
 West Penn Power Sustainable Energy Fund
 Sustainable Energy Fund of Eastern PA
 AccuWeather
 Automated Logic
 BP Solar

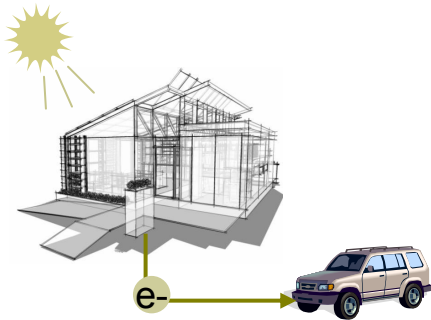
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HyRES Laboratory

Hybrid Energy System Design and Building-Vehicle Interface (BVI).

Advanced control system strategies for solar, wind, and fuel cell energy systems will be explored in the MorningStar home and HyRES lab. Located on Penn State's campus near world famous Beaver Stadium, the HyRes Lab will be open to public tours as a functioning renewable energy residence



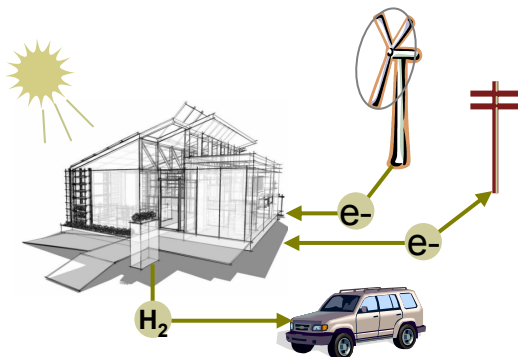
Competition Mode: *Solar Power*

Competition Mode:

MorningStar Home is powered by *100% solar energy* and is off-the-grid. Surplus power used to charge an electric vehicle during the **2007 Solar Decathlon competition in Washington D.C.**

Power System Features

- 8.5 KW roof mounted PV array
- 60 SF Solar Thermal panels



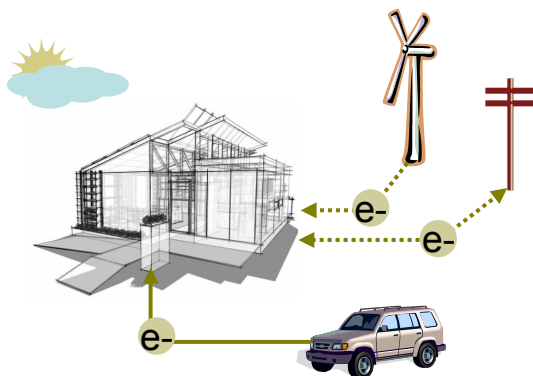
Operation Mode: *Hybrid Power*

Operation Mode:

MorningStar Home is powered by a redundant hybrid system including *solar and wind power*, and is *grid connected*. Net metering is used to balance energy use, and surplus power used to make hydrogen for a fuel cell vehicle.

Power System Features

- In addition to competition systems
- Whisper 500 wind turbine
- Hydrogen Electilizer
- Net metered grid connection



Back-up Mode: *Fuel Cell Power*

Back-up Mode:

In rare cases when the sun, wind, and grid power are unavailable, the MorningStar Home will be powered through a vehicle possessing a fuel cell power system.

Power System Features

- In case of multiple system failure
- 25kW fuel cell (vehicle)
- External hydrogen fuel sources back-up