

The Arizona Research Institute for Solar Energy

<http://www.azrise.org>

Racing Towards Efficiency



Shell Eco-Marathon America

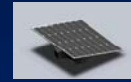


AZRISE
Arizona Research Institute for Solar Energy

The University of Arizona®
in alliance with
University of Phoenix



Solar Array Design Team



Race Premise:

The primary focus of this year's car will be to compete in the Shell Eco-marathon. The race will take place in California at Fontana Motor Speedway at the end of April. The primary objective of the competition is simple: to design and build a vehicle that uses the least amount of fuel to travel the farthest distance. Additionally, the particular class in which the Arizona Solar Racing Team will be competing is the "Urban Concept" class. Cars in this class must have many of the features that a typical road-going car would exhibit. While maximized fuel efficiency is still paramount, Urban Concept cars must have four wheels, lights, mirrors, and should generally resemble the shape of a production car.



Team History

Team History: Dating back to 1999, the University of Arizona Solar Racing Team has been building exclusively solar-powered cars from scratch. Over the years, the UA Solar Racing Team has competed in a host of various races, from Sunrayce in 1999, to the Formula-Sun Michigan competition in 2001, to the exclusive North America Solar Challenge, in which the team has actively competed from 2001 through 2008. Lasting nearly a full month and ranging from Texas to Calgary, Canada, the full length of the race is over 2400 miles. In 2001, the Arizona Solar Racing Team took first place in their class, and, most recently took tenth overall against a total of 22 fierce competitors from around the globe. The Arizona Solar Racing Team is eagerly anticipating this year's current project: designing and building a solar-powered, hybrid race car to compete in the Shell Eco-marathon.

Array Design Concepts:

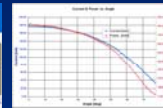
Considered to be the most revolutionary component to the car, the solar array will incorporate a tracking system that autonomously tracks the position of the sun, relative to the car's position and orientation. The array will involve two main types of solar cells: Ga-As, triple-junction cells for maximum efficiency when pointed directly at the sun, and Single-crystal Silicon, CIS₂-CIS₃, or CIS₄ cells for maximum efficiency when dealing with scattered non-normal incident light. These cells offer significantly cheaper production costs. The array team must actively communicate with the chassis and power teams for a seamless integration of the mobile tracking array design.

Urban Car Concept



Urban Concept/Overview:

This year's car will incorporate a wide range of innovative ideas. Befitting of their name, the Arizona Solar Racing Team will be utilizing a very underrepresented resource: Solar Energy. While the car will be capable of incorporating a diesel hybrid motor to aid in cruising ranges and practicality, for the purpose of the Shell Eco-marathon, the team will be exclusively solar-powered. Consequently, the power system of this car has been designed to be modular - i.e., systems can be added or removed from the car depending on what is needed or wanted. Additionally, the photovoltaic array system will integrate a concept that has yet to be implemented on solar cars: an active solar-tracking system. The UA Solar Car Team aims to build the most efficient car possible.



The Array Team collected data to determine the power output of the photovoltaics based on the incident angle of the sun.

Tilting the panels will allow for longer hours of max power accumulation by keeping the panels in the power output range within 30° of the sun's direction.

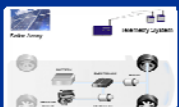
Power Systems Control

Power Systems Control Design:

The power system of the car is designed to be modular. At full capacity, the car will involve two power-collecting systems: a photovoltaic array, and a small diesel generator. Furthermore, the car is designed to utilize two different means of power distribution:

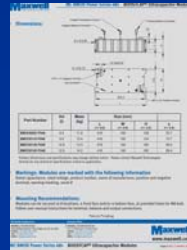
- a lithium-polymer battery pack for light acceleration and cruising,
- a series of super-capacitors, when steep grades and rapid acceleration are needed.

All of the power will be directed through twin hub-mounted, DC, brushless motors at each rear wheel. The motors are equipped with regenerative braking to feed energy back into the super-capacitors. The power system must integrate seamlessly with both the chassis and array systems.



The ideal final result will be:
Extremely efficient (~ mpg)
Extremely lightweight (0 kg)
Run primarily off Solar Energy (100% Solar Powered)

The control circuitry is designed to handle all processes in the car, manage power usage, and protect the system from overloading. Most importantly, it protects and manages the battery pack and super-capacitor bank.

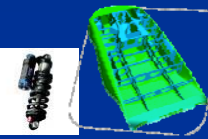


The purpose of the supercapacitors is to give a short quick burst of energy. This power usage will take the high load demand caused by acceleration off the battery thus allowing for longer battery life.

Chassis Design

Chassis Design Concept:

The chassis is the framework, in which the array and power system is integrated. As a result, the chassis has been designed to work integrally with the other two systems. The chassis must be modular itself, and must be capable of accepting the power system's inherent modularity as well. Incorporating a chromalloy steel tube chassis with carbon fiber bodywork, the car will be exceptionally light. The suspension will utilize a Macpherson strut front and rear suspension for increased performance while maintaining very low weight and extremely efficient packaging.



Arizona Solar Racing Team - The University of Arizona - Tucson, Arizona
solarrace@email.arizona.edu
www.solarrace.arizona.edu

