

Decisions when building a high school solar car.

Assuming you don't have unlimited resources and you, like many teams, are wondering how to start and where the money will come from here are some things to consider.

The Big Three

Solar Cells

The very first thing you need to worry about is how you are going to power the car that you are going to build. You may ask, "aren't solar cells the last thing that goes on the car?" You're right, but usually the car gets built around the cells rather than placed on as an after-thought. If you are choosing traditional pre-made solar panels you have more time. If you are planning on buying raw cells and having them laminated for you; you are probably too late. Finding, ordering, and then contracting for the lamination takes a long time. Planning may need to start over a year in advance!

If you choose the third option of buying raw cells and wiring them yourself you have many months of work ahead. Although difficult, it is not impossible. Students will take great pride in the fact that they have built the array themselves and will have a better understanding of how it works. The downside is that the learning curve is steep and you cry every time a cell breaks.

Motor

The motor and the wheels decisions often happen simultaneously. For a first year team choosing a motor should not be a difficult problem. The more your car weighs the bigger the motor needs to be. A standard DC brushed motor like the Briggs and Stratton Etek is easy to wire, runs comfortably at 48 V (or higher!), and doesn't need fancy controls. A standard pulse-width-modulated golf cart controller is relatively inexpensive and simple for students to understand.

Wheels

Although you would think that wheels should be an easy decision, it can often one of the most difficult. So many problems are caused by poor wheel choices! Remember that the wheels must support the weight of your car, you have to find tires that will fit, and you will have to make brakes attach. Teams have used motorcycle wheels, bicycle wheels, mini-dragster wheels, even car wheels! The best (and perhaps the most expensive) option is NGM wheels with custom-made tires. Ordering these wheels and tires is difficult and needs to start very early in the process.

Choosing the number of wheels is just as important as the kind of wheels you use. If you are building a vehicle for a cross-country race a four-wheeled design is the safest. Have a tire go flat on a three wheeled vehicle makes it very difficult to control. At track race a minor spinout won't damage must more than the driver's pride. On the open road however, drivers need to be able to safely stop a handicapped vehicle in a straight and predictable manner.

The next step...

Deciding on the frame of the vehicle starts after you have made the previous choices. How will you support the solar array, connect the motor to the wheel(s), steer, and protect the driver are all important design considerations. Choosing materials for the frame is also very important. Will you choose a material that is easy to work with like 4130 Chromoly steel or something exotic like carbon fiber or titanium. (We have tried them all and keep going back to the Chromoly!) Finding a material that high school students are comfortable working with is more important than the final weight. When mistakes are made will it be easy to fix?

Frame sketches can progress to full-sized models with the help of cardboard tubes. Almost every city has a cardboard tube wholesaler that will often give you factory seconds. The tubes can be easily cut to size and connected together with duct tape. Often times designed that looked great on paper show major flaws when built up to full size! It is much cheaper to discover these problems when you are building with free cardboard rather than \$4/foot chromoly!

Once the main frame is designed you will need to consider how you will add suspension and steering. Have a student read everything they can about camber and caster! There are lots of ways to suspend a car, but failing to design a proper steering system can make it difficult to drive at best, dangerous or undriveable at worst! (We know this for a fact!)

When you have a rolling chassis the fun really begins! Just taking the car out and pushing it around will give you a pretty good idea if you are in the ballpark. Making changes at this point are still relatively easy and learning happens quickly.

Fail quickly!

Nuts, bolts, raw material, hinges, connectors, wire, plastic, pretty much everything: (My number one place to order from.)

<http://www.mcmaster.com/>

Raw materials like tubing (chromoly and aluminum), light-weight supplies, some specialty adhesives.

<http://www.aircraftspruce.com/>

For bigger orders of Chromoly Tubing: Dillsburg Aircraft 717.432.4589 (no website)

For welders that have little experience with Chromoly I would start with 1 1/8" diameter, 0.058" wall thickness. We are building our current frame from 1 3/8" x 0.035" tubing. Much harder to weld, but a fair bit lighter. You may want to order some for the welders to try.

Lightweight solar panels SBM Solar
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8000 poplar tent rd
Concord, NC 28027

Electric motors and controllers Cloud Electric Vehicles
<http://www.cloudelectric.com/>

Maximum Power Point Trackers (MPPTs)
AERL (Australian Energy Research Laboratories)
<http://aerl.com.au/solar-racing-car-applications/solar-racing-car-mppt.html>
or
Solar Converters Inc
<http://www.solarconverters.com/>

Composite materials Express Composites
<http://www.expresscomposites.com/>

Power wires, fuses, connectors, power distribution
<http://www.hifisoundconnection.com/>

Steering parts and linkages (rack and pinion)
www.chassisshop.com/

Brakes and misc go-kart parts
<http://www.apskarting.com/>

Misc. electric car parts KTA Services
<http://www.kta-ev.com/>

Concorde Sun Extender Batteries PVX-840T (and other models)
Centrix International Corp. (This is the lowest cost we have found with shipping.)
<http://www.centrix-intl.com/>

Sanding supplies, finishing products, edging, more adhesives
<http://www.terrys.net/>

LED Turn signal and Brake lights
<http://www.radiantz.com/>

Book: The Winning Solar Car: A Design Guide for Solar Race Car Teams
Doug Carroll
<http://books.sae.org/book-r-343>