SUN CHARGED TRANSPORTATION
STREET LEGAL,
AFFORDABLE, DEPENDABLE
BUILD THIS COMMUTER TODAY

Living off the grid for more than 20 years has taught my family a lot about our future. Our power grid is failing and in need of major repairs. During weather events thousands of people losing power is now the norm, not the exception. Major grid failures can disable large portions of our country. Our transportation system, while fossil fueled, is still dependent on the power grid to remain effective for fuel distribution. Oil is running out and $5.00 a gallon gasoline is in our future.

Our major auto manufacturers are like our grandfathers, set in their ways and not showing any progress in moving our country away from dependence on an oil based system of transportation. Knowing this, and having experience with battery and solar charging led to the development of an affordable, solar charged electric scooter for the daily commute back and forth to work, some 5 miles from our farm. The technological advances in motors, controllers, and related technology led largely by the solar industry, has made this possible.

Solar power is a way of working with Mother Nature. Small amounts of sun energy, tapped over time, allow an acorn to become a mighty oak. Likewise, tapping on a bit of the suns

energy, just enough for our needs, now allows for solar charged transportation to be viable alternative to burning fossil fuels

The basic bike is a stock EVT 4000E available from various dealers around the U.S. The rest of the system consists of a Xantrex (formerly Trace) C-40 charge controller, and 4 Atlantic Solar 30 watt, 16 X 25 inch panels mounted two to a side. The panels fold open while in charging mode and are closed while driving. Mounting hardware is basic off the shelf parts available from any hardware store.

The design criteria was simple. The bike needed to be able to be self contained, that is all charging from the sun, but still allow the factory charger to be used if needed. Any modifications needed to fit within the capacities listed and approved by D.O.T. and should be safe as well as functional. The panels needed to be foldable so they are out of the way of lighting, seating, and protected from road hazards. The panels needed to be clear of shadowing obstructions from the bike when folded out into the charging position and at a good angle for the three seasons a bike can be ridden in Michigan. All parts needed to be "off the shelf" to keep this D.I.Y. user friendly. (During the winter the plan is to plug the 120 watts into our home system for additional winter charging.)

The EVT 4000E is a two seat scooter similar to the Vespa style, just a bit modernized. The system operates at 48 volts. The motor is inside the rear wheel, commonly called a wheel motor or hub motor. With hydraulic disc brakes front and rear, stopping is quick and smooth. Connected to the main power line from the batteries is a motor controller called the "E-scooter Intelligent Controller", which claims a 90% or greater efficiency. The lighting and horn are a 12 volt system running from a 48 volt to 12 volt DC to DC converter mounted under the front cover below the steering column. D.O.T. approval requires lighting remain on at all times in this MOPED class vehicle.

Mounting the solar panels to the bike requires disassembly of the body. A hole needs to be cut on each side bike body panels to allow for a pipe, welded to the main frame, to protrude far enough from the body to attach the rest of the panel assembly. I chose standard 3/4 inch black iron pipe purchased at our local hardware store. Welding to the main frame of the bike should be done by an experienced welder. RE-inforcing gussets need to be added along the pipe to keep the bike sound and support the weight of the panel assembly.

Disassemble only one side of the body at a time so the location for drilling the holes in the body panels can be as accurate as possible. I slid an 18" long piece of 3/4 inch stock pipe, threaded on both ends, with a magic marker inside to mark the location for drilling the hole on the inside of the body panel. There are only a few screws on each side of the body for removal of the panels. Be careful to keep track of where the screws go for reassembly. I use a digital camera as I go along so I can put the pieces back together properly.

The holes were started with a 1 inch spade bit and completed with a cone shaped rotary grinding wheel. You are actually melting the plastic panels rather than cutting, so the edge is clean when done. If you work slowly and carefully you will have a clean opening for the main pipe. A large round file was used to finish off the hole. After marking one side, for drilling, the other side is put back together to allow marking the other body panel for drilling.

With all of the body panels removed, the next step is welding the main horizontal pipe to the frame. I rode the bike 3 miles to the welder. Since safety is first, I left the back brake and tail light assembly on the bike and rode there without body panels. Removing the tail

light assembly is only 2 bolts. Remove the rear plastic lower fender, 2 screws on either side. Remove all 4 batteries and place in order on the floor. Removal of these parts for welding was a 15 minute job while the welder was warming up his equipment.

The metal was scrapped clean at the welding points on the bike frame. The main pipe was carefully measured and held in place and then remeasured. The main pipe was tac welded in place, rechecked for alignment, then fully welded. A 2 1/2 inch by 4 inch piece of flat 1/4 inch stock was welded to the bike frame cross bar connecting the top of the bike frame together.

On the end of the vertical bike frame a bed of welding rod material is built up under the main pipe to act as a support so the main pipe for the panels won't flex or bend during travel. The bike was wiped clean after welding, reassembled, and driven home to begin attaching of the panels.

Use 2, 3/4 inch elbows and 2, 18 inch pieces of black pipe to make the mount. Before threading, the threads on the right side of the bike should be coated with heavy duty pipe thread locker to prevent loosening while traveling. I used permatex, high strength RED, and this stuff holds. The vertical pipes are tightened as far as possible and then eyeballed to an angle just behind the front of the bikes trunk. This will keep the panels high enough when traveling that no modification of the turn signals will be needed.

Next I added a 1 1/2 inch angle stock of aluminum to make a flat mount for piano hinges for attaching the panels. Using #8 self drilling sheet metal screws worked very well. The lip of the black pipe elbow is a nice shelf to sit the bottom of the angle stock on so both sides are even. Again, this was eyeballed in place so the vertical mounting surface is flat on the outer side and back side. (see pic)

Wide piano hinges are used between each ot the solar panels with #8 self drilling screws. Be careful drilling on the panels so you don't damage the EVA plastic coatings. Mount the hinges so the panels fold inward, protecting the face from road hazards like flying stones. The left and right inboard panels are reinforced with a criss cross of aluminum stock to handle the stress and weight of the outer panel. The frame of both panels are also main structural members, so extra strength is worth the minimum additional weight of the aluminum. A piece of angle stock is attached to the top of the solar panels for added strength.

Have a partner hold the panels, hinges attached, to the angle aluminum stock. Mark 2 of the holes with a marker and remove the hinges for a moment. Drill these two holes with self drilling screws until through the metal and turning cleanly. Remove these two screws and have your partner align the hinge from the panels and then tighten the first two screws. If you are happy with the alignment, drill the rest of the screws into the pre drilled openings on the piano hinge and seat firmly.

With the panels properly mounted, the next step is to make the crossover/locking mechanism to lock and support the panels in both driving and charging positions. This piece needs to be both strong as well as easy to use. The purpose of the crossover is to create a triangle joint between both sets of panels to keep them from moving while driving down the road.