Getting Ready to Plug-In

By Stephen Heckeroth July 28, 2010

Plug-in cars will be available for sale by the end of the year, giving individuals the opportunity to reduce their oil dependence and drive with no tail pipe emissions. The installation of a solar energy system on your home can offset the pollution from power plants used to charge plug-in vehicles for true zero emission travel. If enough people make the switch to solar/electric transportation the most dire consequences of fossil fuel dependence and climate change may be avoided.

I have built more than two dozen plug-in vehicles over the last 20 years including everything from electric rototillers to electric Porsche Spyders. The vehicles I built had onboard chargers that could be plugged into common 110 volt (V) or 240V AC outlets. There was no chance of arching or shock when the chargers were plugged in because no current would flow until another switch or timer was turned on.

I stopped building electric cars in 2002 when we purchased one of the few EVs sold by Toyota to meet the requirements of California's Zero Emission Mandate. Although the electric cars I built were fun to drive and never left me stranded, the weight of the lead acid batteries that were available at the time was a very limiting factor.

Our Toyota RAV4EV has a 27 kWh Nickel Metal Hydride (NiMH) battery pack with half the weight of a lead acid pack of the same capacity. Our RAV4 can go 80-100 miles per charge and now has 120,000 trouble free miles on the original NiMH battery. We have a 3.5 kW net metered solar array that feeds enough excess power into the grid during the day when rates are high to offset the power used to charge our EV at night when rates are low. The night rate is about $.07/kWh which means it costs less than $.02/mile to drive our EV. A gas RAV4 costs over $.10/mile for fuel and maintenance so we have saved close to $10,000 dollars driving our electric RAV4 over the last 8 years compared to the gas version. Even more important we have saved about 5000 gallons of fuel and stopped 50 tons of CO_2 from entering the atmosphere.

Our E-RAV and PV charging station

We use our EV for all local driving. For longer trips I have set up the E-RAVs inductive wall mounted charger so that it can be put in the back of the car and plugged into any 30-50 amp (A) 240V outlet.

Up until now EVs produced by the major manufactures have required a wall mounted charging station and they all had different types of conductive plugs or inductive paddles. There is now a new a standard conductive plug called the J1772 that will connect all new EVs with home or public chargers. It was recently announced that $37 million tax dollars were being spent to install 4600 EV charging stations nationwide. That is over $8000 per station. It would only cost from $100 - $300 to install a high power 240V outlet in your garage or carport and an inexpensive meter could be added for billing at 240V outlets that are accessible to the public.

If 240 volt chargers were mounted in plug-in cars (onboard) instead of on the wall the onboard chargers could accept a J1772 plug that is capable of communicating with the grid where and when that capability is available. Starting right now extension cords could be made up that have the J1772 on the car end and the other end could have a plug to fit the most commonly available existing 240V outlets. This would drastically reduce the cost of charging stations because the new chargers wouldn't have to be capable of recognizing every different type of battery. The onboard charger would be sized to the exact specifications of the battery in the car in which it was mounted. The charging station would only need to offer 240V power and a link to the utility.

I would suggest installing the NEMA 14-50R, 50A recreational vehicle (RV) outlets in your garage and wherever you park because there are already thousands of these high power 240V receptacles in convenient locations, like campgrounds and rest areas, throughout the country. A 14-50R (R for receptacle) has 12kW of charging capacity and is capable of giving the 16kWh battery pack in the new Chevy Volt an 80% charge in less than an hour or the new Nissan LEAF 24kWh pack a 100 mile charge in 2 hours.

Chevy just started giving out information on price and charging at the end of July at 1-888-865-8496. Here is what I understand from the Volt rep I just talked with. The 120V charger is on board and will plug into any 120V outlet. The 240V wall mounted charger will be sold with the Volt and it will have a cord with a J1772 plug that will attach to a receptacle mounted on the car. The wall mounted charger could be hard wired or plugged into 30-50A, 240V outlet. In other words you could do the same thing I have done with my RAV4EV wall mount charger. I installed a 14-50R (receptacle) on the wall below the charger and wired a 14-50P (plug) to the charger. This allows me to take the charger off the wall and put it in the back of the car. Then with a 14-50 extension cord I can plug the charger into any RV plug anywhere in the country for a quick charge on the road. The same thing should be true for the LEAF but I haven't been able to confirm it yet.

Wall mount charger plugged into a 14-50R, 240V receptacle.

The 1999 National Electric Code (NEC) includes language about new safety requirements for 240V EV chargers. The main safety feature the electric code requires is an interlock that doesn't allow electricity to flow until the plug is fully engaged and immediately stops the flow of electricity when a strain is put on the cable or the plug. These features could be and are integrated into onboard chargers that offer the same level of safety as a wall mount chargers. There should also be an interlock that does not allow the motor to be powered when the EV is plugged in. This is not mentioned in my 1999 copy of the code but is an important feature that is included in the cars I built and the RAV4EV I now drive.

Thousands of RVs are plugged into 50A, 240V receptacles every day and I have never heard of an incident where someone has been shocked. Electric stoves, clothes driers, welders and other shop equipment all have 240V plugs that do not require special training to use.

If there is something in the current edition of the NEC code that is keeping EV drivers from taking advantage of hundreds of thousands of safe 240V charging opportunities that already exist than the code needs to be changed.

I am sure if you ask the companies that make the wall mount chargers they will give some technical reason that makes it necessary to hard wire the chargers on the wall but I have been using solid state onboard chargers for over 15 years and never had a problem. I am not really sure why there has been such a big push for hard wired off-board chargers. It may be that charging station manufactures may fear that the market for new stations will be reduced if people know about the 240V infrastructure that already exists. This is, of course, pretty short sighted because if people knew about all the 240V charging opportunities that already exist they would be more interested in buying plug-in vehicles and the more EVs the more interest in public charging options and the more business there will be for the charger manufactures.

A metered charging outlet at every new parking space would be a possibility at the low cost of installing a 14-50R receptacle. In colder parts of the US and Canada plugs already exist at every parking space to power heaters to keep conventional engine blocks warm enough to start in the winter.

Smart meters that can handle vehicle to grid (V2G) communication will be important when there are a significant number of plug-in vehicles on the road but smart metering can be done whether the charger is onboard or hard wired to the wall. I would wager that there are already more 240V plug-in opportunities than gas pumps. The priority now should be to make a data base of existing accessible high power 240V outlets and enter the information into navigation systems the same way gas stations and restaurants are listed. If the federal government really wanted to decrease our oil dependence they would take a small fraction of the $billions in corporate welfare that keeps the fossil fuel industry obscenely profitable and make public charging free for the early adopters of zero emission vehicles.

Ask code officials to revise the code to allow the use of safe 240V RV receptacles for charging and ask manufactures to put chargers onboard so that EV drivers can easily take advantage of the charging infrastructure that already exists. Get involved at the local government level to push for metered low cost 14-50R receptacles as a requirement for all new parking spaces. While you’re at it, ask for PV shade structures over all the parking lots that are baking in the sun. -SH