Dialog on Sustainability, July 21, 2012, Kansas State University
Dialog on Sustainability, July 21, 2012, Kansas State University
Solar Power Charging Station
Earth, Wind, and Fire REU
Paul Harrison, Stephen Montgomery, Eleanor Chan, John Santiago, Emery Brown
Kansas State University Summer 2012

Motivation
More and more our world is seeing the need for public charge stations. Consumers are less likely to purchase an all electric vehicle than a traditional automobile out of the fear of being stranded. This means that we need a larger infrastructure of charging stations. However, we have also become aware of the need for alternative energies. Green house gases (GHGs) have been on a steady incline since the 1990s as shown in Fig. 1. We have also become more aware of the amount of coal present on this planet. If we maintain our current coal consumption it is predicted that we will run out in 150 years. This presentation aims to show that we can build more charge stations using solar energy while providing a commodity that many people appreciate: shade.

Solar Challenges
How much energy can we produce from the sun is a matter of how efficiently we can convert the energy from light into usable energy for our electronics. The efficiency rates of photovoltaics (PV's) keep increasing with time. Fig. 2 is a chart of the recent efficiency rates for many different types of cells versus time. Although we have been able to achieve rates above 40% these types of cells are very expensive to make. Buying cells at such a high price drives up the cost per unit energy of PV's. For current residential solar panels the cost per unit energy is 10.25 cents/kWh. The current average in the U.S. for conventional power generation is 10 cents/kWh.

Structural Designs
There are currently many different designs being used to produce shade and create energy. In Fig. 3 there are two working charging stations and one conceptual charging station displayed. The idea that parking lots are great ideas for places to put solar panels has been recognized by many companies such as General Motors, Google, and local just to name a few. In order to build such a station here in Kansas would require a good deal of effort in the structural engineering. The average wind speed in Kansas is around 15 mph and maximum speeds can exceed 100 mph. With this in mind it is clear that whatever housed the solar panels would need to be very structurally sound.

Possible Locations
There are many possible locations on Kansas State University’s campus to put such a charging station. The parking lot west of Memorial Stadium is a possible location because it’s very open. However it’s not very centralized. Four other locations that are more centralized and have minimal shade coverage from trees and buildings have been marked in Fig. 4 with large blue circles.

Electric Cars
The energy efficiencies of electric vehicles is on the order of 50% while traditional internal combustion engines are around 30%. This makes using electric vehicles as transportation seem to be a much wiser choice that seems to be catching on. Over the last 10 years the world market has seen a substantial increase in hybrid and electric vehicle sales. Fig. 3 shows the sales of all hybrid and electric vehicles versus time until 2009 and its projection up to 2014. This increase in sales means that there will be an increase in the need to charge vehicles away from our homes. Good examples of the hybrids making a big push in the U.S. are the Chevy Volt and Toyota Prius shown in Fig. 4. Tesla Motors Co. just released the model S for sale in which the base model can go 140 miles on a single charge. They have also debuted the model X which will be available for sale next year.

Life Cycle Analysis
Another benefit of a solar powered charge station for electric vehicles is its comparatively low life cycle emissions. Photovoltaic cells produce the lowest emissions per unit of energy compared to wind, coal, and natural gas second only to nuclear energy. Electricity generated from photovoltaic cells emits 13-55 g CO2-eq/kWh, whereas electricity generated from coal 823-824 g CO2 eq/kWh. Considering that coal is the dominant fuel in the energy mix, deriving electricity for the charge station from a solar source has great potential in reducing greenhouse gas emissions.

Bibliography
Dialog on Sustainability, July 21, 2012, Kansas State University