Research Paper for Project Plug in Evergreen

Energy Systems Program, The Evergreen State College, Fall-Winter 2007-2008
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Abstract
Nearly half of America's CO2 emissions are from transportation, and an even greater majority of our fossil fuel use goes directly to powering those vehicles. Currently electric vehicles (EVs) aren't the cure for our transportation and energy woes, but each new development brings our nation closer to understanding the importance of these alternative vehicles.

The Evergreen State College would see marginal benefits by installing a modified electric charger in C Lot. The electric vehicle movement of Thurston County provides a supportive and cost-effective backdrop for furthering the installation of charging infrastructure.

Introduction
The intention of Project Plug in Evergreen (PIE) was to improve the Evergreen State College's eco-conscious image. From the start, Evergreen has committed itself to sustainable construction and operation. Buildings are designed not only to reduce electrical consumption but also to recycle natural building materials more commonly discarded. So far, Evergreen has catered to the desire of reducing their 'carbon footprint' on the campus. Concerning transportation, incentives such as parking permits are provided for carpooling and a large majority of students use mass transit lines. However, what is lacking on campus are charging options for the local EV drivers who frequent the college. Our approach was to research and purchase an electrical charging station for the potential electric vehicle drivers.

Question and Hypotheses

Question:
Considering the financial feasibilities, which type of EV charging station, would be the most relevant for EV drivers?

Hypotheses:

Preferred:
Evergreen State College is willing to purchase an electric vehicle charging station.

Alternative:
Evergreen campus will not benefit from an electric charging station, and therefore would not purchase a charging station.

Null:
There are no electric vehicle drivers in the surrounding area who frequent campus.

Methods
Our preliminary research into electrical charging stations led us to Avcon, promoting its Avcon EV Power Pak, running at $512 per unit. We initiated contact with very helpful connections like Joe Lambrix, President of Plug-In Olympia and Ron Freund, Chairman of Electric Auto Association.

In Fall quarter of 2007, we applied for funding from the Clean Energy Committee. After the deliberation with the committee, they had decided not to fund our project as it stood. They required more information on the labor and maintenance costs for our station. From then on, our objective came to performing cost-benefit analysis of the project.

Cost-benefit analysis required research into what types of electric vehicles people were driving around the area, and if there were other options besides stations. What we found was surprising. The charging of electric vehicles includes three levels of power. The first two levels range from 120 to 240 Volts, and 12 to 32 Amps. Beyond level one charging, voltage is so high that a charging station is required. Charging stations require a metal to metal connection from the station to the battery, via a paddle. The level two charging requires stations similar to the Avcon Power Pak. Cars that utilize Avcon are predominately found in California, where the commercial electric vehicle market was well established. Level three charging is extremely powerful, and only found in electric trucking fleets. Most electric vehicles on the road, including low-ranged NEV (neighborhood electric vehicles) and gas-electric hybrids, only require level one charging. Level one charging can be achieved at electric voltages similar to standard wall outlets (120 Volts/ 12 Amps). Many of the charging facilities across the United States use this lowest standard of charging. In early 2000, car manufacturers nearly phased out fully electric cars, which utilized level two and three charging.

	Voltage (VAC)	Current (Amps)	Power (kVA)	Freq. (Hz)	Phase	Standard Outlet
Level 1	120	12	1.44	60	Single	NEMA 5-15R
Level 2	208/240	32	6.7/7.7	60	Single	SAE J1772/3
Level 3	480	400	192	60	Three	N/A

http://www.ci.pasadena.ca.us/waterandpower/program_ev_evcharging_info.asp

Level one charging connection is a relatively simple process, and requires connecting to a pre-existing electrical line. Businesses that provide electric vehicle charging outlets usually “tie into” their power line via parking lot light posts.

By mid-Fall quarter our research project shifted focus into networking with local businesses that have installed level one charging outlets. Using a Mapquest site provided by the Plug-In Olympia website, we discovered that well over a dozen charging outlet facilities exist in the Olympia-Lacey area.

We also came to realize that Olympia-area EV drivers only use their EV for localized, short trips (<25 miles). The EVs they drive only have about a 100 mile or less range on full charges, which generally takes four to six hours depending on battery level.

Timeline

November 19th, Noon, Forrest met with Susie Seip, Parking Supervisor to inform her of our research project. I gave a brief run-through of Project PIE’s focus of having outlets installed in Parking Lot C. Susie liked Project PIE’s intentions, and told me that for a while now Evergreen Parking had been contemplating installation of charging technologies. Apparently, several times in the past the parking booth had received requests for EV accommodations.

January 11th, 11:45am we had our first meeting with Director of Facilities, Paul Smith and Rich Davis, Evergreen Engineer. They expressed interest in our project and gave us recommendations for looking into other institutions for examples of similar projects. Paul Smith proceeded to tell us that the State of Washington had just passed legislation stating that businesses who installed charging capabilities were required to provide free electricity to drivers. From there Murdoc contacted the UC Davis Plug-In Hybrid Electric Vehicle Research Center. Forrest contacted Kevin Stormans, who had outlets installed at their Ralph’s and Bayview Thriftway of Olympia.

January 28th, 11:00am, Murdoc met with Susie Seip to gain insight on the demographics of Evergreen’s EV drivers. Susie showed me the flaws of the parking registration system and decided to include fuel type on all preceding registration forms. This will be of great help to any other project dedicated to studying alternative fuel vehicles.

January 30th

We utilized our aesthetically pleasing poster designed by Murdoc to show at Focus the Nation. At our table we talked with Evergreen students who would have the eco-conscious attitude that reflects our institution. Much to our surprise we encountered our first bit of criticism. One representative’s view is that we would be removing a parking space to provide for a more expensive vehicle.

February 22nd
We met Dave Raileanu for an interview for Cooper Point Journal to explain our project to the campus. The article “Project Plug in Evergreen” was printed on February 28th, 2008.

Week 8
Surveyed students with the following survey concerning Project PIE.

	Yes	No
Do you own an electric vehicle?	0	20
Would you like to own an electric vehicle?	19	1
Would having a means to charge your electric vehicle affect your decision?	11	9
Do you think Evergreen would benefit from installing Plug-In Utilities (ex: modified outlets, charging stations) in C Lot?	16	4
Are you surprised that Evergreen does not already have these utilities?	7	13
Would you like more information on Project PIE or EVs/PHEVs?	10	10

The results of this survey are inconclusive. A larger participation is needed, with a more informative version of the questions. Many were participants were undecided on the issue as well as unacquainted with electric vehicles.

Results

For our institution a charging station with projected costs of over $1000 doesn’t seem financially feasible. Aside from the price, level two and higher charging is not relevant to the charging capabilities already used by local EV drivers. Research has shown that most local EV drivers can only charge their cars through Level One. The most practical location for a modified outlet is C Lot, due to high volume of space and the location near campus. Charging outlets would be the most practical solution. Information garnered from Kevin Stormans and his electrician project the cost at $200-400 per outlet, depending on the work needed to tie into the electrical grid. Some higher-voltage lines may require a step-down transformer. Charging outlets are affordable, and well within the financial means of the Evergreen State College.

Discussion

From our surveys and attendance at Focus the Nation we've come to the conclusion that not everyone agrees that charging equipment would benefit the college. Some students see it as a frivolous expense. However, Project PIE is aimed at local EV drivers, and possibly Evergreen faculty and staff who would have the financial means to invest in cars and utilize our outlets. In truth, electric vehicles are only conditionally eco-friendly. With our institution, it is the case that they do not harm the environment because we utilize green power. While the consumer market may be far from adopting electric vehicles as a standard for the road, it would open up the opportunity for progressive-minded individuals to respect our institution. If the college were to construct a charging infrastructure they would join the list of local Olympia and Lacey electric outlet viabilities.

Future Work

The implementation of Project PIE requires a few more key steps. During our March 3rd meeting with Director of Facilities, Paul Smith, we were made aware of the possible intentions of Evergreen replacing five campus vehicles with electric vehicles. Smith informed us that the money would be made available from a rebate given by the Puget Sound Electric Company for the purchase of a water cooler system last summer. The day before the meeting, the city of Olympia announced that they would be replacing a vehicle with the Miles ZX40S electric vehicle. The city is splitting the cost with the Olympic Region Clean Air Agency. Near the future, Smith says the college would probably purchase the same electric Miles car. The research done for Project PIE, and the contacts made will help to ease the process of installation of more electric outlets to charge the campus EV fleet. Although it is too early to tell, the outlets for the maintenance vehicles will most likely not be in the parking lot focused in Project PIE.

On the same subject of parking, towards the end of our research project, Susie Siep, Director of Parking, informed us of an Evergreen student's intention of adding parking spaces for alternatively fueled vehicles, hoping to gain 'points,' for a Leadership in Energy and Environmental Design (LEED). If there is some way we could synchronize the LEED project with our own, availability for parking spaces geared towards alternative vehicles could increase.

During the final week of the project, Forrest contacted Chuck Papiez, an electrician at Capital Electric. Chuck Papiez is the electrician involved in most of the electric outlet installation around the Olympia area, including Ralph's Thriftway and Intercity Transit's central office. In Spring quarter, the members of Project PIE, Chuck Papiez, Rich Davis, and Paul Smith plan to meet outside at the desired parking lot to discuss installation and logistics for an electric outlet. One important consideration is whether the Campus would prefer to leave the electric line open for all-hours charging, or if there should be a time-off switch.

All this work is going to boil down to the finances. Evergreen Parking and Facilities have encouraged Project PIE to propose another Clean Energy Committee grant. In so, we plan on submitting our final, polished proposal for the Spring, deadline is March 14th 2008.

Acknowledgements
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Joe Lambrix, President of Plug-In Olympia, joe@pluginolympia.com
Paul Smith, Evergreen State Director of Facilities, smithpa@evergreen.edu

Updated Annotated Bibliography:

1. Pacific Gas and Electric Company Website. Copyrighted 2007. http://www.pge.com/about_us/environment/electric_vehicles/

This website provides details concerning the type of electric vehicles currently on the market today, including brief explanations of the differences between the several available. Pacific Gas and Electric Co. supports the EV market by supplying energy-cost ratings for charging stations. With a detailed graph outlining use in the summer season, this website provides cost analysis for day and night-time use.

2. California Air and Resource Board's Fact Sheet: Battery Electric Vehicles- Refueling, Energy Use and Charging. http://www.arb.ca.gov/msprog/zevprog/factsheets/evinformation.pdf August 2003

A concise fact sheet pertaining to charging station logistics, and small figures on charging times. This website's main focus is on the EV market of California, an advantage due to the high amount of charging stations and EV use in this state. The very bottom of the website provides phone numbers and directories for additional information pertaining to electric vehicle use.

3. Personal web-site from a group of students at Raffles Junior College, Singapore. "Global Warming: Electric Vehicles"

http://geocities.com/shawn_kwek2002/e-cars.html

This website is a personal web-page designed by a group of students from Raffles Junior College seeking to make a "difference." Their numerical figures are researchable, and provided in the bibliography. What I found best about this website is how they break down the different processes of building and maintaining an electric car. Several of the different styles, both inductive and conductive charging stations, are spotlighted. Photographs provide visual capabilities of the several possibilities for charging stations on the market today.

4. "Why We Need Electric Cars." Mother Earth News Magazine. Oct/Nov 2006. Issue 218 pg. 94-99 Website, provided by EBSCO with images: http://web.ebscohost.com/ehost/detail?vid=10&hid=17&sid=861f93d0-9888-4d7c-a798-0532c4a90d30%40sessionmgr2

Mother Earth News is generally a reliable source for alternative energy. Although some of their articles may have an 'eco-friendly' spin, this article provides detailed and factual history about the history of electric vehicles. The very bottom of the article outlines incentives for driving an electric car versus traditional petroleum-powered vehicles.

5. United States Department of Energy: Energy Efficiency and Renewable Energy "Washington State and Federal Incentives and Laws"
Government Website, Last updated- September 2007
http://www.eere.energy.gov/afdc/progs/view_ind_mtx.php/tech/ELEC/WA/0

This website provides break-downs for electric vehicle owners in the State of Washington. Also included are newly designated State codes and laws pertaining to incentives and legalities for electric vehicle drivers. This is an important resource for residents' know-how on all aspects of owning and operating their electric vehicle.

References

1. Batcheldor, Matt. "Electric Car to join city fleet." *The Olympian*; March 1st, 2008

   http://www.theolympian.com/southsound/story/376260.html

2. Freund, Ron. Electric Automobile Association. http://www.eaaev.org/ 2007.

3. Lambrix, Joe. Plug-In Olympia. http://www.pluginolympia.com/ 2007.

4. Raileanu, Dave. "Project Plug in Evergreen." *Cooper Point Journal* 36(Feb 28, 2008): pg 5