Alaska University Transportation Center

Feasibility Study of Electric Cars in Cold Regions

Prepared By:

Jing Zhang
Michael Golub

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Prepared By:

Alaska University Transportation Center
Duckering Building Room 245
P.O. Box 755900
Fairbanks, AK 99775-5900

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Electric vehicles — cars that run on electricity stored in batteries —have drawn increasing interest from federal agencies, the auto industry, and academia as a promising path to reduced reliance on fossil fuels and elimination of pollutants. This project studied the feasibility of using electric vehicles as reliable transportation in cold regions. Researchers evaluated conditions in which the electric car is appropriate, and they addressed the use of electric cars as a mode of transportation, the optimal distance between origin and destination, and potential environmental impacts on transportation operations. Data was collected in several Alaska urban areas, including Fairbanks and Barrow, as a case study. Project results include data and analysis of electric car performance for urbanized areas in cold regions. Results suggested that electric vehicles can be a viable option for certain users in subarctic and arctic communities. For example, researchers learned of a 1986 Chevy Sprint converted in Barrow, Alaska. The car is driven daily for three miles, from one heated garage to another. Electric cars are infamous for not going too far or too fast. Student researchers compiled energy usage on nine test vehicles during driving and while charging. Initial results showed that one test car, a Chevy Metro, used a trim 250 watt hours per mile. The study found that many variables affect electric car efficiency. As one example, in colder areas such as Alaska and Canada, some infrastructure for public heater block outlets already exists, in parking garages and at parking meters, provided primarily for engine pre-heating. When an electric car uses these outlets, its efficiency doubles. The knowledge gained through this study will assist departments of transportation in cold regions when considering adopting electric cars as an alternative transportation method.

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ABSTRACT

Electric vehicles (EVs) are cars that run on electricity stored in batteries. Electric cars have drawn increasing interest from federal agencies, the auto industry and academia as a promising solution to reduced reliance on fossil energy and elimination of pollutants.

Many government agencies and automobile manufacturers have conducted or initiated research projects investigating the feasibility of electric vehicles. This year, the National Aeronautics and Space Administration (NASA) Kennedy Space Center (KSC) issued a request for proposal of electric car feasibility studies. GM and ZAP (Zero Air Pollution) are also carrying out their own feasibility studies. However, these tests are carried out in a mild environment, not in cold regions such as Alaska. A feasibility study focusing on cold regions is needed for future development.

In a feasibility study, geographic considerations and variety in use are major factors in determining the appropriate size and distribution of electric cars. Recognizing that electric cars have limited range and require strategically placed recharge stations, it is important that these factors be analyzed and applied to the appropriate situation. Unfortunately, the feasibility and effectiveness of electric vehicles in cold regions have not been well investigated.

We will conduct the study in Fairbanks and neighboring towns, e.g., North Pole, Alaska, use it as a case study, and devise an exemplary electric car performance for urbanized areas in Alaska and/or other cold region cities with similar characteristics.

INTRODUCTION AND RESEARCH APPROACH

In this study, we will carry out a feasibility study of electric cars in cold regions in a more comprehensive manner. The significance of the study includes (i) the data to be collected from the proposed research will provide critical information for evaluating the performance of electric cars in cold regions. Currently, this data is not available in literature yet. The data will enable researchers and government agencies to have a clearer image of the energy issues in Arctic regions; and (ii) the outcome of this research will also provide useful information for the Alaska Department of Transportation and Public Facilities toward future adoption of electric vehicles as an alternative transportation method in selected conditions.

FINDINGS

Researched and connected several data loggers to measure voltage, amperage, temperature and location.

We used several Data loggers to evaluate the vehicles. We attempted to obtain data from each battery; however some of the equipment was not robust enough for cold weather conditions. By the conclusion of this research we used data loggers that were less accurate, but were able to perform in arctic conditions. Our research will continue on various data logger systems available.

Using Argonne Lab's GREET 1.8b, we were able to model emissions from electric cars. We used previously data of electric utility companies regarding the sources of electric power generation.

We created a 2- credit course, ES 166 Electric Car Conversion. The course will emphasized the environmental advantages as well as the feasibility of driving electric cars in the arctic, and will be taught throughout Alaska, and perhaps other arctic countries.

We have a total of nine test vehicles completed.

INTERPRETATION

We compiled energy usage during driving and while charging. Initial results showed that the Chevy Metro used about 250 watts/mile. While our electric snowmobile uses 1KW/mile depending on conditions. Many variables will effect efficiency. Depending on fuel used to generate electricity Green House Gases can be reduced. In colder

areas such as Alaska and Canada, there already exists some infrastructure for public Heater Block Outlets, in parking garages and at parking meters, provided primarily for engine pre-heating. When an electric car uses these outlets the efficiency doubles.

APPLICATIONS

1) Presentation at REAP's Renewable Energy Fair in Anchorage (Aug 9, 2008)

2) Presentation at Chena Hot Springs Energy Fair (Aug 23, 2008)

3) Presentation at AAAS Arctic Science Conference, Fairbanks (Sep 16, 2008)

4) Marketplace competition static display, Anchorage (Oct 22-24, 2008)

5) Taught 2- credit course of Electric Vehicle Conversion at UAF's winter intersession. (Jan 2009) The course emphasizes the environmental advantages as well as the feasibility of driving electric cars in the arctic. Car is equipped with watt meter.

6) Presentation at AK Forum on Environment, Anchorage, AK (Feb 2009).

7) Display of an electric snowmobile at e-week open house, UAF (Feb 2009).

8) Taught 1-credt course of Electric Vehicle Conversion at Ilisagvik (Mar 2009).

9) Participated in the SAE Clean Snowmobile Challenge in Houghton, MI (Mar 2009). Won beat range at 16.6 miles and finished 2nd overall among 5 electric sled teams.

10) Presentation at the Western Alaska Interdisciplinary Science Conference and Forum, Nome, April 9

11) Presentation at the all-hands meeting, EPSCoR Anchorage, May 13-15, and won 3rd place undergraduate poster competition.

12) Participated in AFN Marketplace competition, May 4, 2009

13) Taught an "Mat-Su" Electric Car Course, May 1-3, 2009

14) Presentation at Noel Wien Library, Fairbanks, July 15, 2009

15) Participate in REAP, Anchorage, AK , August 1, 2009

16) Participate in Chena Hot Springs Energy Fair, August 22, 2009

17) Presentation at AAAS, Juneau, Sep 15, 2009

CONCLUSIONS

Electric Vehicles can be a viable option for certain users in the subarctic and arctic communities. Perhaps the best example of this is the 1986 Chevy Sprint converted in Barrow, AK. The car is driven daily for 3 miles from one heated garage to another. Electric cars are infamous for not going too far or too fast. Our next project will deal with electric ATVs. They have the advantage of not requiring cabin heat for the driver.

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APPENDIX

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"Charging ahead with nature-powered wheels," Bristol Bay Times, Jan. 22, 2009, by Tammy Judd http://www.thebristolbaytimes.com/news/show/4642

"Fairbanks engineering students build award-winning electric snowmachine," Fairbanks Daily News-Miner, April 4, 2009, by Tim Mowry http://newsminer.com/news/2009/apr/04/uaf-engineering-students-build-award-winning-elect/

"New York native, engineering student builds electric car," The Alaska Post, Feb. 6, 2009, by David Bedard http://www.alaskapostonline.com/articles/2009/02/06/features/doc498c996b53741151930319.txt

Palmer course information:
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