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Electric Vehicle Project Report

Transportation is the third largest source of greenhouse gas emissions at Tufts behind electricity and heating. Approximately 6% of the university's carbon-dioxide emissions result from commuting to and from campus and driving on campus. As part of its commitment to alleviate the impact of Tufts' emissions on the global environment, the Tufts Climate Initiative (TCI) works with other university departments to procure and use vehicles that produce zero or near-zero emissions. Through a partnership with Toyota Motor Corporation established in 2002, Tufts University leases two electric vehicles that are operated by the Mail Services Department (EV#1) and the Department of Public Safety (EV#2). (The university also leases two other vehicles that are in service as part of the Zipcar program, but those vehicles were not included in this performance review).

This study by the Tufts Climate Initiative has evaluated the performance of the two electric vehicles, in order to assess the environmental and financial benefits from their use on campus. Data on electricity consumption and mileage was gathered from the Facilities Department, the Mail Services Department and the Department of Public Safety. Some required data that was not available from these sources was estimated; these estimates were based on the available data. The following is an overview of the results of the evaluation.

Mail services EV: (EV#1)

- All six mail services operators on the Medford/Somerville campus have been trained to drive the Toyota RAV 4 electric vehicle for mail deliveries.
- The use of electric vehicles for mail distribution is especially beneficial as electric vehicles are better at idle when compared with conventional cars.
- EV#1 is used for normal mail delivery on campus and is driven to Boston campus twice a day. The average mileage of EV#1 is 35 miles/day. (the mileage is not tracked on a daily or weekly basis)
- The EV is charged overnight in a parking spot in Dowling Hall.

The following two charts show the electricity consumption and estimated efficiency of the mail services vehicle:

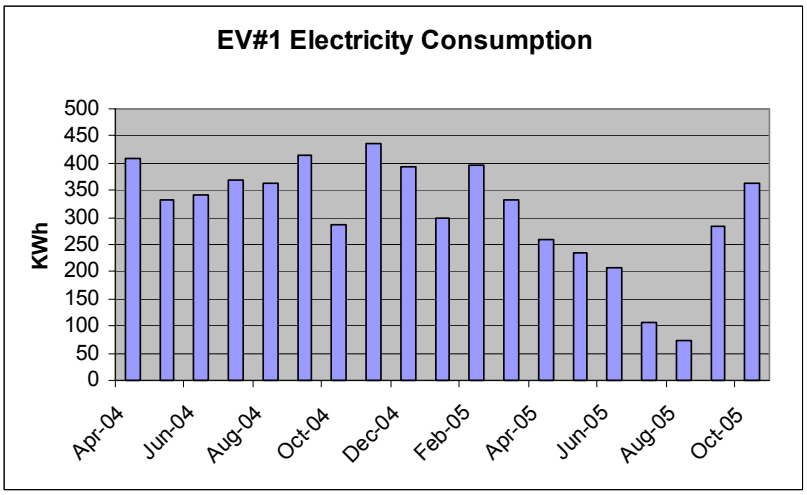

Figure 1: Electricity Consumption for the EV used by Mail Services.

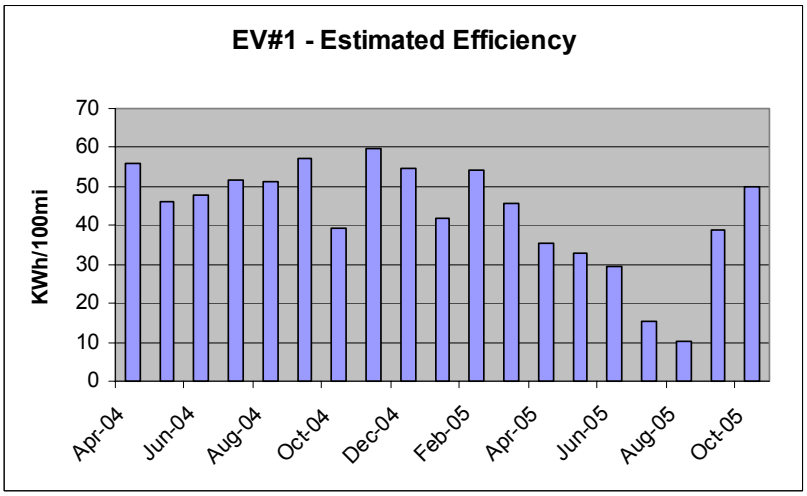

Figure 2: Calculated efficiency for EV#1 (using real electricity consumption and assumed mileage values)

As figure 1 shows, electricity consumption by EV#1 is slightly higher during winter. However, the academic calendar, as one would normally think, is not the primary factor behind this phenomenon since the Mail Services EV operates throughout the year with little variation in its daily mileage. Therefore, the difference between winter and summer electricity consumptions may be attributed to the operation of the heating appliances in the car or the decrease in battery efficiency during winter.

As Figure 2 demonstrates, EV#1 is generally more efficient during the summer months which can be attributed to the reasons mentioned above. However, the graph shows that EV#1 (Toyota RAV 4) consumes more electricity than its published efficiency which is 27 kWh per 100 mile (Source: www.fuelefficiency.gov). On the other hand, the results presented in Figure 2 should be viewed with caution since monthly mileage data was not available for this vehicle and had to be estimated using the average daily mileage which could result in substantially different results.

Public Safety EV: (EV#2)

- EV#2 is driven an average of 15 miles/day.
- The primary users are the parking enforcement operators, although the vehicle is also used for student safety escort purposes as an additional vehicle.
- The EV can be driven by up to 15 different operators. It is also charged overnight in a parking spot in Dowling.

The following two charts show the electricity consumption and estimated efficiency of the Public Safety vehicle:

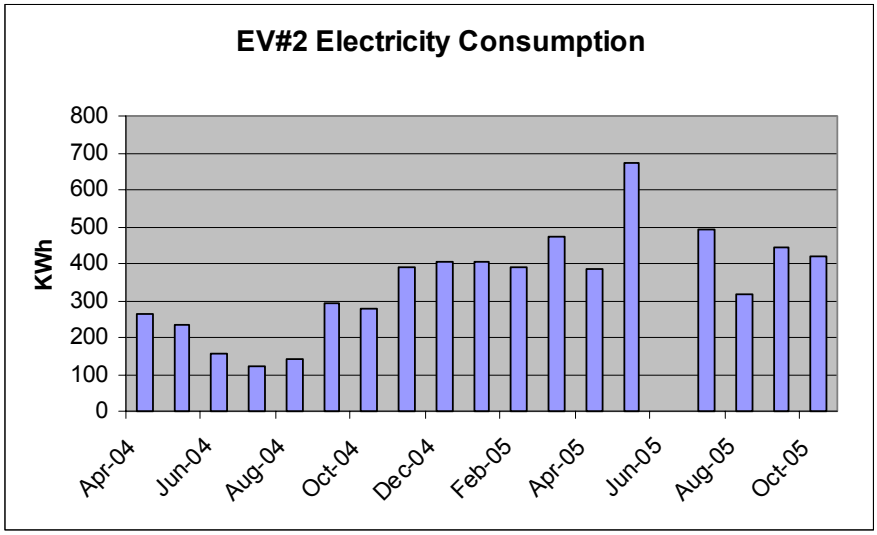

Figure 3: Electricity Consumption for the EV used by the Department of Public Safety.

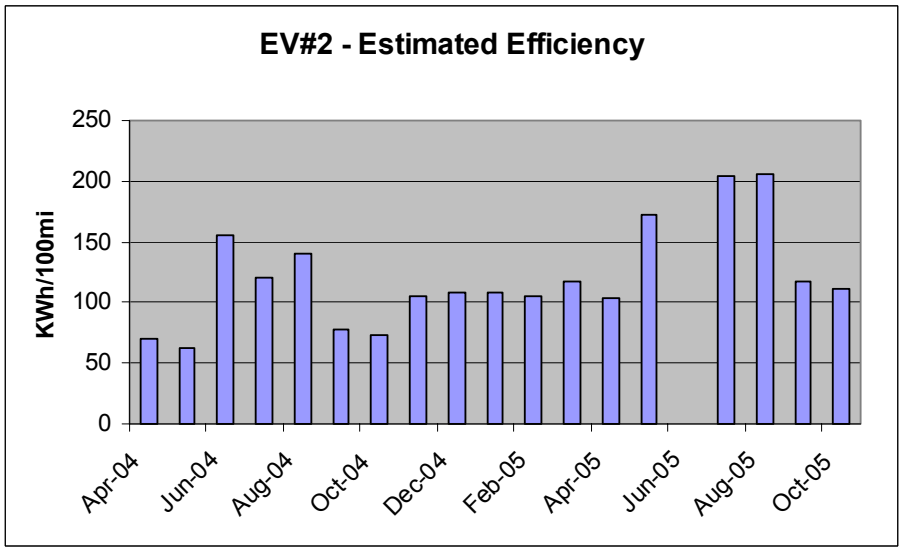

Figure 4: Calculated efficiency for EV#2

Figure 3 displays the electricity consumption for the electric vehicle used by the Department of Public Safety. Compared to the graph in Figure 1, the EV#2 electricity

consumption graph shows a more dramatic seasonal difference. In this case, electricity consumption has been significantly higher in winter months and the consumption pattern follows the academic calendar.

Figure 4 shows the estimated efficiency for EV#2 throughout the 19-month period. This figure presents some surprising results. Contrary to the observations made for the previous vehicle, EV#2 seems to be more efficient in winter months and throughout the academic year compared to the summer months when the University is on holiday. In addition, one can observe that EV#2 is much less fuel efficient than the electric vehicle used by the Mail Services Department.

The study also looked at two alternative vehicles that could be used for the same purposes on campus and compared their financial and environmental performance to the electric vehicles. A 2002 Toyota RAV 4 and a 1997 Dodge Caravan were chosen as potential replacements for this analysis. The rationale for this decision was that the closest comparable gas-powered vehicle would be the standard 2002 RAV 4. The Dodge Caravan was chosen because this is the type of vehicle that was replaced by the Public Safety electric vehicle. It was assumed that these vehicles would have the same monthly mileage as the electric vehicles, but the MPG may not reflect the actual fuel efficiency of a vehicle that was allowed to idle and drive at low speed as much as the EVs.

Alternatives to EV#1:

The following figures compare the monthly carbon-dioxide emissions and financial costs for EV#1, the Toyota RAV 4 and the Dodge Caravan.

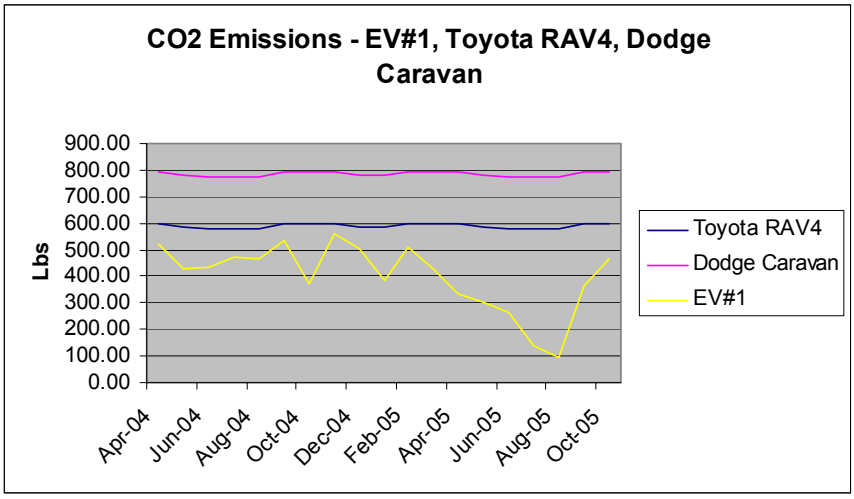

Figure 5: Comparison of CO_2 impact for the same monthly mileage.

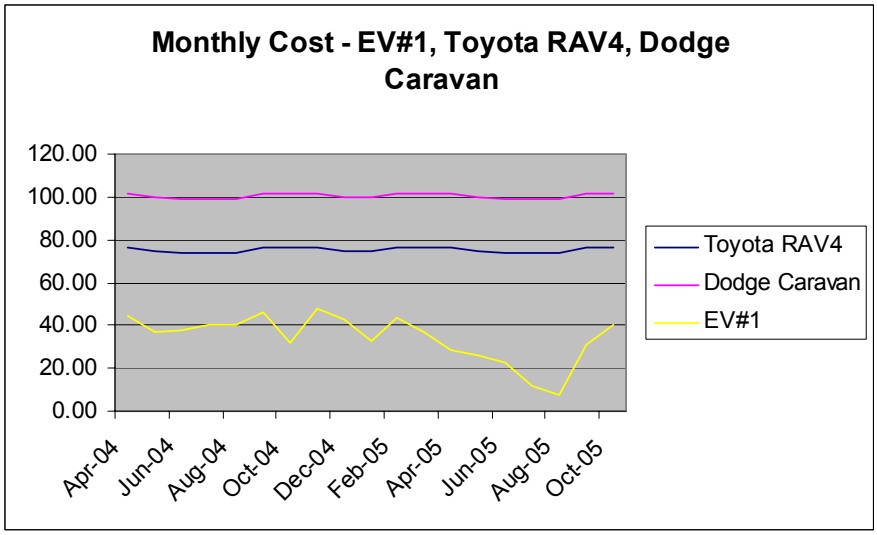

Figure 6: Comparison of monthly cost of operation for the same monthly mileage.

Alternatives to EV#2:

The figures below present a comparison of monthly CO_2 emissions and costs, between EV#2 and the alternatives.

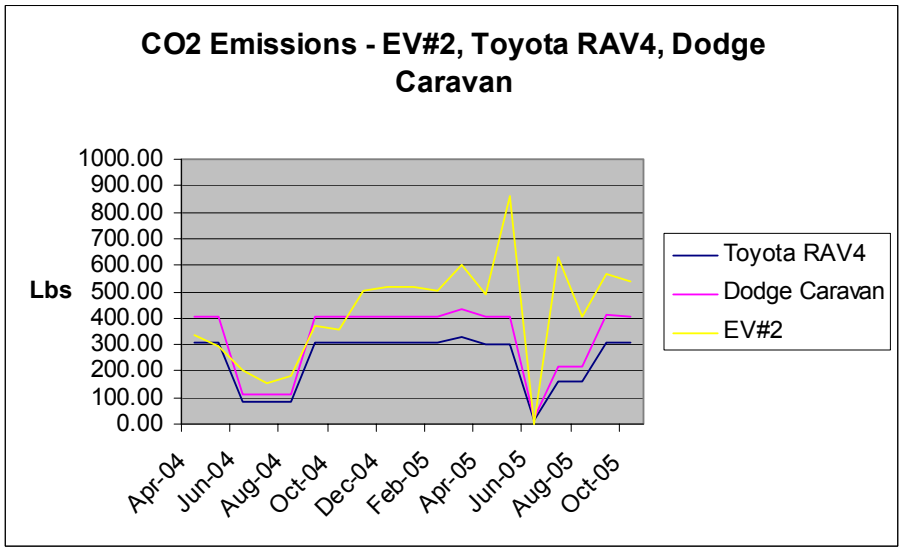

Figure 7: Comparison of CO_2 impact for the same monthly mileage.

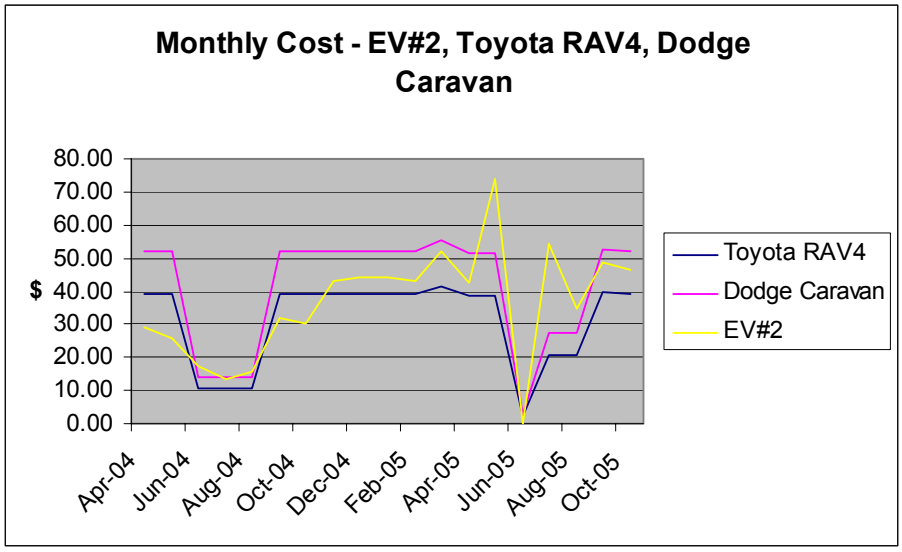

Figure 8: Comparison of monthly cost of operation for the same monthly mileage.

Conclusion

This data review shows that the EV have not performed as well as anticipated by the EPA, if the mileage data is accurate. The CO_2 emissions are also higher than expected, especially for EV#2. It should also be noted that New England has one of the cleanest electricity grids in the country, so these numbers would be even worse in other parts of the country such as the Midwest or the South that depend more heavily on coal-fired power plants. However, these vehicles do not have any tailpipe emissions, so there has been a local air quality benefit on the Tufts campus and in its host communities. Additionally, the operators of these vehicles have generally been happy with their performance and they have served their purposes well.

The Tufts Climate Initiative, on behalf of Tufts University, thanks Toyota Motor Corporation for the opportunity to use these vehicles. TCI looks forward to continuing its relationship with Toyota in the future.

Special thanks to Sinan Seyhun for his help preparing this report.