Evaluation of Solar-Assisted, Electric and Gas Golf Carts

Bathurst Glen, Richmond Hill, Ontario

Municipalities are making efforts to reduce air pollution from small gasoline engines such as those found in lawn-mowers and gas-powered golf carts. These engines produce smog and greenhouse gases (GHG) and often cost more to operate than their electric equivalents.

Gas carts are popular because they are perceived to be more reliable and easier to operate than electric carts. An electric cart battery bank takes hours to recharge, while gas carts can be re-fuelled in minutes. Gas carts can also be driven longer, which means less down-time. However, considerations such as the rising cost of fuel, pollution impacts, and improved real-world performance of electric vehicles have prompted a re-examination of the tradeoffs between gas and electric carts.

Study Objectives

This study examines the potential benefits of switching from gasoline to electric or solar electric golf carts through a side-by-side field evaluation of two solar-assisted electric golf carts, two standard electric golf carts and two gas-powered golf carts. The study took place over a 3-month period from July to October 2009 at the Toronto and Region Conservation's Bathurst Glen golf course in the Town of Richmond Hill. The carts were assessed with respect to energy use and associated GHG emissions, dependability, and overall capital and operating costs. Golfer preference for carts was evaluated by means of a feedback survey.

Results

The study showed that both the standard and solar-assisted electric carts provide several important advantages over gas carts. The electric carts had 85% lower fuel costs and produced one-quarter of the emissions of the gas carts (Figure 1). They were also about three times more fuel efficient and were preferred by golfers for their quietness, smooth operation, and lack of exhaust fumes.

If all golf courses using gas carts within a 100 km radius of Toronto were to switch to electric carts, it is estimated that GHG emissions would be reduced by 3.8 tonnes CO_2e* per day, or 608 tonnes annually, which is roughly equivalent to taking 155 mid-sized gasoline cars off the road.

** CO_2e = Carbon Dioxide Equivalent*

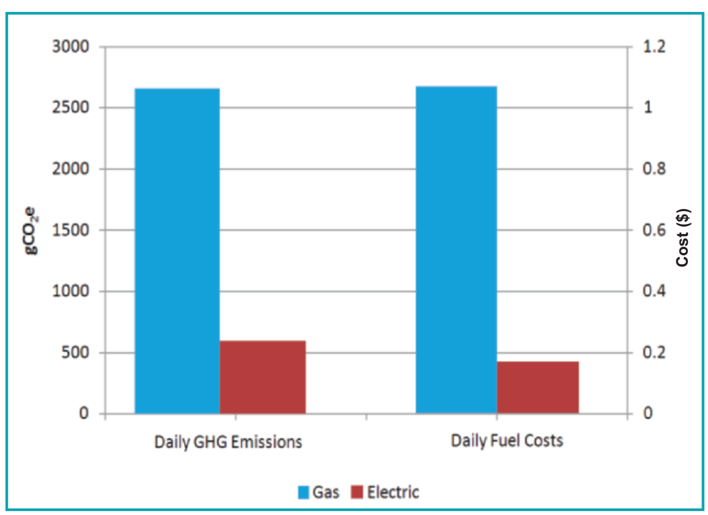

Figure 1: Daily greenhouse gas emissions and fuel costs for gas and electric carts.

Figure 2: The difference in fuel efficiency between electric and gas carts is comparable to that of a Toyota Prius and a Hummer H3 SUV.

Adding solar panels boosted the electrical input to an amount equivalent to 12% of DC consumption. When the carts were recharged at night, this 12% benefit was reduced to between 7 and 10% (measured in AC from the power grid) due to efficiency losses inherent in the charging process. In the cart comparison, however, this 7 to 10% savings in consumption was masked by the overall variation among the carts (Figure 3), suggesting that other factors relating to cart condition (e.g. tire pressure) or driver behaviours are at least if not more important than the solar panels in determining overall energy consumption.

Golfers offered positive feedback on the solar-assisted carts as being "a great idea" and "eco-friendly", suggesting that these carts can help contribute to the "green" image of the golf course. They also showed a strong preference for the quiet and smooth ride associated with electric or solar-assisted electric carts.

Overall, the electric golf carts appear to be a far better investment financially and environmentally on golf courses where topography is suitable. The addition of solar panels to electric carts can marginally improve performance and offer a marketing advantage to golf course operators.

Installing the solar panel in an area with full sun exposure and connecting directly to the grid would maximize generation potential by eliminating losses caused by shading and battery charging.

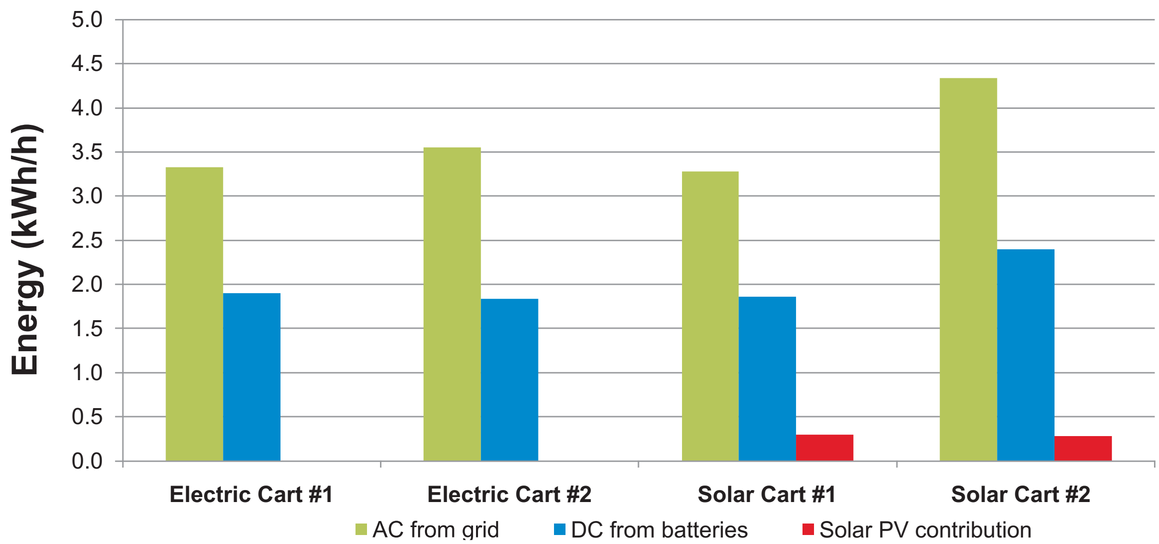

Figure 3: DC electricity drawn from batteries, with PV production and AC consumption expressed in kilowatt hours of energy per hour of cart use. The difference between AC and DC consumption represents inefficiencies in the battery charging process.

For more information about this project or the Sustainable Technologies Evaluation Program (STEP), contact Tim Van Seters at (416) 661-6600 x5337. The final report for this study is available for download from the STEP website at www.sustainabletechnologies.ca.

Project Partners

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