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Future looks bleak for fuel cells

By Richard Gilbert
Special to Globe and Mail Update

My [last post](#) described one way of benefitting from electric traction while also dealing with the “range anxiety” resulting from batteries’ low energy capacity. It is to equip the vehicle with an internal combustion engine (ICE) that can charge the battery and even drive the wheels.

The ICE and associated drive train, pollution control devices, and fuel tank are little used if the daily range requires no more energy than can be provided to the battery from an overnight charge.

Conversely, the electric motor and battery are little used during long journeys on highways. In each case, such hybrid vehicles carry a mostly unnecessary, heavy, and costly load.

Moreover, to the extent the ICE is used, the vehicle would likely use an oil product. This would defeat the objective of moving away from a reliance on oil toward electricity - a much better vehicle fuel, for the most part.

Another way of generating electricity on board a vehicle is to use a fuel cell. There were once high hopes for this option. A 2005 Scientific American article claimed, “Car company executives ... foresee no better option to the hydrogen fuel-cell vehicle in the long run.” In the same year, a report by the International Energy Agency suggested, “...30% of the global stock of vehicles could be powered by hydrogen fuel cells by 2050 – about 700 million vehicles.”

Canada was a leader in the development of fuel cell applications, through the work of Vancouver-based Ballard Power Systems Inc. The November, 2007, announcement of Ballard’s sale of its automotive fuel

cell division to Daimler and Ford was the first major nail in the fuel cell coffin. The decision was characterized as “a tacit admission that the hydrogen fuel car, the Holy Grail Ballard has chased for two and a half decades, is dead.”

The second, near-final nail was hammered in on March 4, 2008, when General Motors and Toyota separately announced they saw little future in fuel-cell vehicles. Both companies were concerned about the continuing high costs of fuel cells. Toyota also noted the lack of infrastructure for hydrogen distribution.

The announcements came two weeks after the spot price of light crude oil first rose above \$100 a barrel on the New York Mercantile Exchange. This gave urgency to the task of getting off oil.

Even if fuel cells became much cheaper, and the challenges of piping and storing hydrogen were solved, a fundamental problem with the so-called “hydrogen economy” would remain: its inherent inefficiency.

The long-term vision for this economy is to produce hydrogen from renewable sources rather than from natural gas, the fossil fuel from which almost all hydrogen is now produced. This will involve first generating electricity from wind power, solar panels, marine currents or other such means. Then the electricity will be used to make hydrogen through the well-established process of electrolysis. After distribution and storage, the hydrogen will fuel a vehicle’s on-board fuel cell.

Electrolysis has an energy-conversion efficiency of about 50 per cent, as do fuel cells. This means that only a quarter of the initially available energy reaches the electric motor. If the intermediate product, hydrogen, is liquefied to facilitate storage, the energy loss becomes 80 rather than 75 per cent.

Compare this system, which wastes 75 or 80 per cent of the energy it generates, with the fuelling of Calgary’s light-rail vehicles. Since 2001, Calgary Transit has purchased the amount of power used by the light-rail system from the operators of 12 wind turbines in southern Alberta. The system is in effect fuelled by renewably produced electricity, hence the program’s name: Ride the Wind. The energy loss across the Alberta electricity grid, between the wind turbines and the vehicles’ electric motors, is about 10 per cent.

In an energy-constrained world, a system that loses 80 per cent of its initial energy will not fare well when up against a system that loses only 10 per cent.

If batteries stood between the turbines and the motors rather than the wires of the grid, the losses would be greater, but nowhere near as large as the fuel-cell system loses.

My next few posts will focus on grid-connected vehicles such as those of Calgary’s light-rail system (and Vancouver’s trolleybuses, Toronto’s streetcars, Montreal’s subway trains, and more). I’ll discuss how personal vehicles and trucks could enjoy the huge efficiencies and other advantages of continuous connection to an electrical grid.

Richard Gilbert is a Toronto-based consultant who focuses on energy and transportation. His latest book is Transport Revolutions: Moving People and Freight without Oil, written with Anthony Perl.