

A new value proposition for vehicles?

By Robert Mauro, General Manager, PATH

On a long plane flight I began to think about the future role of hydrogen and fuel cells in an idealized scenario for the U.S. I have heard that fuel cell costs are projected to be \$225/kW in large scale production for vehicles. This was good news but nowhere near the projected cost of \$50/kW or less necessary for large scale commercialization.

The issue that bothered me as I thought about it more was that fuel cells are portrayed as a disruptive energy technology, yet the proposed commercial introduction is substitution of fuel cells for IC engines. This is the least iconoclastic approach to commercialization possible. This led to the next question. Is there another value proposition other than a direct substitution can provide a commercialization path for fuel cell vehicles with a higher fuel cell price?

The surprising answer to this question is yes and no. The yes is that I can postulate a future which can tolerate a much higher fuel cell price for a vehicle which provides both transportation and stationary power. The no is that the fuel cell for the vehicle must have a much longer life and the hydrogen fuel must be relatively inexpensive.

Let me illustrate. If you assume that a hydrogen fuel cell vehicle can be made to operate for 10 years as a vehicle operating 500 hours per year and as a source of stationary power for 500 hours per year. Assume that the power is worth an average of 10 cents per kilowatt-hour. Then the vehicle fuel cell with efficiency anywhere between 40 and 50 percent could have a present worth of over \$400/kW assuming the hydrogen was free and the fuel cell could operate efficiently for at least 10,000 hours. However hydrogen is not free. If we attribute \$175/kW of the fuel cell capital cost to the production of electricity and \$50/kW of the fuel cell capital cost to the fuel cell propelling the vehicle, then the hydrogen fuel would have to be about \$.91/kg to achieve a break-even capital cost. This is below a reasonable expectation about fuel cost and probably below the cost for any kind of hydrogen production from electrolysis regardless of improvements to efficiency and reductions in cost.

If you carry out the same calculation with the capital cost of the fuel cell reduced to \$100/kW, the hydrogen fuel cost can rise to about \$1.25/kg still \$.25/kg below DOE's ultimate target price for hydrogen delivered to the tank.

In fact to break-even with the fuel cell capital cost of \$100/kW and the DOE target price for hydrogen delivered to the on-board vehicle tank the fuel cell must operate as an electric generator for 1,500 hours per year rather than 500 hours. I did not carry this calculation any further because it illustrates that if you can fix the fuel price, then you will trade off fuel cell capital cost against fuel cell life. The current fuel cell program is designed to deliver a vehicle fuel cell with 5,000 hours of life. The value propositions that I propose over the same 10 year period require fuel cell lives of 10,000 hours and 20,000 hours respectively.

Twenty thousand hours would seem to be a suitable fuel cell life for bus applications. This raises the question of whether the bus fuel cell and car fuel cell should be the same device. The answer depends on how the fuel cell is sold and ultimately used by the consumer.