BALLARD®

SMARTER SOLUTIONS FOR A CLEAN ENERGY FUTURE

FCvelocity®

Fuel Cell-Powered Buses: A Cost-Benefit Perspective

Ballard's fuel cell technology provides efficiency in bus operations, making it the ideal solution for transit operators focused on "green" bus fleets.

SITUATION

Governments the world over are promoting measures to reduce airborne emissions and greenhouse gases (GHG's) from motor vehicles, including mass transit buses. Conventional urban diesel buses produce carbon dioxide emissions in the range of 140 to 150 tonnes CO_2e/year. In addition, these buses produce significant amounts of pollutant emissions - especially particulate matter (PM) and nitrogen oxides (NOx) - that cause deterioration in air quality. Reducing GHG emissions and air pollutants produced by buses will pave the way to a cleaner, healthier environment.

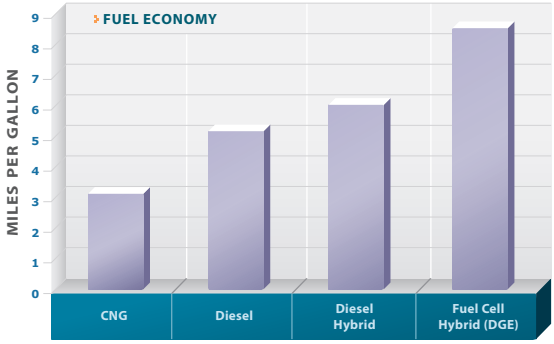
Transit ridership is increasing as citizens recognize that traveling by public transportation uses less energy and produces less pollution than travel in private vehicles. It is imperative that transit agencies deliver a set of benefits that can meet increasing expectations of the general public ridership, while managing spending within prudent budget limits.

SOLUTION

Fuel cell buses offer a number of advantages over the diesel bus alternative, generating a positive cost-benefit equation:

A. Improved Fuel Economy

Fuel cell buses running on hydrogen are two to three times more efficient than buses powered by combustion engines. By converting more of the fuel's energy into motive power, fuel cell buses offer the potential to reduce overall fuel costs. And fuel cells and electric drive systems have no moving parts, which can reduce engine wear and maintenance costs.



SOURCE: Public Transit Special Issue 2008 & NREL Reports

B. Greenhouse Gas (GHG) Emission Reductions

Fuel cell-powered buses that run on hydrogen derived from renewable poewr offer a significant reduction in GHG emissions on a well-to-wheels basis. Since fuel is currently transported from Quebec to British Columbia tests conducted for BC Transit suggest that CO_2 emissions are 62% less, in comparison to diesel buses. For the BC Transit's fleet of 20 fuel cell buses, this equates to an annual displacement in excess of 1,800 tonnes of CO_2 emissions. And once a renewable source of hydrogen is available in British Columbia, the reduction in CO_2 emissions will approach close to 100%.

SOURCE: Prototype evaluation data (BC Transit, 2008)

C. Improved Air Quality

Zero-emission fuel cell buses improve general air quality by reducing oxides of nitrogen (NOx) and particulate matter (PM). NOx and PM are dangerous emissions that are closely associated with respiratory problems.

CONTINUES ON OVERLEAF

2010 OLYMPICS
The World's Largest Fleet of Hydrogen Fuel Cell Hybrid Buses

BC Transit deployed the world's first fleet of 20 fuel cell buses integrated into the regular operational service of an urban transit system. Ballard is part of the consortium that delivered a fuel cell hybrid bus fleet (and accompanying hydrogen refuelling infrastructure) to BC Transit.

The new fleet is based in in Whistler, British Columbia, Canada and provided public transportation for the 2010 Olympic and Paralympic Winter Games. The buses have been integrated into regular service as part of BC Transit's provincial fleet.

The ultimate goal of the project is to demonstrate for the first time the integration of hydrogen fuel cell buses into the regular operational service of an urban transit system, allowing monitoring of operations, maintenance and fuelling over a sustained period. The low-floor buses have a range of 500km (approximately 300 miles), and meet other specifications of a standard bus.

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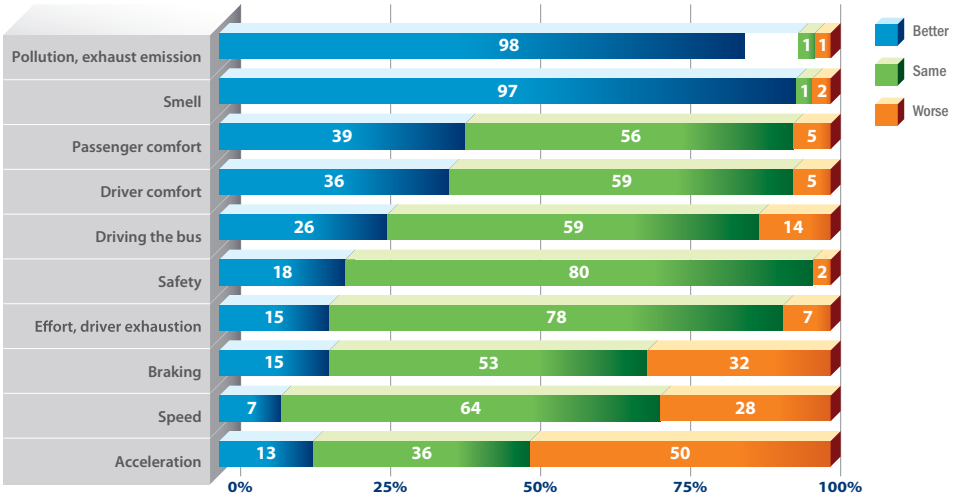
D. Enhanced Rider Experience

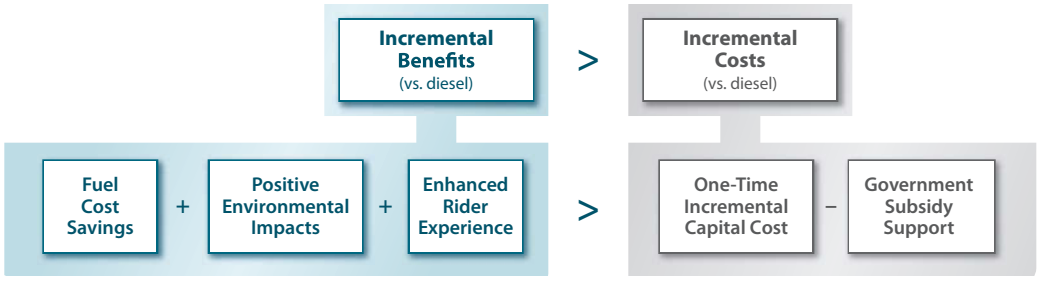
An electric motor powered by fuel cells ensures quiet and effortless acceleration for a full-size transit bus, translating into increased customer satisfaction. In fact, passengers have been known to let diesel buses pass them by in order to wait for, and ride, a fuel cell-powered bus.

Not only do passengers appreciate the benefits of fuel cell buses but, in addition, bus drivers themselves rate performance positively in comparison to diesel buses. The vast majority of drivers have noted that fuel cell bus performance meets or exceeds that of diesel and CNG buses, across a range of important dimensions.



COST-BENEFIT EVALUATION

For any transit operator considering investment in alternative energy fuel cell-powered buses, a balanced evaluation should consider the impacts of each of the foregoing elements, as part of an overall cost-benefit evaluation. The cost-benefit algorithm, in general terms, follows this approach:



A prudent investment in fuel cell buses should guarantee that incremental benefits exceed incremental costs, in comparison to a diesel bus alternative. As a result, the investment decision considers operational savings in addition to more-challenging-to-quantify environmental gains and enhanced rider experience… as compared to the net incremental one-time capital cost impact. Environmental gains and enhanced rider experience, while challenging benefits to place a monetary value on, are nevertheless significant and crucial elements to consider in any balanced evaluation of the fuel cell alternative.

Ballard would be pleased to discuss each of the cost-benefit elements with you in detail.

BALLARD'S FUEL CELL PRODUCTS

Ballard's participation in demonstration programs through five generations of heavy duty fuel cell development has yielded over 3,000,000 km (~1.9M miles) of actual revenue service, transporting over 7,000,000 passengers in various locations around the world. Ballard's next generation heavy duty fuel cell module, the **FCvelocity® -HD6**, delivers enhanced fuel cell durability and improved efficiency at a reduced cost, while offering an industry leading 12,000 hour/ five year warranty.

ABOUT BALLARD

Ballard Power Systems, Inc. is recognized as a world leader in the design, development, manufacture and sale of clean energy fuel cell products. Our **FCgen** family of stationary power products and **FCvelocity** family of motive power products offer important business benefits not available from traditional power sources.

Learn how to put fuel cells to work, contact us:
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