TECHNICAL NOTE

FUEL CELL LIFE CYCLE ASSESSMENT

FCveloCity®-HD Module for Heavy Duty Motive Applications

Scope

Fuel cell and hydrogen technologies will play an important role the decarbonization of transportation, to address climate change, air quality, and other environmental issues. As such, it is important to quantify the greenhouse emissions (GHGs) associated with their production, and identify areas where emissions could be decreased to ensure sustainability.

Ballard recently undertook a life cycle assessment (LCA) of our 85 kilowatt FCveloCity®-HD module, which powers zero emission heavy-duty motive applications. Ballard is continually working to reduce the total life cycle emissions of our fuel cell products. This report is a key step in understanding the overall life cycle emissions from fossil-fuel powered vehicles in comparison to Ballard-powered fuel cell vehicles.

Life Cycle Assessment Methodology

The LCA boundary was cradle-to-gate, meaning all GHGs produced upstream of Ballard for this product, and the FCveloCity®-HD manufacturing phase were quantified. The cradle-to-gate life cycle phases include the extraction and processing of raw materials, manufacturing and assembly of individual components, upstream transport, and manufacturing and assembly of the fuel cell module.

Primary data was collected by Ballard, which included detailed composition information for the fuel cell module and energy use at the assembly facility in Canada. SimaPro's LCA software (the world's leading LCA tool) was used to model the module's life cycle phases, and assess the cradle-to-gate GHG impacts (in kg CO2e) of the product. The Ecoinvent database was used to obtain lifecycle impact information for the materials and parts that ake up the module. When information was unavailable in the Ecoinvent database for a particular component, secondary data from the scientific literature was used.

TECHNICAL NOTE

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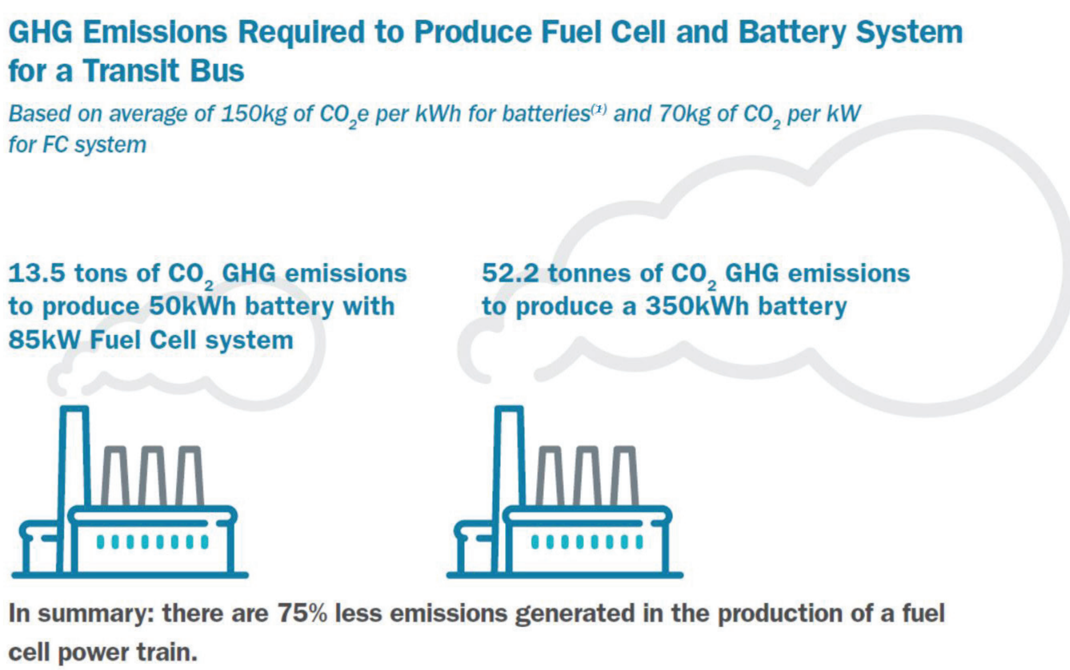
Results

The LCA for our 85 kilowatt FCveloCity®-HD fuel cell module determined that each module generates 5.6 tons of CO2 (GHG emissions) during its production from cradle to gate.

The highest GHG impacts arise in producing the metals—especially the aluminum and the platinum catalyst—for the membrane electrode assembly (MEA) and other components. This is due to the high energy intensity of mining and refining activities.

When the fuel cell stack reaches end-of-life, Ballard recycles 95% of the platinum catalyst. This is not factored into the LCA, but it would drastically reduce the overall GHG profile in a full "cradle-to-grave" assessment.

The FCveloCity®-HD module is designed to power fuel cell electric buses. From a lifetime emissions and environmental impact perspective, fuel cell electric buses are cleaner than battery electric buses. There are 75% fewer emissions generated in the production of a fuel cell power train with an 85kW fuel cell system than a 350kWh battery-only system.



Reference:

1) ICCT 2018 Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions - https://theicct.org/sites/default/files/publications/EV-lifecycle-GHG_ICCT-Briefing_09022018_vF.pdf

Here for life™

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