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Life cycle assessment of a polymer electrolyte membrane fuel cell system for passenger vehicles

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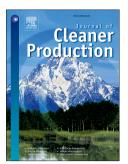
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ACCEPTED MANUSCRIPT

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7	
8	Abstract
9	In moving towards a more sustainable society, hydrogen fueled polymer electrolyte membrane (PEM) fuel cell
10	technology is seen as a great opportunity to reduce the environmental impact of the transport sector.
11	However, decision makers have the challenge of understanding the real environmental consequences of
12	producing fuel cell vehicles (FCVs) compared to alternative green cars, such as battery electric vehicles (BEVs)
13	and more conventional internal combustion engine vehicles (ICEVs). In this work, we presented a
14	comprehensive life cycle assessment (LCA) of a FCV focused on its manufacturing phase and compared with the
15	production of a BEV and an ICEV. For the manufacturing phase, the FCV inventories started from the catalyst
16	layer to the glider, including the hydrogen tank. A sensitivity analysis on some of the key components of the
17	fuel cell stack and the FC system (such as balance-of-plant and hydrogen tank) was carried out to account for
18	different assumptions on materials and inventory models. The production process of the fuel cell vehicle
19	showed a higher environmental impact compared to the production of the other two vehicles power sources.
20	This is mainly due to the hydrogen tank and the fuel cell stack. However, by combining the results of the
21	sensitivity analysis for each component - a best-case scenario showed that there is the potential for a 25%
22	reduction in the climate change impact category for the FCV compared to a baseline FCV scenario. Reducing
23	the environmental impact associated with the manufacture of fuel cell vehicles represents an important
24	challenge. The entire life cycle has also been considered and the manufacturing, use and disposal of FCV,
25	electric vehicle and conventional diesel vehicle were compared. Overall, the ICEV showed the highest GWP and
26	this was mainly due to the use phase and the fossil carbon emissions associated to the use of diesel.
27	

Keywords: fuel cell vehicles; life cycle assessment; manufacturing; catalyst; PEM; hydrogen tank

1. Introduction

The urgency of tackling climate change is pushing policy makers and industrial sectors to investigate new technologies for the reduction of emissions and fuel consumption, especially in the transport sector. In the EU,

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