C-Motive Carbon Emissions Comparison

Current State

Motors play a critical role in manufacturing infrastructure, and it is necessary to develop both more energy and environmentally efficient motors. C-Motive's novel motor technology has a lower environmental impact with respect to greenhouse gas emissions during both the use phase (Scope 2) and with respect to the environmental impacts embodied in the raw materials (Scope 3) when compared to other motors on the market. Figure 1 presents the comparative greenhouse gas emissions (in kilograms - kg of carbon dioxide equivalents per motor) for the environmental impacts embodied in the raw materials utilized to produce both C-Motive's motor and their competitors. Two life cycle inventory databases are used, although both provide somewhat different numbers, regardless the C-Motive option is significantly less than the AC Induction option.

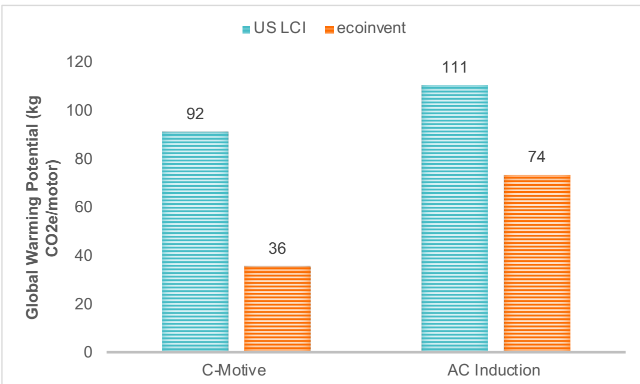

Figure 1: Greenhouse gas emissions for the raw materials utilized in motor production (US LCI and ecoivent are two different common life cycle inventory databases)

Although the embodied emissions in the materials that comprise the motor are important, the majority of the environmental impact (above 90%) will occur while it is in service. Which makes reducing the carbon emissions, and increasing the energy efficiency, of the motor when it is running much more critical. Figure 2 presents the in service carbon emissions of the C-Motive motor compared to the other industry standard option using an average United States electricity generation profile relevant to 2021. It is anticipated that as the electricity grid continues to decarbonize, that the service related (Scope 2) carbon emissions of all motors considered would be reduced.

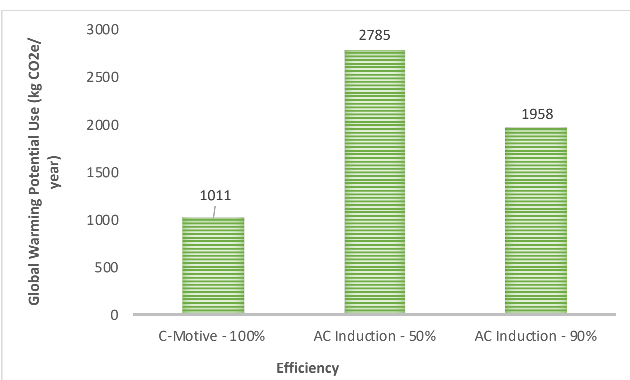

Figure 2: Greenhouse gas emissions for 1 year of use using average US electricity profile

Future Implications

As was highlighted by periodic shortages during the global Covid-19 pandemic, supply chains are relatively fragile. Many conventional motors utilize materials which are relatively critical and have supply chains which may be in jeopardy due to both geopolitical conflict and global climate change. From a resiliency perspective, this increases the benefits of the C-Motive motor due to the relatively abundant constituent materials utilized. There will also likely be future opportunities to reduce the carbon emissions of the raw materials of the C-Motive motor due to actions such as sourcing of recycled components.

Scope

This analysis is comprised of the upstream carbon dioxide emissions, in carbon dioxide equivalents, of the materials utilized to produce the motors according to the bills of materials and the forecasted use phase electricity consumption. The emissions related to the raw materials are generated using the SimaPro life cycle assessment software and the US LCI and ecoinvent databases, along with the TRACI midpoint environmental impact assessment method. The emissions related to the use of the motors is compiled using mean emission factors from the National Renewable Energy Laboratory. An average US electricity mix is modeled based on US Energy Information Administration data, comprised of natural gas (38%), coal (23%), nuclear (19%), wind (9%), hydropower (6%), solar (3%), biomass (1%), and geothermal (<1%). This analysis does not include the final environmental impact embodied in the final fabrication of the motors nor the eventual disposal of the motors once they have reached their end of life.

Credentials

Andrea Hicks PhD is an Associate Professor the University of Wisconsin-Madison in the Department of Civil and Environmental Engineering. In her research she studies the environmental impacts and sustainability implications of emerging technologies, using tools such as life cycle assessment, agent based modeling, and optimization. She is the recipient of the 2021 Laudise Medal from the International Society for Industrial Ecology for outstanding achievements in industrial ecology.