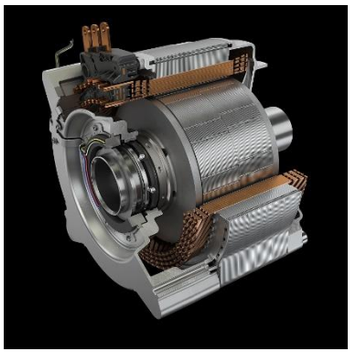
[Circular Economy in Electromobility]: Second Life for Electric Motors

An increasing number of electric cars are being sold, consequently raising the quantity of produced electric motors. At the end of their useful life, these electric motors are shredded and then recycled. The individual components and assemblies cannot be reused. So far, there has been a lack of sustainable value retention strategies for remanufacturing and recycling electric motors as part of a modern circular economy. In the REASSERT project, researchers at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA are working alongside industry partners to pursue various concepts for repairing, remanufacturing and reusing electric motors as well as new designs for the circular economy.



The REASSERT project aims to develop a prototype electric motor for the

The electrification of the powertrain is continuously progressing. The electric motors used contain valuable raw materials such as copper as well as rare earth metals like neodymium, where China holds a quasi-monopoly, and which cannot be recovered with current recycling methods. Hence, extending the usage phase of the motors is increasingly important. Furthermore, the raw materials used have a bigger carbon footprint compared to a combustion engine. Because of this, it is crucial to extend the use phase of these motors. "Innovative value retention strategies offer significant potential for emission reduction in terms of sustainability". Fraunhofer researchers in consortium with partners are working on development of innovative methods for remanufacturing electric motors and reusing them in vehicles. They focus on the value retention strategies of reuse, repair, remanufacture and raw material recycling. These are key elements for a circular economy, enabling the reduction of natural resource consumption and minimization of waste.

Reducing Environmental Impact: At present, recycling of raw materials is the established value retention strategy. Through either manual or automated recycling methods, materials such as copper and aluminum in particular are recovered. Electric traction motors are disassembled, shredded, sorted into individual material fractions, and melted down for this purpose. However, the recycled material, which is often contaminated, can no longer be used for motor applications, and individual components and assemblies are destroyed. Therefore, raw material recycling should only be chosen as a last resort for recycling and replaced by high-quality value preservation strategies such as reuse, repair, remanufacturing, and material recycling. To ensure and establish a closed-loop system the project partners define reuse as reusing the entire engine for secondary use and repair as the replacement of defective components and assemblies. In 'remanufacturing,' all components are disassembled, cleaned, reconditioned, and reassembled. For raw material recycling, the project partners plan to disassemble the motor and sort the individual materials prior to shredding. The project partners are using reference motors from the passenger car sector to analyze and select which value retention strategies should be used in a given application.

Building a Process Chain from Inbound Inspection to End-of-Line Testing: The project involves establishing a complete process, each step of which boasts its own demonstrator and test rig — from inbound inspection for motor classification to disassembly, demagnetization, cleaning, component diagnosis and remanufacturing, all the way through to reassembly and end-of-line testing, where the motor's functionality is assessed.

AI Decision-Making Tool Helps with Selection of a Value Retention Strategy: An AI tool developed as part of the project helps to select the best value retention strategy for a given application. It has access to the product and process data for the electric motor, which are saved in a digital twin.

Fraunhofer is also working on **Second Life of Lithium-ion Traction Batteries in Mobile and Stationary Applications**: Suitable aging models were developed for lithium-ion batteries to meet the project objective. These models are the basis for the subsequent investigations of business models and the derivation of requirements on the BMS (battery management system).

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Thanks and Regards,

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