

Press Release

FEV and RWTH Aachen University develop rare-earth-free electric drives with modular rotors

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Aachen, October 2025 – FEV has partnered with the Teaching and Research Area Mechatronics in Mobile Propulsion (MMP) at RWTH Aachen University to develop a modular concept for electric drive units. The approach significantly reduces dependence on critical raw materials such as rare-earth magnets in electric machines. The objective is to completely eliminate the use of rare-earth elements, which are costly and available only in limited supply. Their mining also presents significant environmental and geopolitical challenges. The developed concept uses a design with a common stator, housing, cooling system, and converter, while the rotors are interchangeable. Studies have shown that the rare-earth-free alternatives can achieve overall efficiencies of up to 94 percent while offering lower cost volatility and reduced CO₂ equivalents over the entire life cycle.

Permanently excited synchronous machines with rare-earth magnets are the most common type of drive found in today's electric vehicles. The high magnetic flux density of the permanent magnets enables optimum efficiency and excellent performance in a compact design. However, for the reasons mentioned above,

this technology is associated with growing risks. For their study, experts from FEV and RWTH Aachen University developed solutions using electrically excited synchronous machines, ferrite-based electric machines, as well as asynchronous machines, and examined them in terms of performance, cost, and environmental compatibility. The platform concept is engineered to meet varying power demands in the mid-range (C segment) and luxury (D segment) vehicle classes, delivering peak outputs of 160 kW and 250 kW respectively. It also supports scalable adaptation for lower vehicle segments through modular design.

A central element of the concept is an innovative oil cooling system with direct stator and rotor cooling, which enables a significant increase in continuous power. The resulting ratios of continuous to maximum power significantly exceed those of conventional systems by up to 75 percent.

Future-proof perspectives for OEMs

“Our platform approach allows vehicle manufacturers to react faster and more flexibly to market shifts, raw material shortages, and cost fluctuations. This is achieved without compromising efficiency or performance,” said Patrick Hupperich, President and CEO of FEV Group.

The modular unit enables different drive concepts to be realized using the same stator and converter by simply changing the rotor. This flexibility allows OEMs to diversify their supply chains and reduces development costs. Additionally, it lowers overall costs through economies of scale. In addition, the rare-earth-free

alternatives offer the opportunity to combine technological diversification with sustainability goals.

Footage



Caption: Electric motors without rare-earth elements reduce the environmental footprint and economic risks while delivering practically the same performance.
Source: FEV

About FEV

FEV has always pushed the limits.

FEV is a globally leading engineering provider in the automotive industry and internationally recognized leader of innovation across different sectors and industries. Professor Franz Pischinger laid the foundations by combining his background in academia and engineering with a great vision for continual progress. The company has supplied solutions and strategy consulting to the world's largest automotive OEMs and has supported customers through the entire transportation and mobility ecosystem.

As the world continues to evolve, so does FEV.

That's why FEV is unleashing its technological and strategic expertise into other areas, applying its forward thinking to the aerospace and energy sectors. Thanks to its software and system expertise, the company also leads the way making intelligent solutions available to everyone. FEV brings together the brightest minds from different backgrounds and specialties to find new solutions for both current and future challenges.

But FEV won't stop there.

Looking ahead, FEV continues to push the limits of innovation. With its highly qualified 6,100 employees at more than 45 locations globally, FEV imagines solutions that don't just meet today's needs but tomorrow's. Ultimately, FEV keeps evolving – to a better, cleaner future built on sustainable mobility, energy and software that drives everything. For the company's partners, its people and the world. [#FeelEVolution](#)