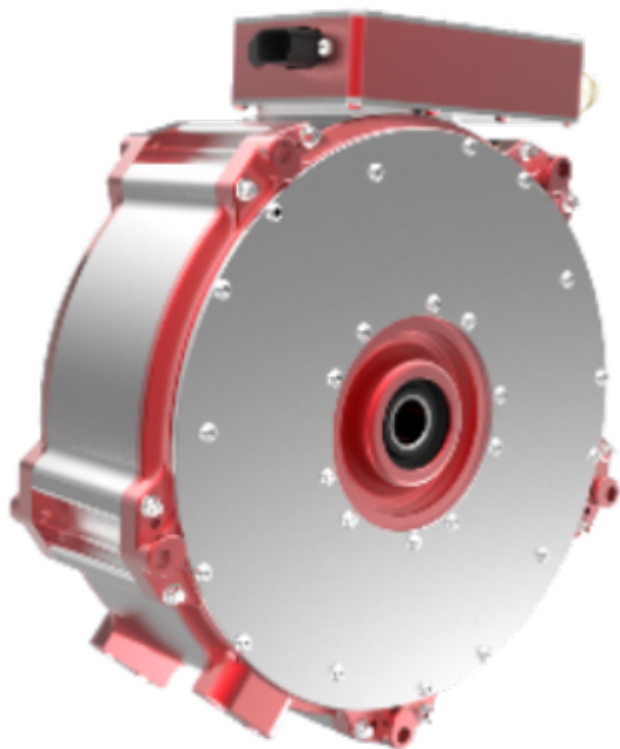


# **ELECTRIC      MOTOR      SYSTEM INNOVATION**



# **ELECTRIC      MOTOR      SYSTEM INNOVATION IS ESSENTIAL**

***Our Mission:***

***Innovate For Our Clean, Efficient,  
and Sustainable Energy Future!***

# ELECTRIC MOTOR SYSTEM INNOVATION IS ESSENTIAL:

Although today's rare-earth permanent magnet (RE-PM) electric motor system is *anecdotally* considered the most efficient and compact, the electric motor system community is *ethically* searching for innovation that will reduce (if not eliminate) RE-PMs, which are monopolized by a global adversary seeking world dominance with harmful emissions, such as net zero carbon, material shortages, such [copper](#) and rare-earth materials, electric motor innovation, exploited labor, human rights, environmental, and geopolitical consequences:

- [“Automakers outside China are scrambling to develop electric motor designs that use no permanent magnets](#), partly because the magnets require rare earths, and mining rare earths causes pollution. It's also partly because the mining is [done in China](#), a formidable automotive competitor” (12-May-2021)
- [“As the world builds more and more electric cars and trucks](#)—and electrifies other modes of transit—a race is underway to build the ideal, mean-and-green motor. The goal is a traction motor that's at least as powerful, reliable, and lightweight as today's industry standard rare-earth permanent magnet [synchronous motor](#).” (15-Mar-2024)
- [“Among the countless challenges of decarbonizing transportation, one of the most compelling involves](#)

[electric motors...It's a huge challenge currently preoccupying some of the best machine designers on the planet.](#) (15-April-2024)

Today's advances in electric motor system (**EMS**) innovation is technically limited to "me-too" electric machine systems, which are always with the "non-optimal asymmetry" of a wasteful "passive rotor" comprising either slip-induction windings, reluctance saliencies, rare-earth permanent magnets (**RE-PM**), or DC field windings that reasonably consumes half of the electric motor system cost, loss, and size, while including associated friction, electronic control, and enabling components for consistently maintaining the air-gap flux density during rotation, but cannot contribute additional active power to the electromechanical energy conversion process along with the universally essential "active stator" for primary torque and working-power production. Instead, the *symmetric* EMS, as only provided by SYNCHRO-SYM with brushless and sensor-less real-time emulation control (BRTEC), with the symmetry of active rotor comprising another directly-excited multiphase winding set (as found on the active stator) provides another increment in working power to the electromechanical energy conversion process, which in accordance to EMS physics, provides 2-8x the performance/price with the same packaging as any other (i.e., asymmetric) EMS.

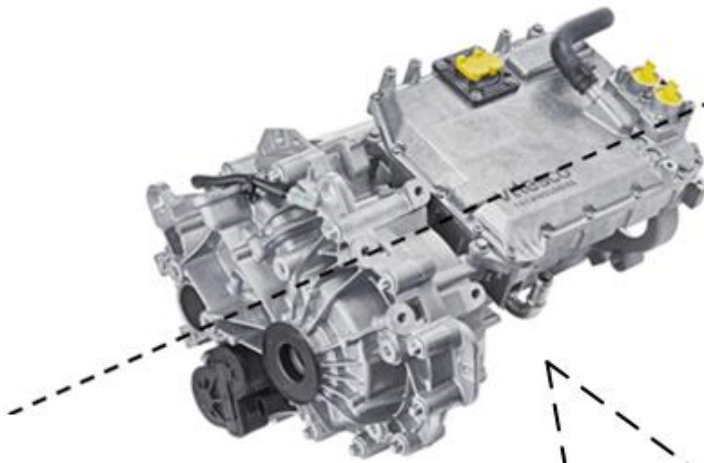
Although the EMS is the *backbone* of the industrial and commercial electricity infrastructure as well as the electric transportation infrastructure, the question isn't "Will the electric vehicle (**EV**) dominate the transportation market in order to motivate electric motor system innovation?" Instead, the question should be "What is the best propulsion drivetrain solution for any type of vehicle, regardless of fossil, hydrogen or battery fueled," which will more efficiently and reliably replace the "gearbox and differential mechanical drivetrain" of today's so-called EVs, which is necessary to improve peak torque and to reduce the amount of RE-PM

materials with a *smaller*, ultrahigh speed asymmetric RE-PM electric motor system? By ignoring the established mechanical drivetrain infrastructure or the monopoly on EMS innovation by a global adversary, most would choose the “electromagnetic drivetrain” with high peak torque, direct-drive (gearless) electric motor and generator systems, and high power and energy storage ballast for energy recovery, such as supercapacitors and batteries, as the best solution but only provided by SYNCHRO-SYM.

As the following informal rendering shows, two SYNCHRO-SYMs can replace the typical EV high speed *asymmetric* electric motor system package with its complementary high frequency electronic controller, speed-reduction gears, and differential (e.g., Vitesco EMR-3 or EMR-4) without increasing the original package size, loss, or cost but delivering twice the power, twice the reliability, half the complexity, and rapid precision independent torque vectoring of the two wheels, full electromagnetic braking, full regeneration, etc.:

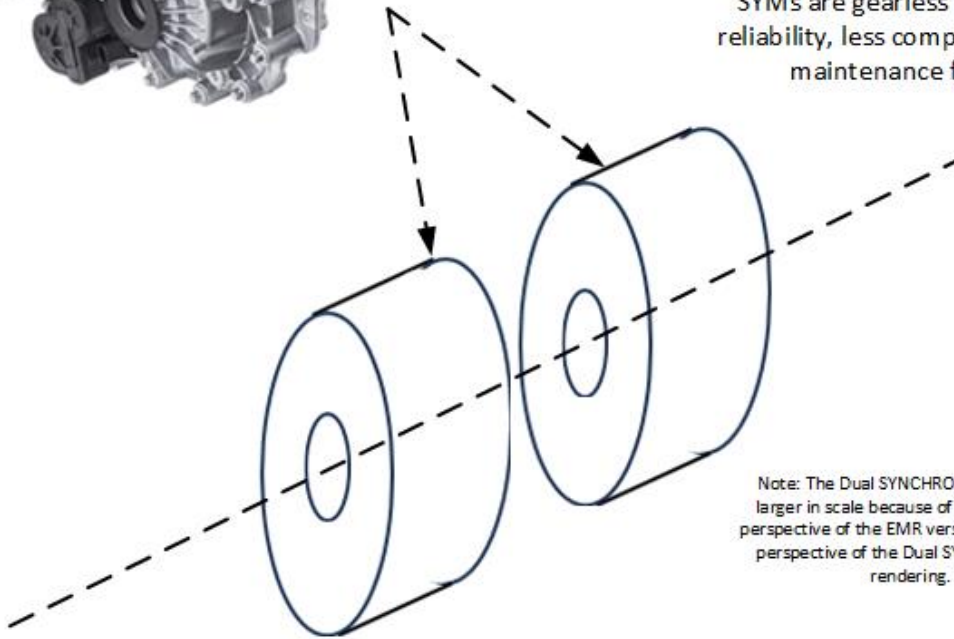
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Vitesco EMR-3 or 4  
versus  
two side-by-side SYNCHRO-SYMs Scaled Rendition



The radial-flux Vitesco EMR-3 or 4 is replaced with two side-by-side axial-flux direct-drive SYNCHRO-SYMs (with embedded BRTECs), which provide twice the power and octuple the peak torque at the same loss, cost, and size as the EMR.

Note: Direct-drive SYNCHRO-SYMs are gearless for more reliability, less complexity, and maintenance free.



Note: The Dual SYNCHRO-SYMs appear larger in scale because of the top-down perspective of the EMR versus the isotropic perspective of the Dual SYNCHRO-SYMs rendering.