



#RTR2026

Design, manufacturing, and validation of ecocycle electric traction motor

VOLTCAR

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With the support of



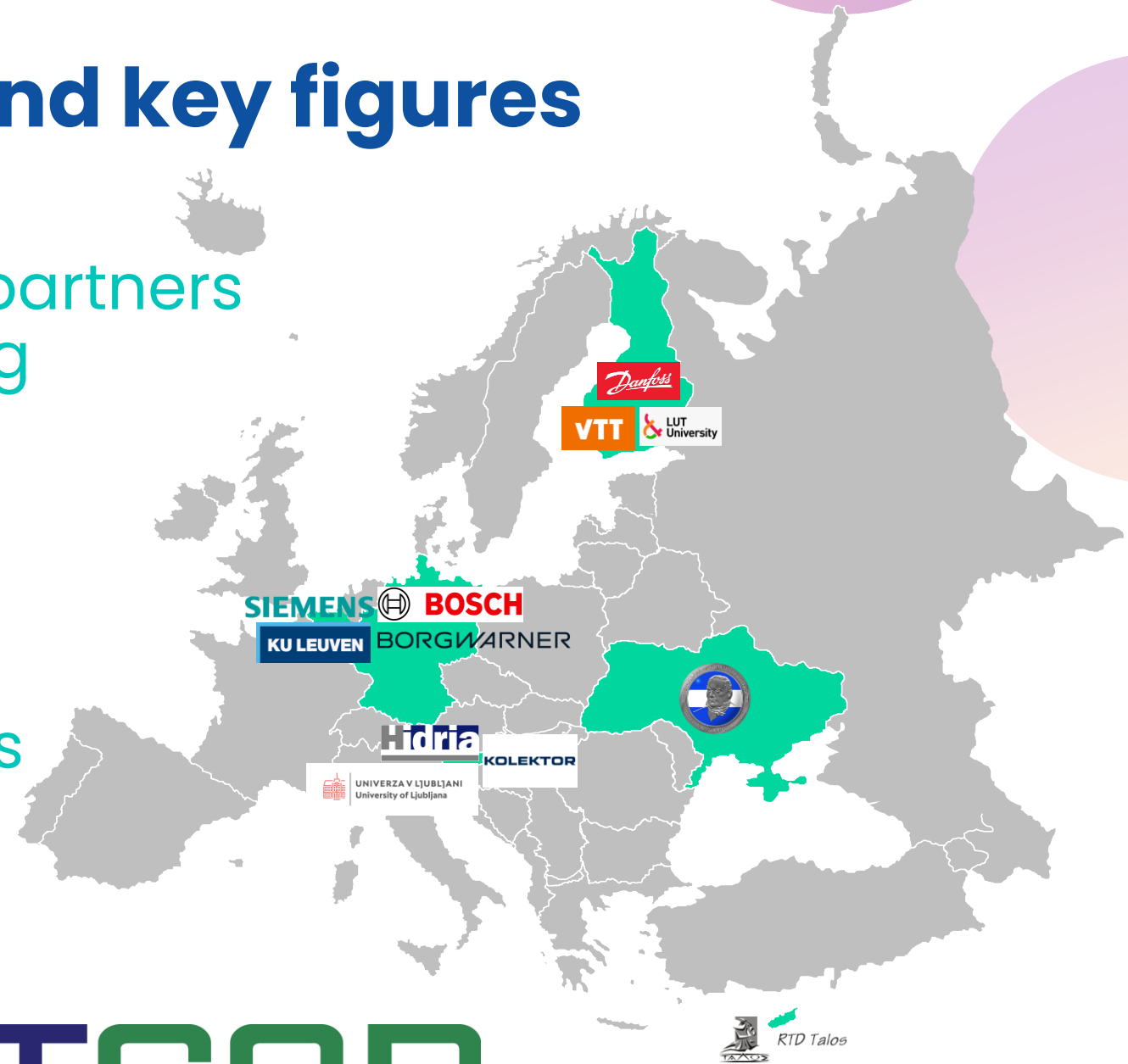
This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101096557

Overall project presentation



Project consortium and key figures

- Consortium comprises 12 partners from six countries including
 - seven industrial and
 - five research partners
- Maximum grant amount 5,997,135.75 EUR
- Project duration 44 months
01 Feb 2023 – 30 Sep 2026
- <https://voltcar-project.eu/>



Project objectives



Creation of **highly compact and efficient VOLT CAR traction motors** with **reduced** amount of **rare materials** for passenger cars and vans (nom. 50–120 kW)

>23 kW/litre and >7 kW/kg

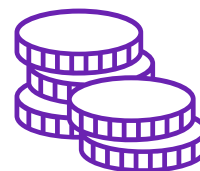
Reduction of rare resources, Neodymium Iron Boron (NdFeB) magnets, by >60%



Development of **circular technologies** for next generation electric traction motors

Technologies to enable reuse of magnets

65% recyclability rate, or functional recycling of the magnets



Demonstration of a **cost efficient, durable, over the life cycle digitalised** motor

Unit cost at mass production levels (100,000 units/year)

<6 €/kW



Comprehensive **testing and validation** of VOLT CAR traction motors and systems with advanced and virtual testing methodologies

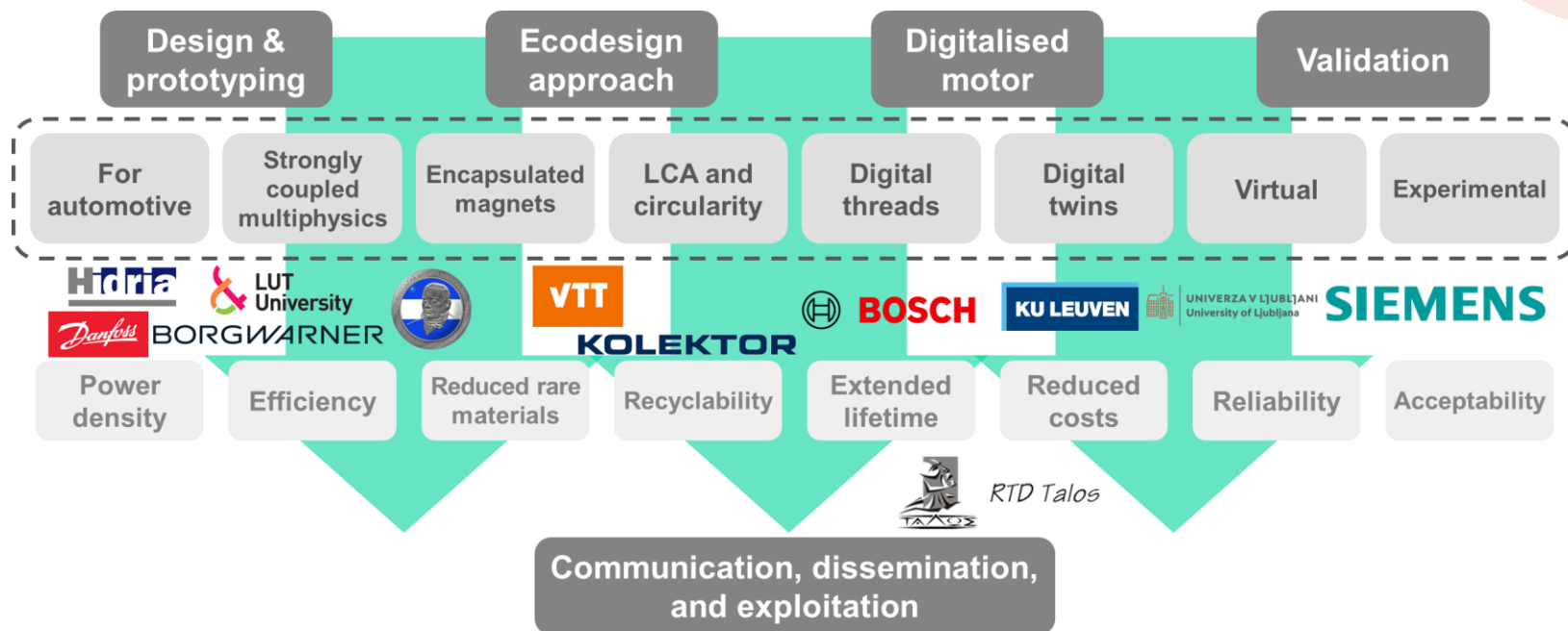
Demonstrating of reduction of losses by 20%

Results presentation



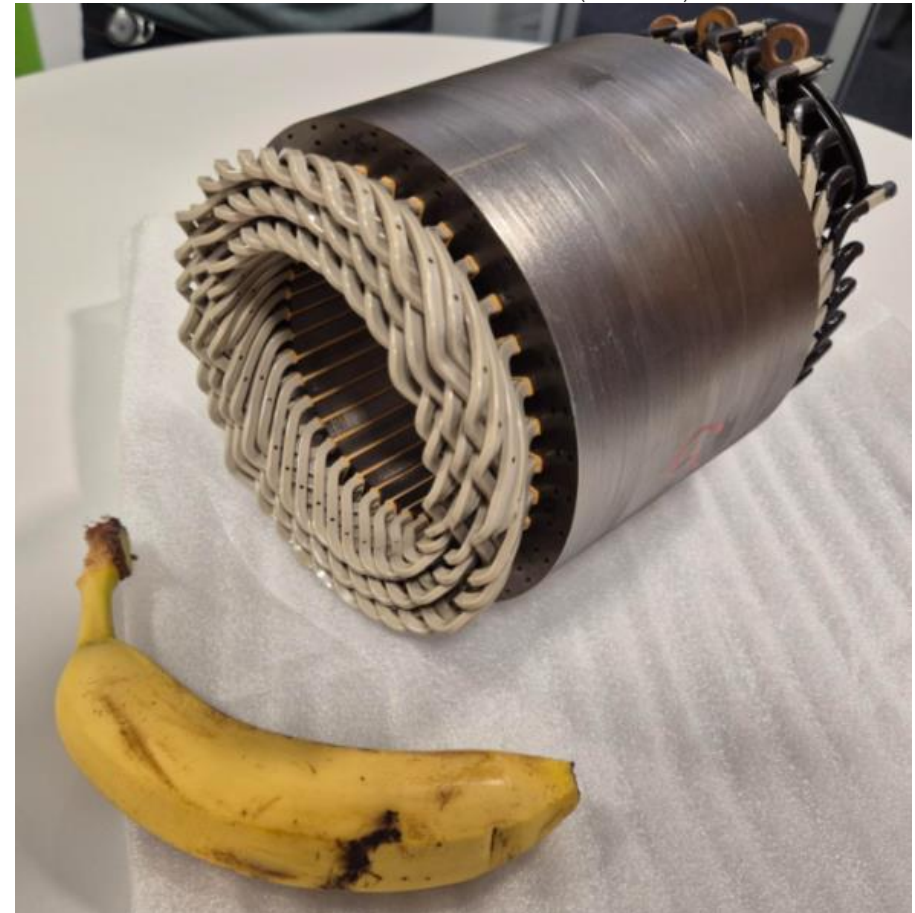
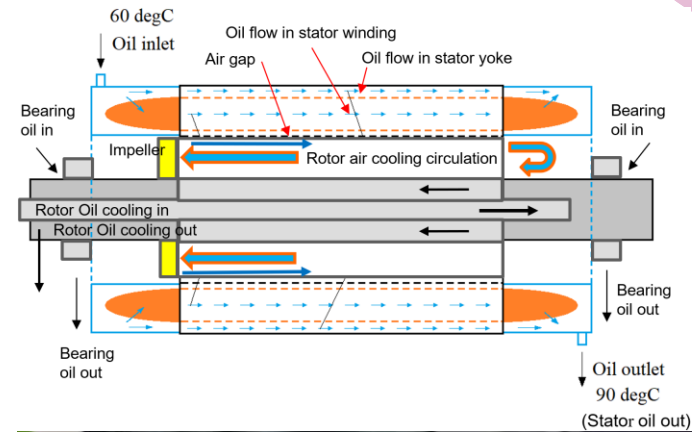
VOLTCAR proposes

- Radial flux high-speed permanent magnet synchronous reluctance motor (PMSynRM)
- Power continuous/peak: 120/210 kW
- Speed rated/max: 12,000/30,000 rpm
- DC voltage max: 800 V
- Direct liquid cooling
- Full assembly includes a gearbox and inverter



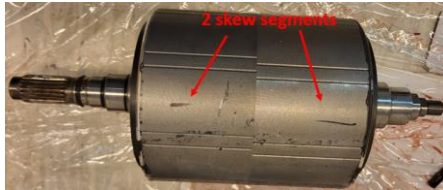
Design & prototyping

- Intermediate 50-kW and final 120-kW motor prototypes are currently being assembled, incorporating the following advanced features
 - Direct liquid cooling of the stator conductors and shaft,
 - Hairpin winding with innovative insulation,
 - Quasi-skewing (for easier assembly),
 - Baking varnish lamination stacks.

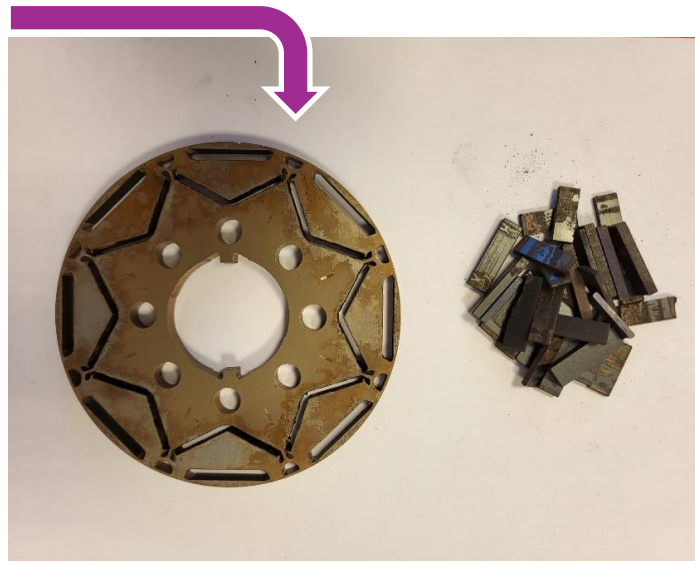
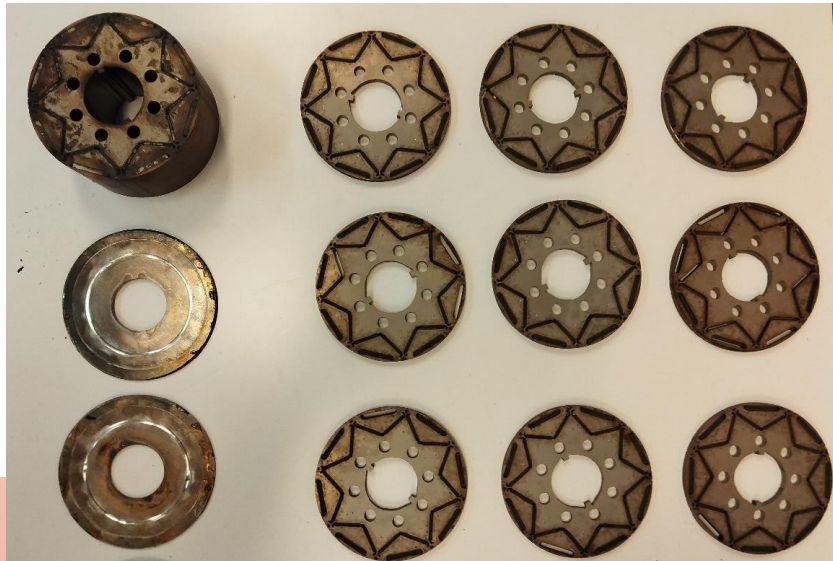


Ecodesign approach

Nissan Leaf motor dismantling



Ecodesign principles are used to reduce PM use and improve circularity. Current work focuses on shortening recycling routes by reusing PMs or, when needed, extracting and remanufacturing them (with optional blending).

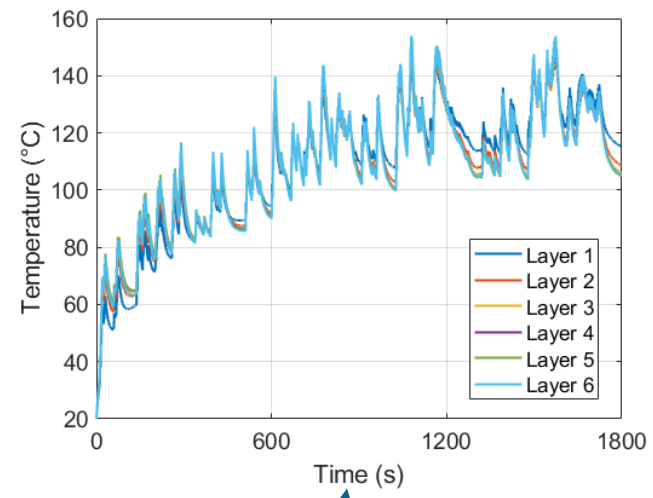
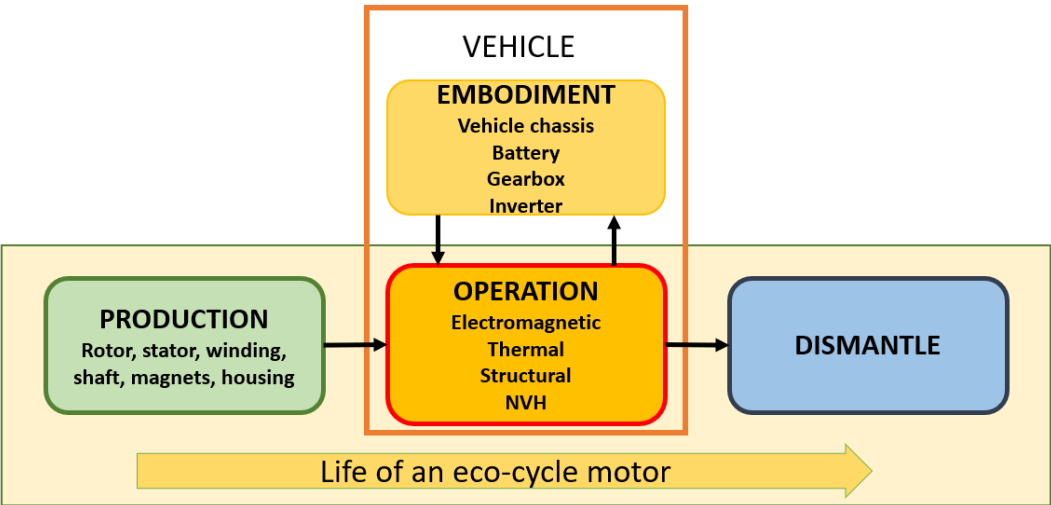


Nissan Leaf motor rotor yields ~1.8 kg of magnets containing rare-earth elements (REEs).

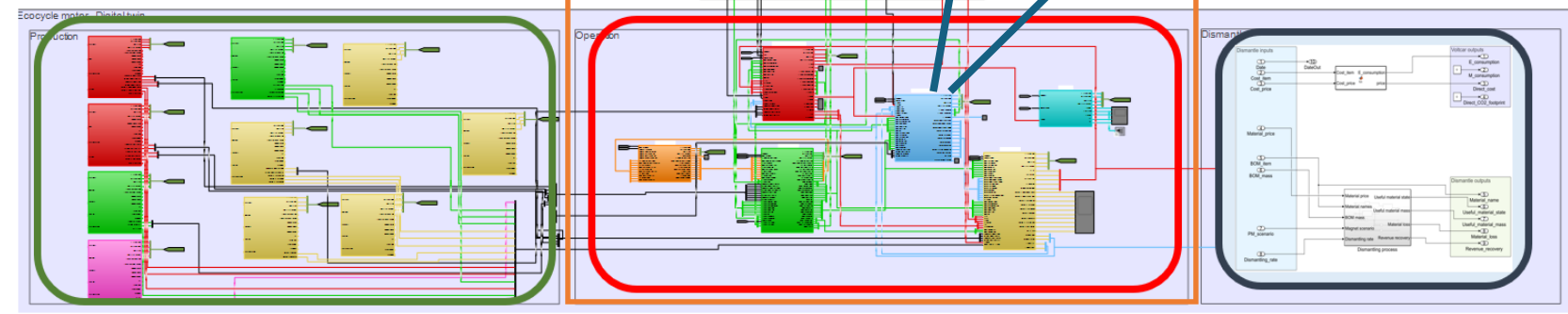
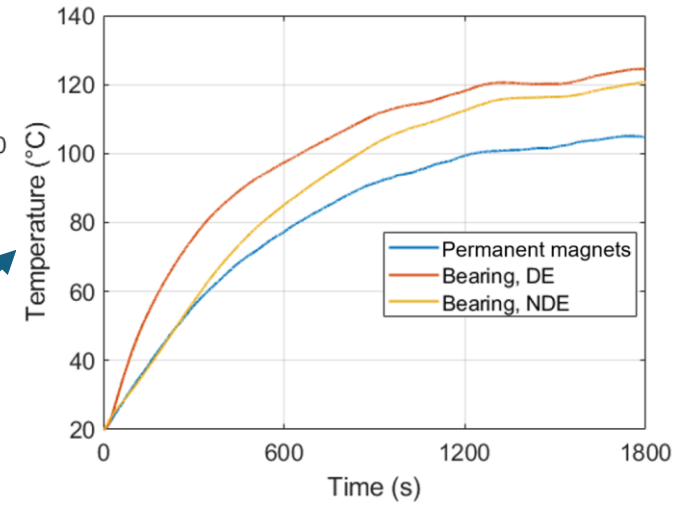


After sorting, the magnets can be reused either in existing or new motor designs or materials recycled

Digitalised motor



Temperature in the most critical parts of the motor during one WLTP driving cycle: (left) stator wires; (below) magnets, bearings.

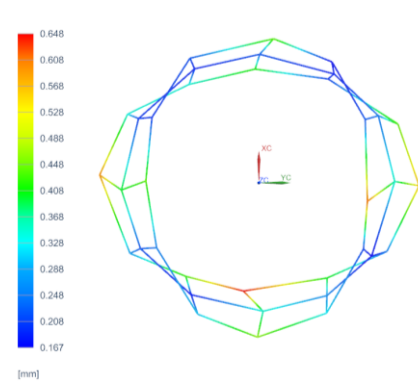
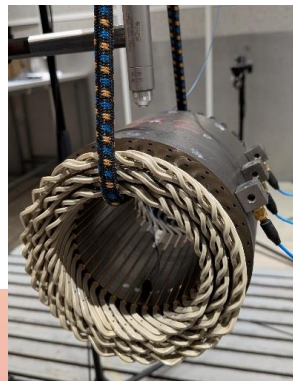
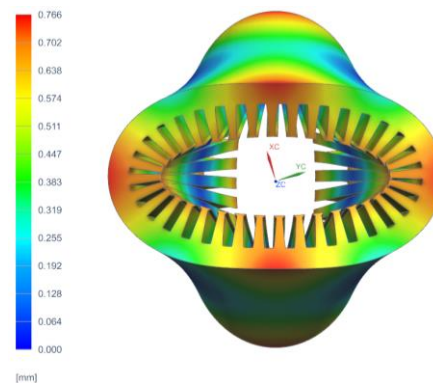
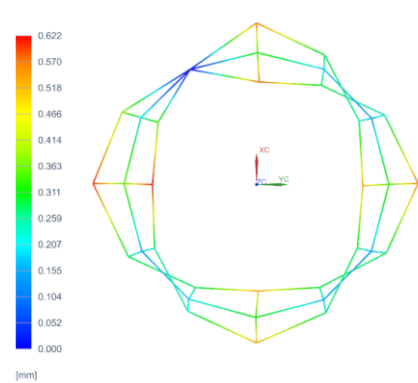


Life of an eco-cycle motor

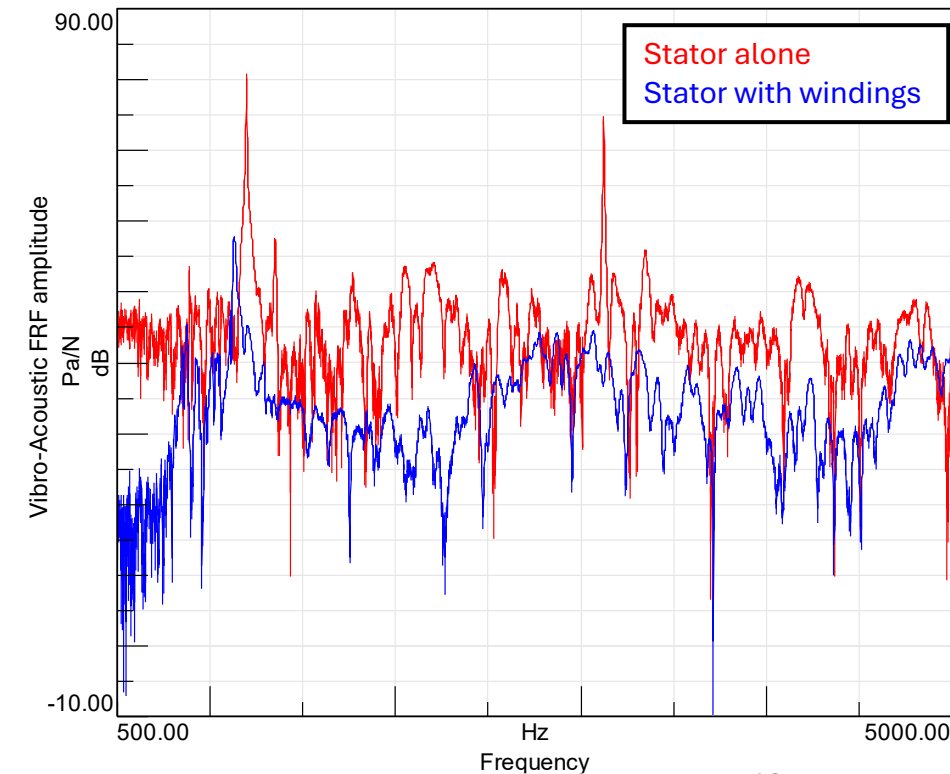
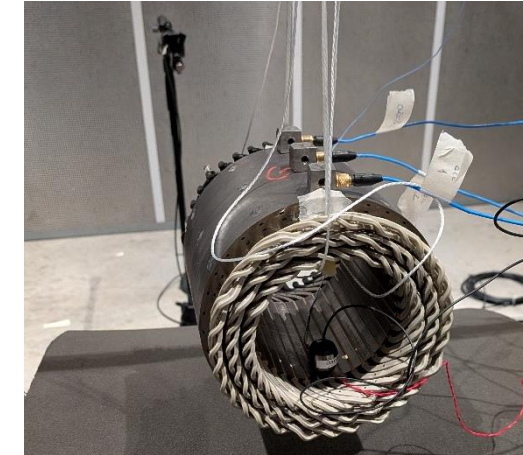
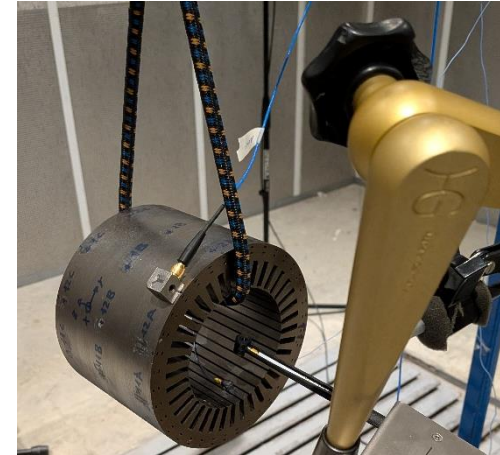
Validation: Stator measurements

Measurements of stator w/wo windings

- Modal analysis
- Vibro-acoustic (VA) FRFs at a microphone position

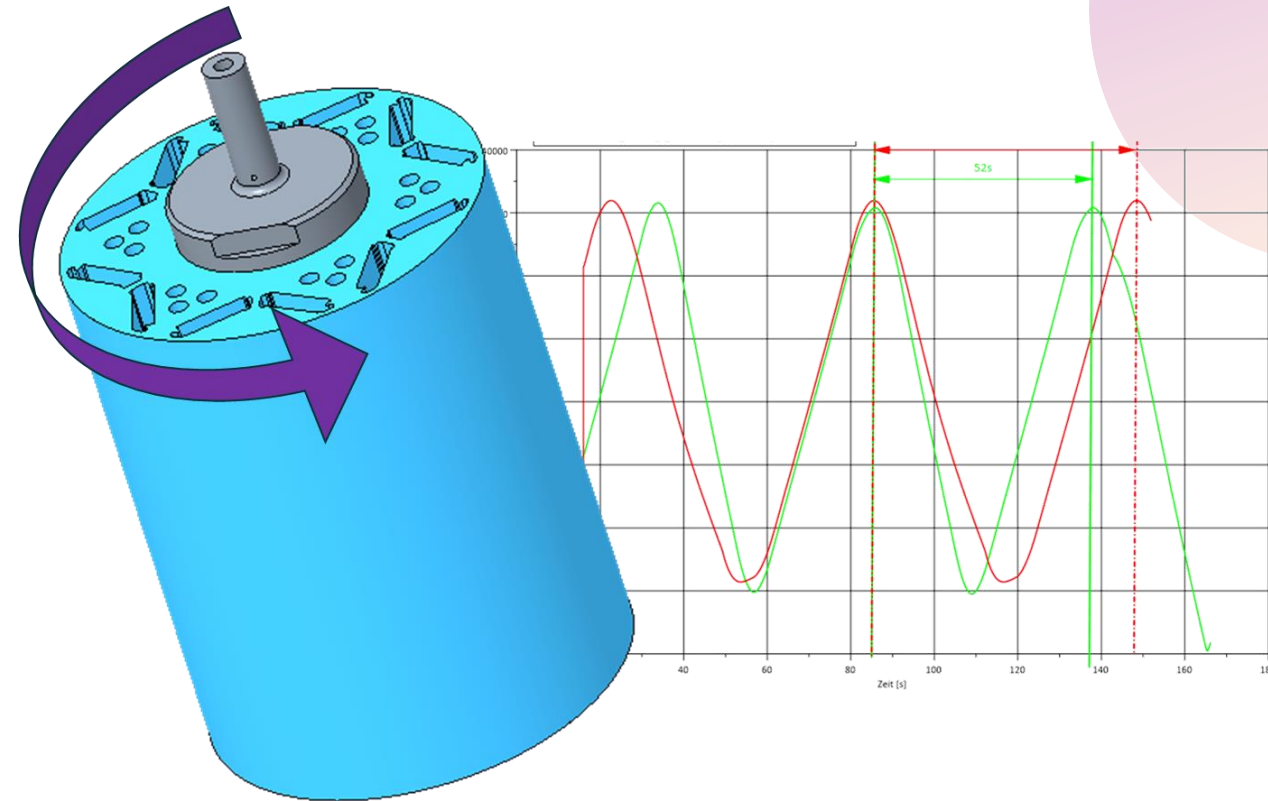


Mode 2
Stator alone: 1,338 Hz
Stator with windings: 1,317 Hz



Validation: Rotor spin testing

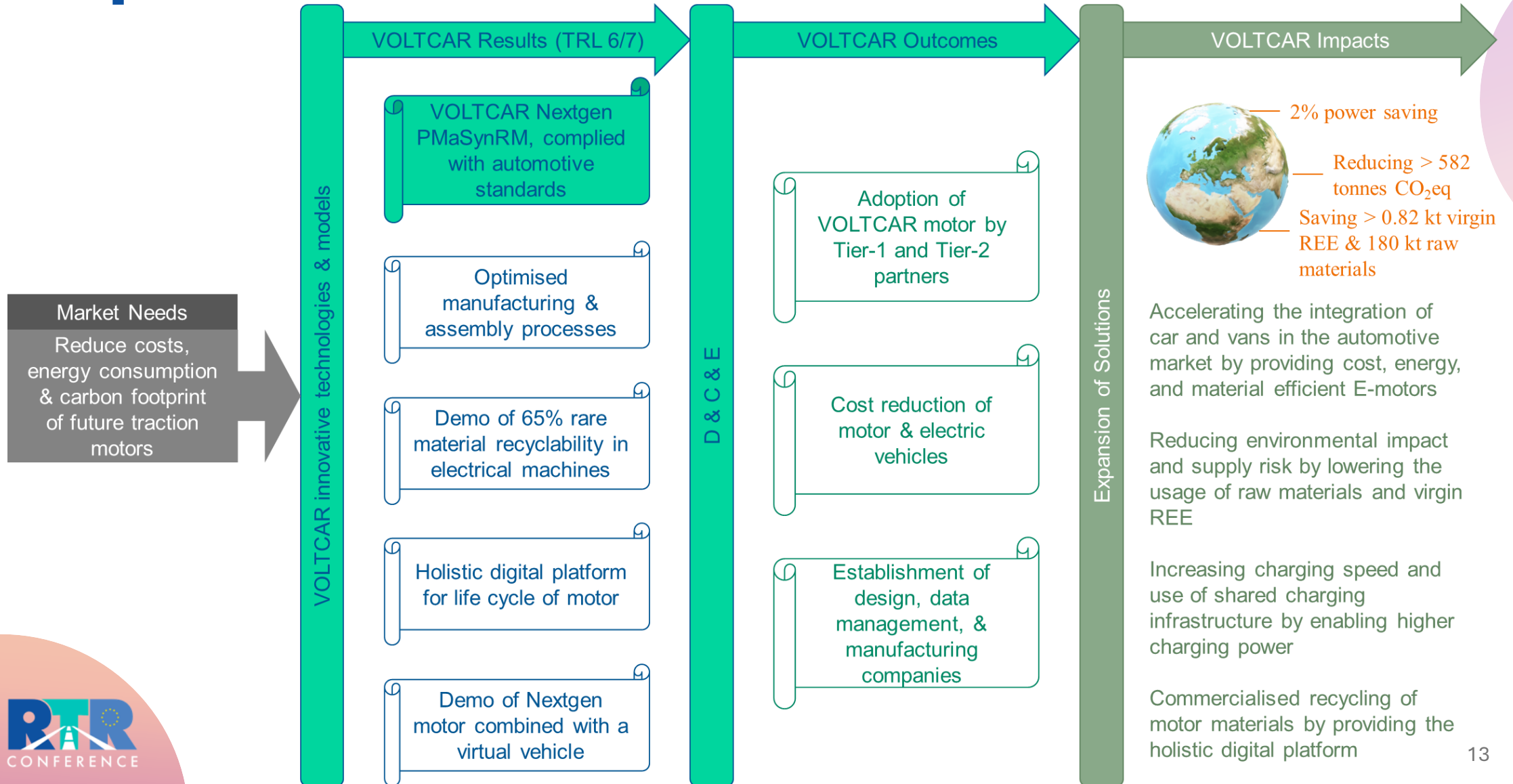
- The safety speed must be validated using a spin test.
- The test cycle included up to 20,000 cycles over 350 hours, with rotational speeds ranging from 5,000 rpm to 36,000 rpm.
- The rotors of both the 50-kW and 120-kW motor prototypes successfully passed the spin test.



Mid to long term expected impacts of the project



Impact



Measures to maximise impact

- Communication and dissemination are tailored to each audience. Focused messaging to lower barriers, such as concerns about range, cost, and sustainability.
- As part of the E-VOLVE cluster, VOLTCAR seeks synergies and joint actions with other projects.
- Key Exploitable Results are monitored and managed, and although further development is needed for market uptake, activities follow industrial best practices to minimise exploitation barriers.
- Observations:
 - Accepting slightly lower specific power greatly eases the reduction or removal of rare-earth PMs.
 - We focus on enabling PM reuse after motors' first life and providing data on future PM sources and efficient recycling. Magnet-quality data at installation and removal helps identify the best applications for recycled magnets.





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THANK YOU

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