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 Bundesministerium
für Wirtschaft
und Klimaschutz
aufgrund eines Beschlusses
des Deutschen Bundestages

SCALE-UP
E-DRIVE

Consortium Study “Innovative Materials in Electric Motors”

Manufacturing a Rotor Prototype Using Innovative Materials and Processes

-  thyssenkrupp
-  BAUER
-  Fraunhofer IFAM
-  SHwire
-  SYNFLEX
-  MARSILLI
-  Sonplas
-  Mubea
-  AXALTA
-  VFAE
wir bewegen Zukunft
-  PEM RWTH AACHEN UNIVERSITY
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-  DLR
-  e-mobil BW
-  RWTH AACHEN UNIVERSITY
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Consortium Study – “Innovative Materials in Electric Motors”



Manufacturing a Rotor Prototype Using Innovative Materials and Processes

1

Scale-up E-Drive – Introduction to the Research Project

4

Demonstrator’s Geometrical Key Data

2

Motivation for the Study

5

Materials and Production Processes

3

Overview of the Consortium

6

Project Lead Contact

Consortium Study – “Innovative Materials in Electric Motors”



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3

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“Scale-up E-Drive” Research Project



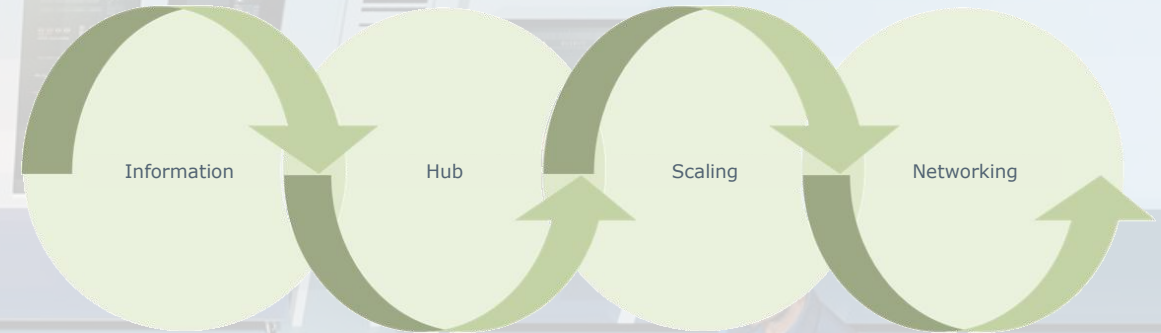
Transformation Hub for Electric Drives

Challenge

- By 2030, up to **200,000 jobs will be lost** in the automotive industry due to the **shift away from internal combustion engines** to electric drives.
- Small and medium-sized enterprises (SMEs) with a high level of technological expertise in special applications of internal combustion engines are at **risk of missing the boat in the ongoing transformation.**
- The hub’s activities will provide SMEs with **targeted support** for the transformation.

Approach & Goals

- The **overarching goal** of the Scale-up E-Drive transformation hub is to **process current trends** and industry information and **make it accessible** to the players in the value chain of electric drives in Germany **on a non-discriminatory basis.**
- PEM’s task** is to **prepare essential findings** from industry and research **for a broad audience** and to convey fundamental knowledge on electric drives in an interactive and practice-oriented manner.
- In addition, **new and existing players** in the value chain are **networked in innovative formats**, to jointly address central issues.



Project Partners



Grantor	BMWK	Duration	Jan. 1 st 2023 to Dec. 31 st 2025
Project Sponsor	VDI VDE IT	Funding Code	16THB0006E

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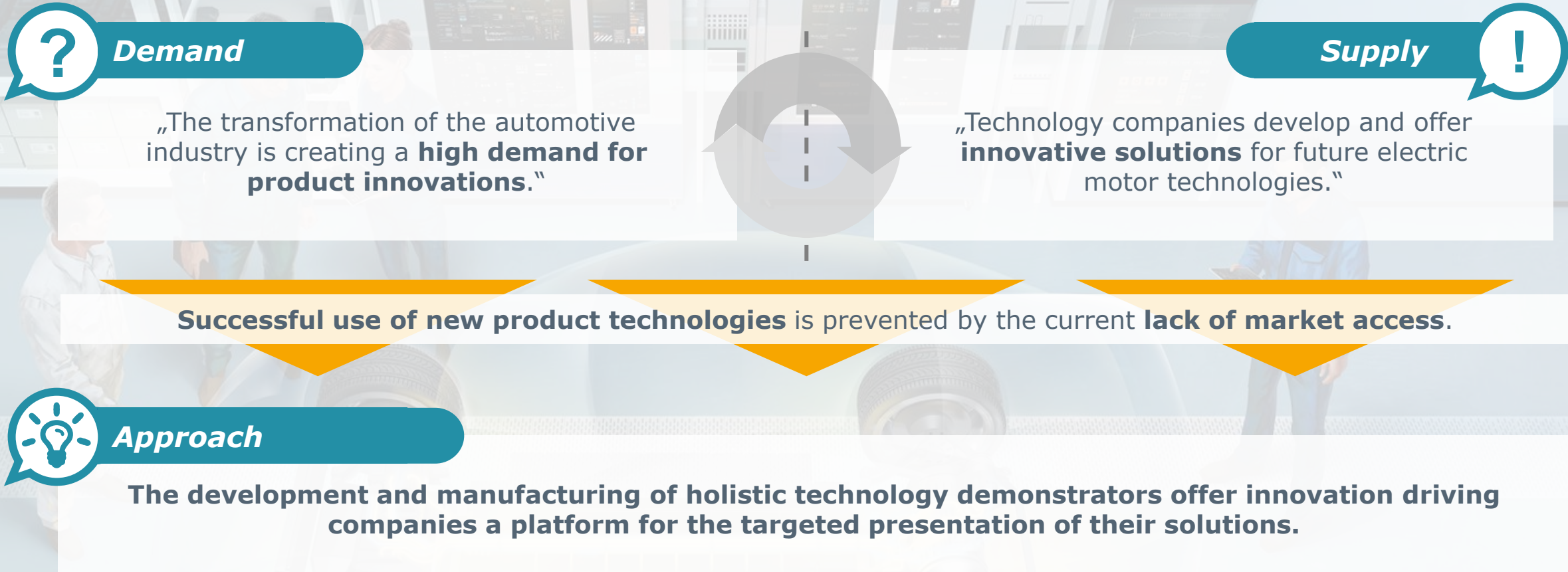
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“Scale-Up E-Drive” Transformation Hub



Motivation for the Study – “Innovative Materials in Electric Motors” Technology Demonstrator



“Scale-Up E-Drive” Transformation Hub



“Innovative Materials in Electric Motors” Technology Demonstrator



What is shown?

Innovations for **individual components of electric motors** for traction applications



Who is the consortium?

Companies with a **product innovation with a physical proof-of-concept** and **valid property right**



What is done?

Manufacturing of demonstrators based on a **neutral reference design**, including process documentation and preparation of the results



Where is it presented?

Key events 2025:

- Coiltech Augsburg
- Coiltech USA



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Materials and Production Processes

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Overview of the Consortium

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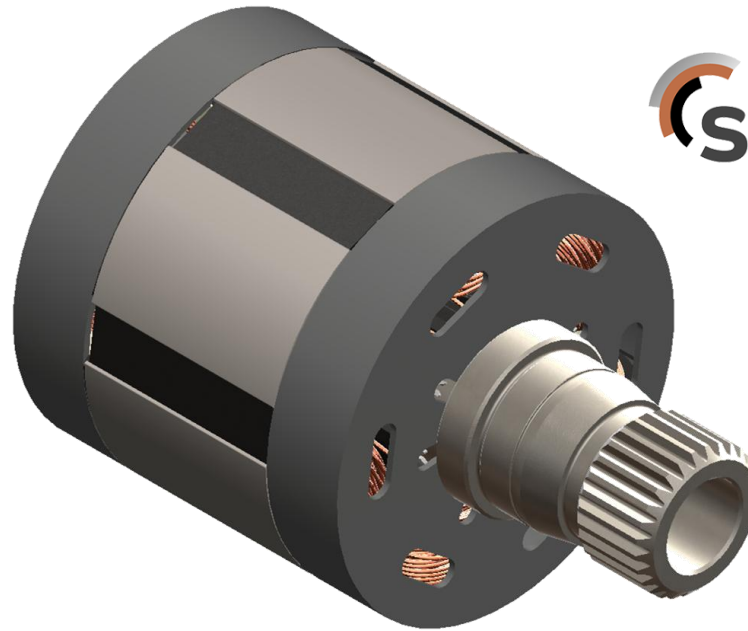


SCALE-UP
E-DRIVE

Objective and consortium



MARSILLI



Mubea



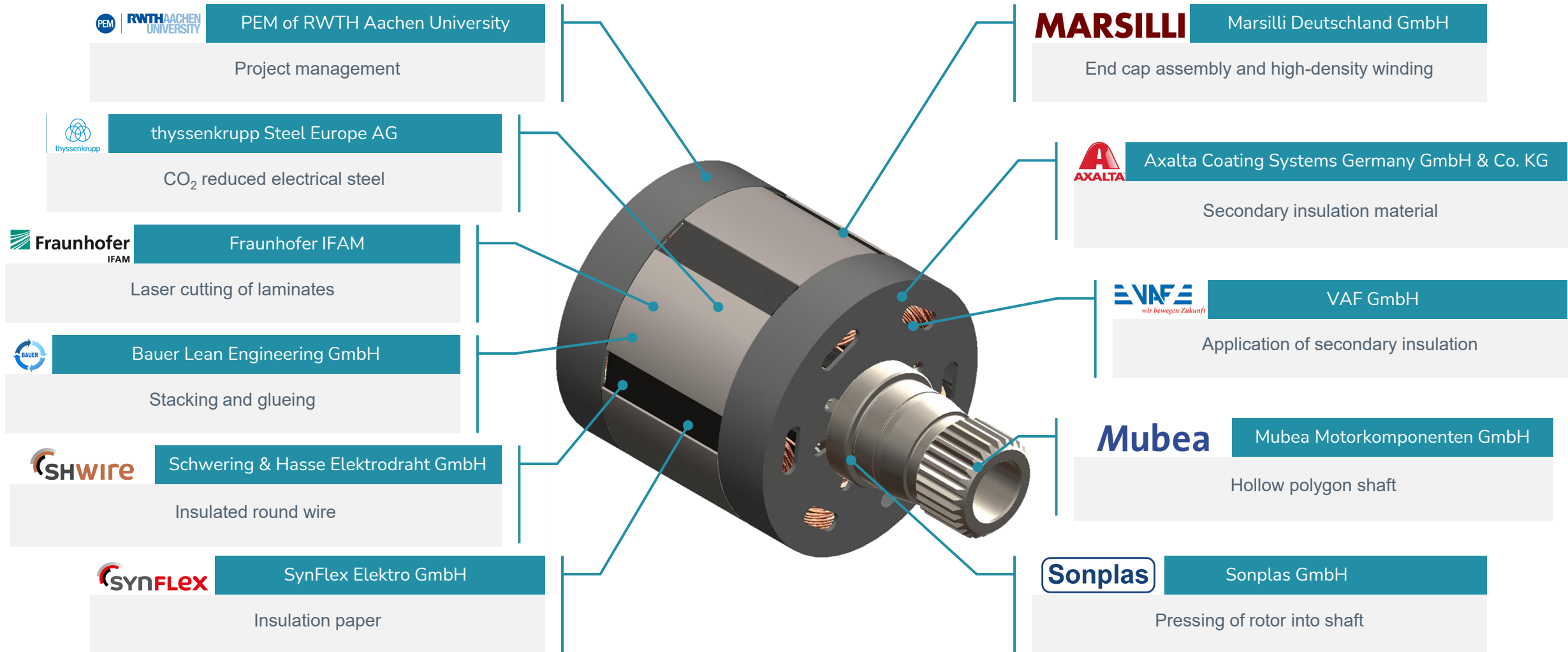
Objective

Design of a **rotor technology demonstrator** using **innovative materials** and **processes** in a **specialized consortium**, enabling **accelerated prototyping**.

Consortium Study – “Innovative Materials in Electric Motors”



Overview of the consortium’s contributions



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Materials and Production Processes

3

Overview of the Consortium

6

Project Lead Contact

Geometrical data of the Rotor Prototype



Key-data of the technology demonstrator



Active length:

70 mm

Outer diameter stator:

215 mm

Outer diameter rotor:

150 mm

Winding topology:

6 pole concentrated winding

Conductor material:

Copper

Conductor dimensions:

1,32 mm



Objective

The aim of the second iteration of the “Innovative materials in electric motors” technology demonstrator project is to **set up a technology demonstrator** for the rotor and stator and to **exhibit it again at the key trade fair Coiltech.**

Consortium Study – “Innovative Materials in Electric Motors”



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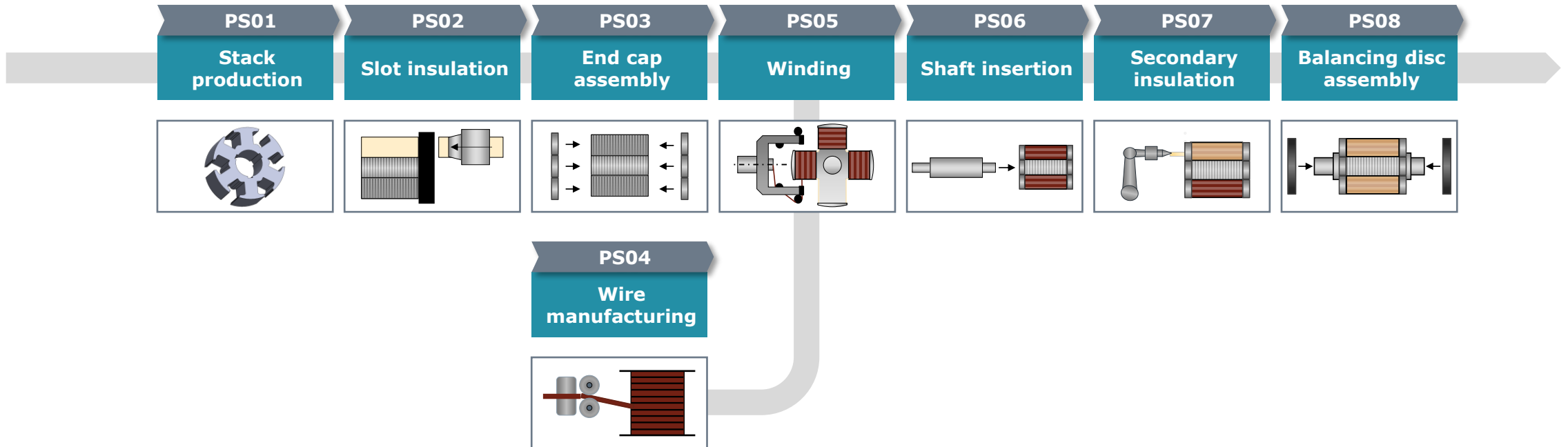
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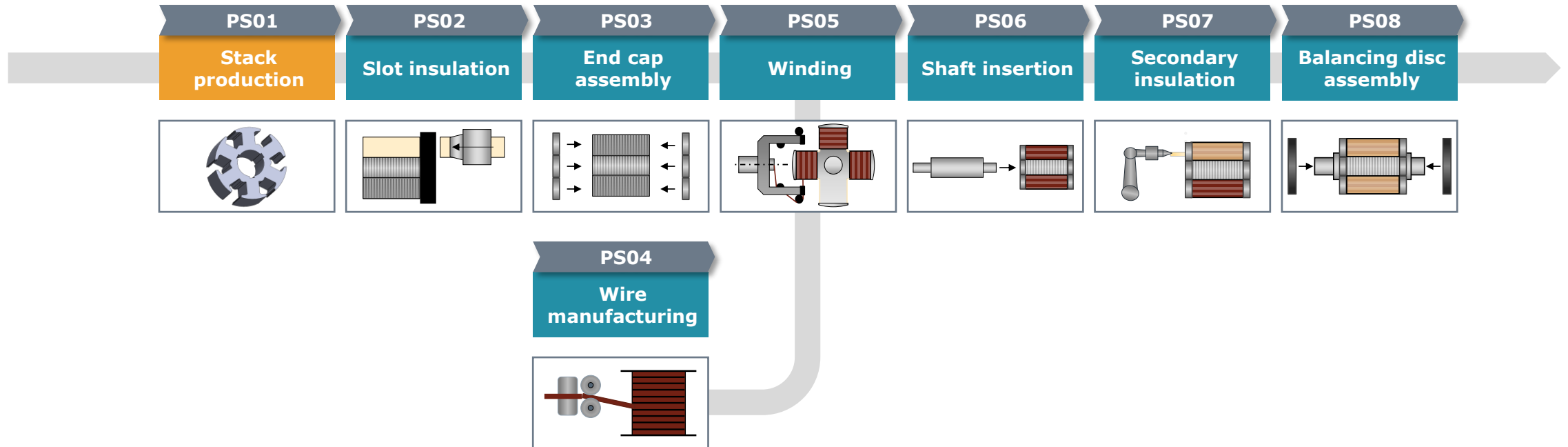
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Project Lead Contact

Process Chain for Rotor Demonstrator Manufacturing

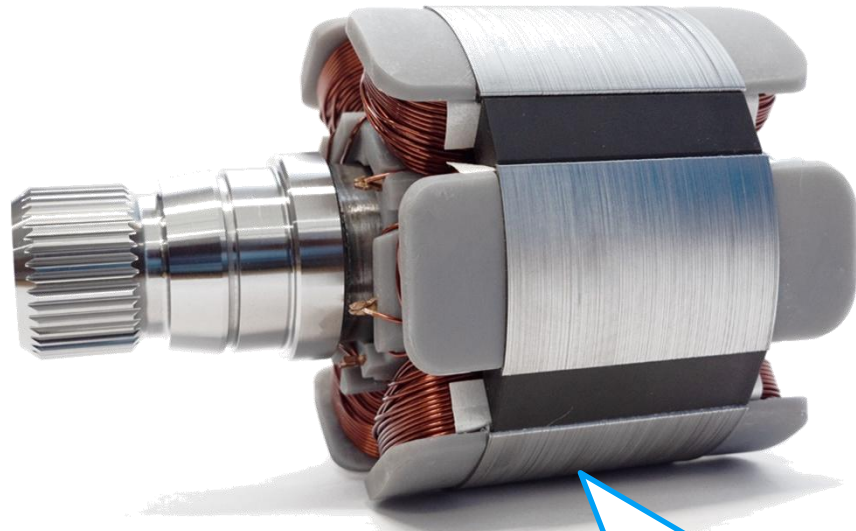


Process Chain for Rotor Demonstrator Manufacturing



Advanced NGO electrical steel - CO₂-reduced powercore®

thyssenkrupp Steel Europe AG, Duisburg, Germany



powercore® traction NGO
025-125Y420 - bluemint®

Contribution information:

- thyssenkrupp Steel is the largest flat steel manufacturer in Germany and leading supplier of non grain oriented (NGO) & grain oriented (GO) electrical steel in Europe
- Newly developed e-mobility top grade NGO 025-125Y420 with least possible power loss and high strength – ideal for high-efficient high-speed drives
- Maximum efficiency in the electric motor in combination with adhesive packaging systems based on application-oriented insulating varnish systems
- Maximum sustainability: available as CO₂-reduced steel - bluemint® recycled 25 corresponds to a scrap input of 25% in the blast furnace (mass balancing), up to 13% CO₂-savings compared to the conventional product achieved

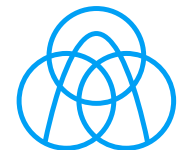


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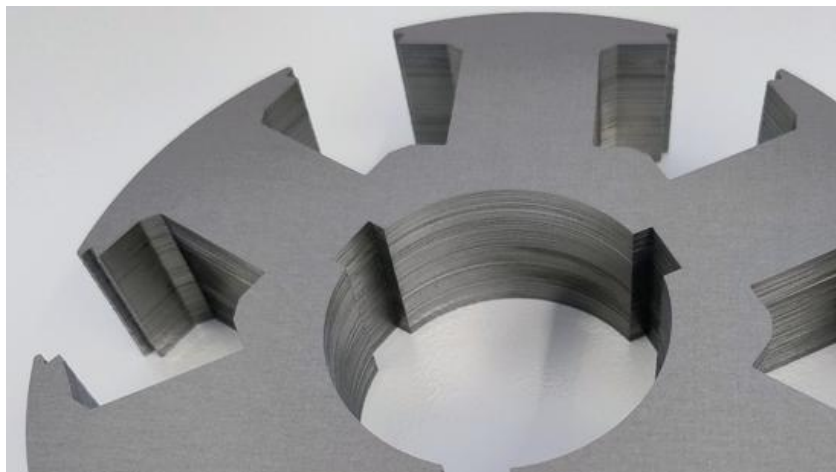


thyssenkrupp

Low Volume Stacking with Adhesive



BAUER Lean-Engineering GmbH, Vaihingen an der Enz, Germany



Contribution information:

- BAUER Lean Engineering is a solution provider for manufacturing technologies in the context of electrical steel processing and tool manufacturing
- In this project, BAUER Lean Engineering supported through the development of the stacking tooling, the glue application and subsequent stacking
 - Application of a product-specific matrix of adhesive dots to the laser-cut individual lamination and insertion into the stacking device
 - Stacking the required number of laminations until the stack height is reached
 - Closing the stacking device with a cover plate with tie rod
 - Heating of the entire device to approx. 100°C to activate the adhesive



Gerd Kücken

Sales / Project Management
BAUER Lean-Engineering GmbH

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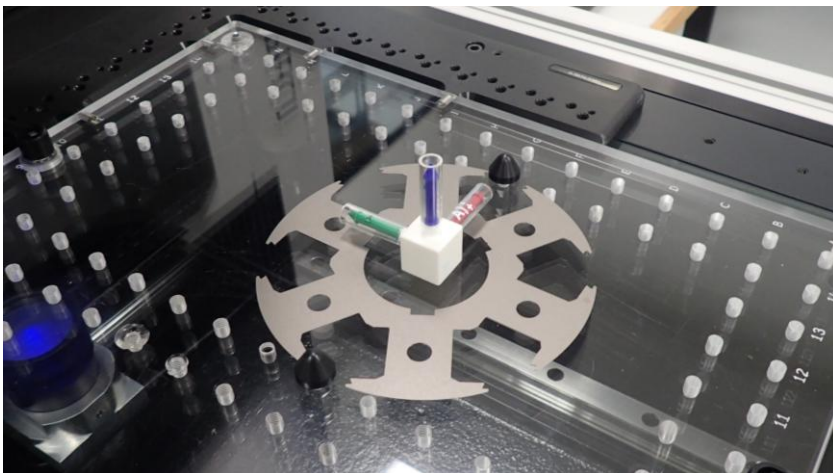
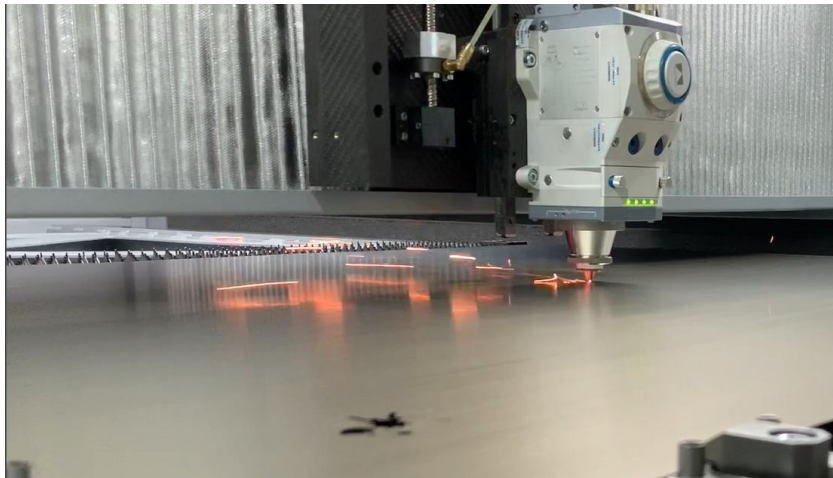
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Flexible laser cutting of electrical steel



Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Bremen, Germany



Contribution information:

- The Fraunhofer IFAM is one of Europe's most important independent research institutes in the fields of manufacturing technology and materials science
- The Electric Drives working group uses the existing competencies at Fraunhofer IFAM to further develop the transformation of development processes and manufacturing innovations for electric drives and thus offer the opportunity to carry out technology evaluation, technology transfer and the development and testing of drive concepts
- In the consortium study, Fraunhofer IFAM's expertise in the field of high-precision laser cutting for the manufacture of electrical steel laminations and production measurement technology for quality monitoring was utilized



Markus Hempel

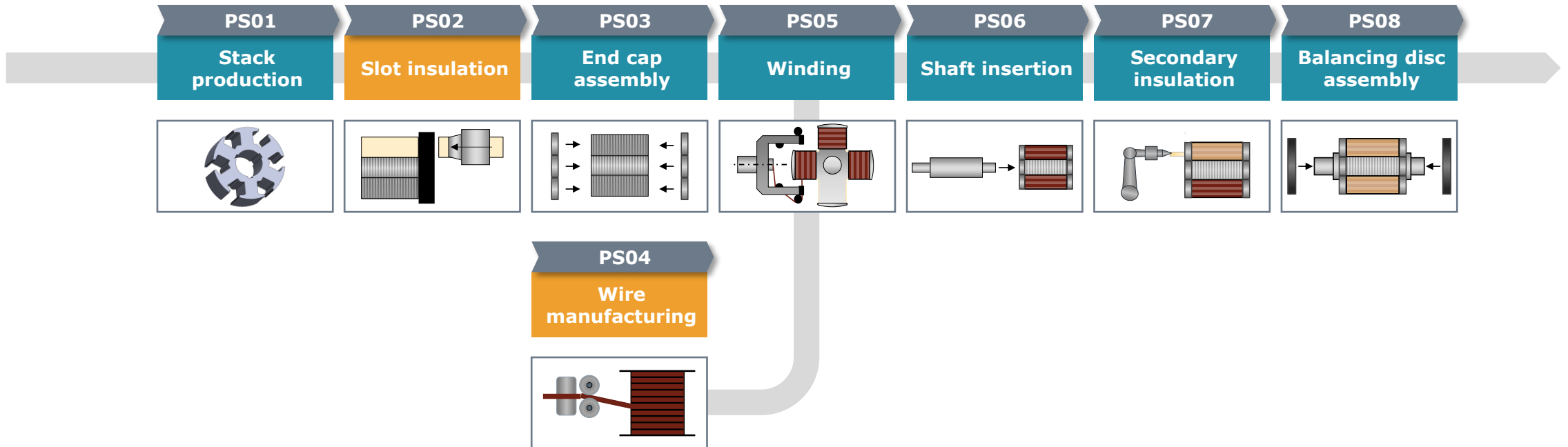
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Process Chain for Rotor Demonstrator Manufacturing



Slot insulation for Rotor

SynFlex Elektro GmbH, Blomberg, Germany



Contribution information:

- SynFlex Elektro is the system expert for the entire insulation system of electric motors, generators, transformers and complementary winding goods and battery systems with integrated products and services
- SynFlex supplied **SynTherm® APA/40 SI**, a newly constructed, surface-improved 3-layer slot insulation material, ideal for use in automated slot insulation.
- The PET-based laminate with aramid paper provides high mechanical strength and reduced abrasion, enabling smooth automated processing.
- A double-sided surface coating supports low-wear insertion during rotor slot insulation
- The insulation is used in rotor and stator windings and meets the thermal requirements of class H (180 °C)



Dr. Patrick Josephs

Head of Product Management
SynFlex Elektro GmbH

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Insulated round wire for rotor



SHWire (Schwering & Hasse Elektrodraht GmbH), Lügde, Germany



Contribution information:

- SHWire is the quality market leader for innovative flat and round magnet wires in Europe
- SHWire contributed its **SHXLife® 220 Round** wire – a newly developed enamelled wire designed for extended lifetime under inverter-driven conditions
- The advanced enamel system is designed to withstand high-voltage stress and rapid voltage changes typical of inverter-driven environments
- Thus, SHXLife® 220 Round offers high partial discharge resistance, ensuring significantly longer lifetime under demanding operating conditions
- This allows reduced insulation thickness for optimized slot fill and efficient winding.



Fabian Radeck

Head of Product Management
SHWire, Schwering & Hasse Elektrodraht GmbH

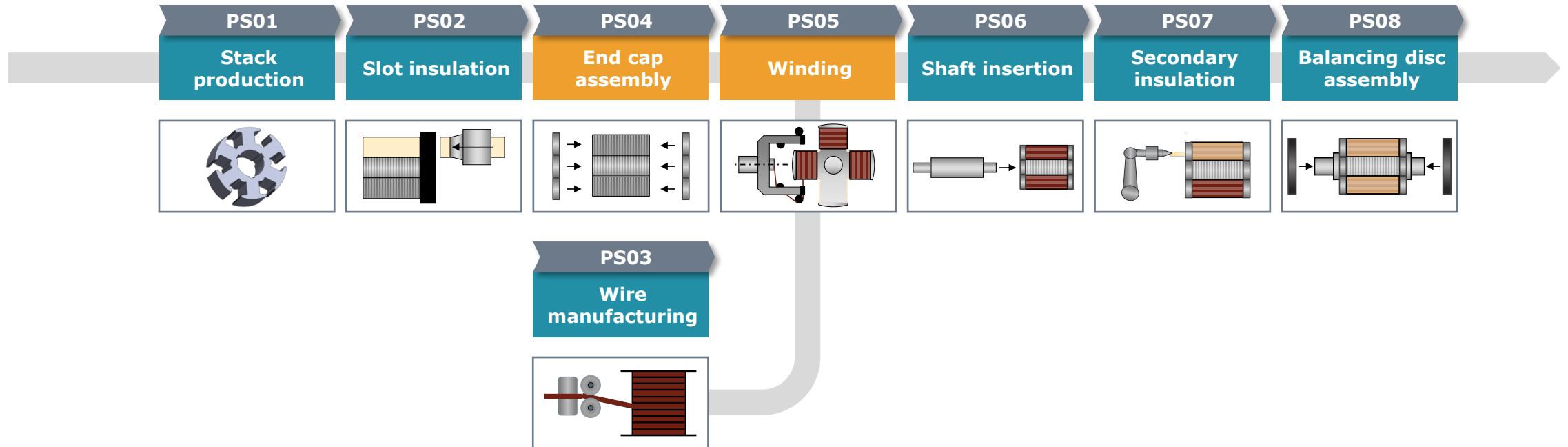
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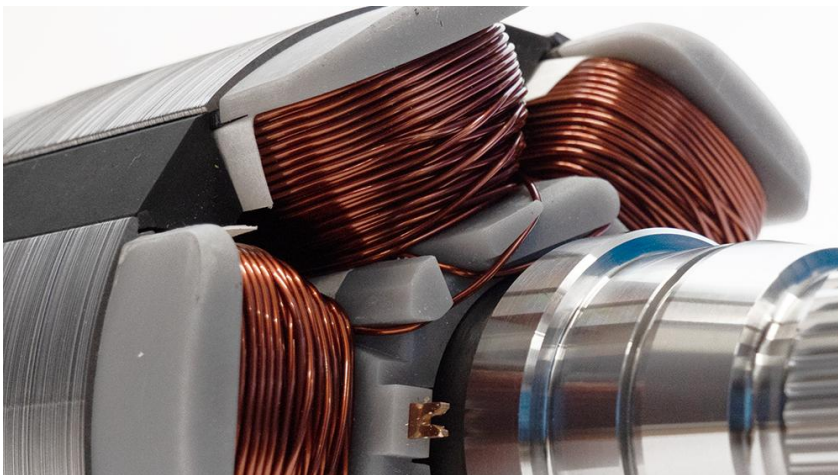
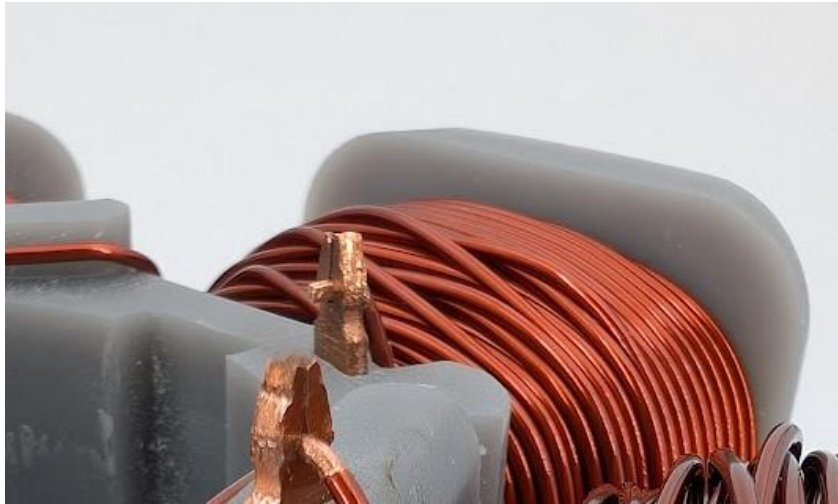
Magnet Wires
Part of SynFlex Group

Process Chain for Rotor Demonstrator Manufacturing



High density round wire winding

Marsilli Deutschland GmbH, Karlsruhe, Germany



Contribution information:

- Marsilli Deutschland GmbH contributes as the German subsidiary of Marsilli S.p.A. Marsilli S.p.A is the leading supplier of winding equipment for e-mobility, automotive auxiliary and industrial drives/coils
- Marsilli contributed with Co-Engineering regarding process design and Lab testing for EESM solutions on serial like equipment
- Newly developed e-mobility winding machine RoMa | NeW and serial manufacturing equipment for EESM Rotors was used for the shown demonstrator



Christoph Kaden

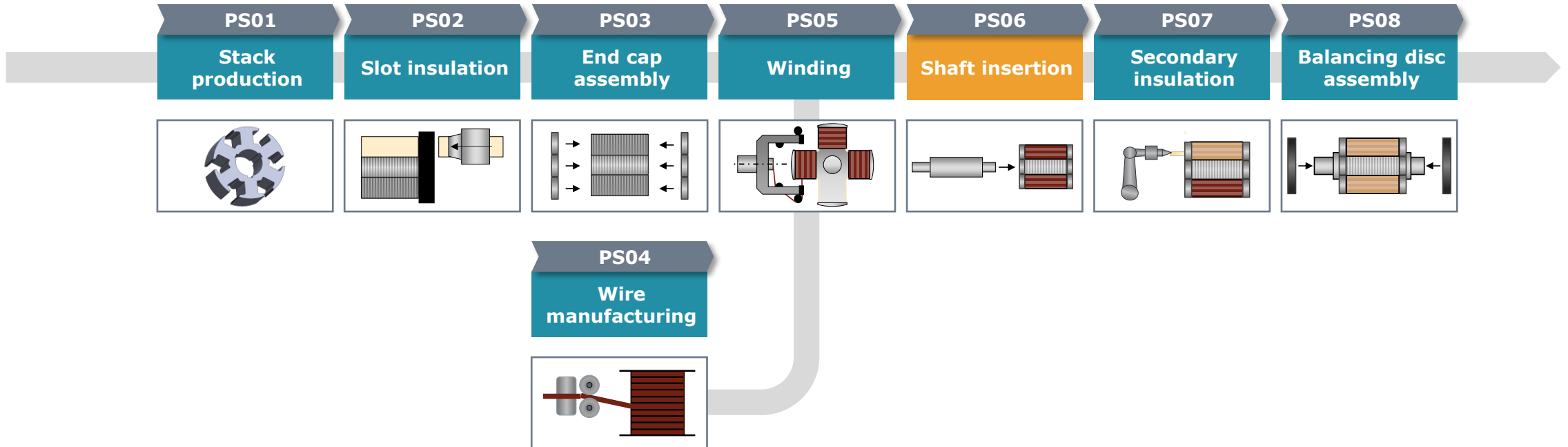
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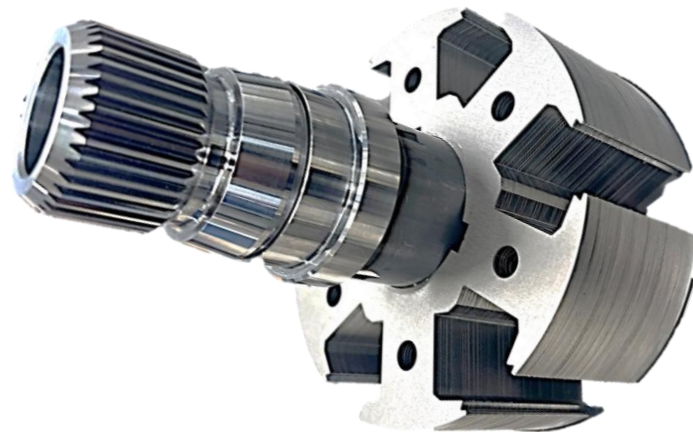


Process Chain for Rotor Demonstrator Manufacturing



Flexible rotor shaft for electric drives

Mubea Motorkomponenten GmbH



Contribution information:

- Mubea is an automotive supplier with about 20,000 employees, producing automotive lightweight components for chassis, body and powertrain on 54 locations worldwide
- In the consortium study, Mubea developed and produced flexible rotor shafts, which enable a secure and easy assembly as well as performance improvement
- Customer benefits:
 - Lower assembly cost by elimination of thermal processes or form-fit elements
 - Improved power density by higher rpm (> 20,000 rpm)
 - Simplified disassembly for recycling or refurbishing



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Press joining of wound rotor & shaft

Sonplas GmbH, Straubing, Germany



Contribution information:

- Sonplas GmbH is a solution provider for special purpose machines in the field of electric drivetrains, among many others
- Provided services include process development as well as support in prototype assemblies
- In the scope of this study, Sonplas GmbH supported by press fitting the flexible rotor shaft into the wound rotor stack



Dr. Johann Peer

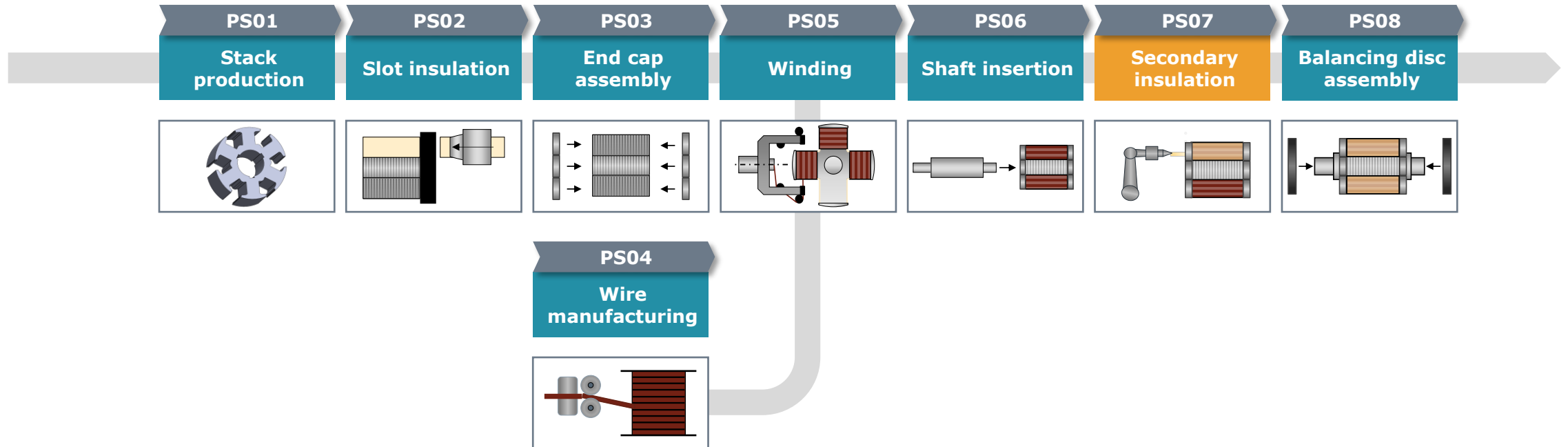
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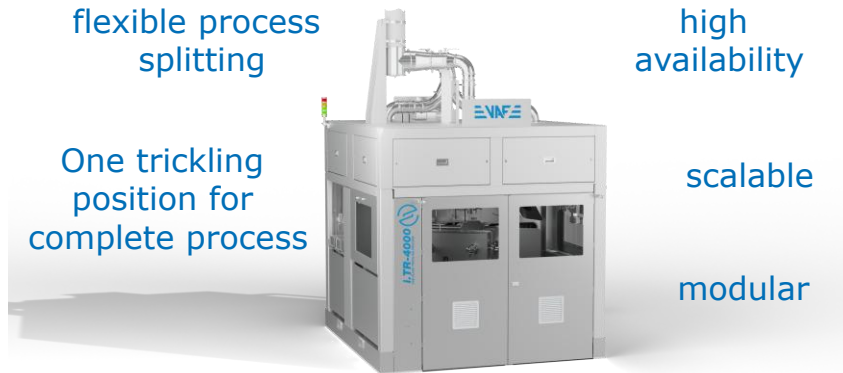


Process Chain for Rotor Demonstrator Manufacturing



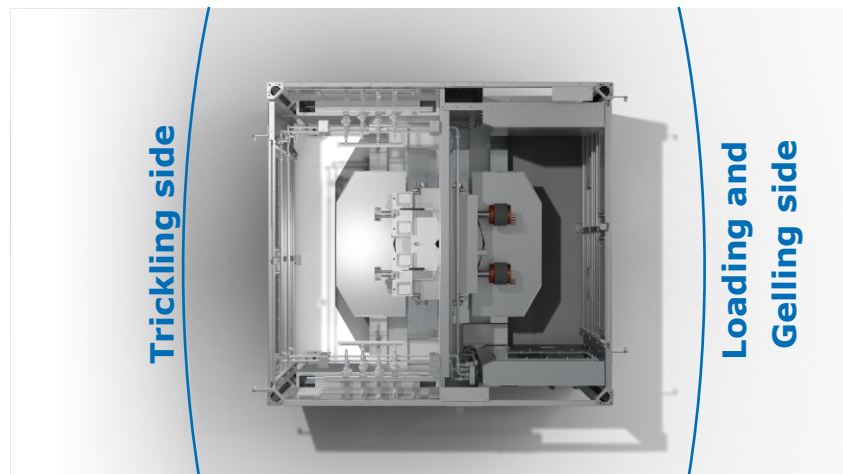
Rotor impregnation – i.Tr-Serie

VAF GmbH, Bopfingen, Germany



Contribution information:

- VAF is a special machine manufacturer for assembly lines. These include production lines for electric motors including impregnation systems, battery assembly lines and lines for hydrogen applications.
- For impregnation applications, VAF uses the laboratory facilities for trickling and dipping. Process optimizations are carried out and materials are qualified.
- In this project we supported with our expertise in the field of impregnation
- Compact trickling module with different size options that splits process into two sides
- Flexible process design with heating, trickling, intermediate gelling and gelling in one module without reclamping, offering best traceability of the trickling process thanks to an uninterrupted trickling position and high availability and adaptation to fluctuating quantities by switching off or autonomous operation of individual modules



Matthias Fischer

Development
VAF GmbH

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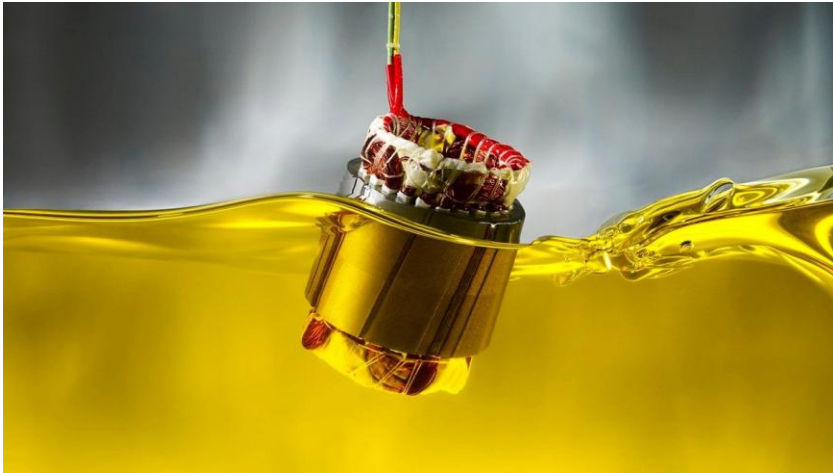
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Insulation Materials for High Performance E-Motors



Axalta Coating Systems Germany GmbH & Co. KG, Wuppertal, Germany



Contribution information:

- Axalta Coating System is a global supplier of impregnating materials, wire enamels and electrical steel coatings with manufacturing locations on all relevant continents.
- Core competence of Axalta are tailor-made products for individual customer applications and offering a broad range of standard products for industry sectors
- Latest developments inside Axalta's impregnation portfolio focus on enhancing:
 - thermal conductivity: Voltatex® 4224, up to 20 % temperature reduction
 - reduced CO₂ footprint: Voltatex® 4204, 38 % based on renewable materials



Thorsten Heinrichs

Product Specialist E-Mobility Energy Solutions
Axalta Coating Systems Germany GmbH & Co. KG

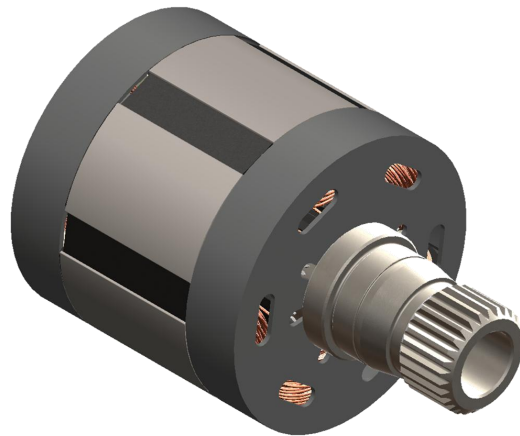
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Balancing disc / Project management

PEM RWTH Aachen University, Aachen, Germany



Contribution information:

- PEM RWTH Aachen is a research institute for production engineering of e-mobility components, with a research group focused on electric drive production
- The team at PEM was responsible for project ideation, overall project management as well as the marketing strategy
- Within the project, PEM contributed to the rotor design
- The balancing discs were 3D printed at PEM RWTH Aachen



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4

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2

Motivation for the Study

5

Materials and Production Processes

3

Overview of the Consortium

6

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SCALE-UP
E-DRIVE

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