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SUSMAGPRO
SUSTAINABLE RECOVERY, REPROCESSING AND REUSE OF RARE-EARTH MAGNETS IN THE CIRCULAR ECONOMY

VALOMAG SEMINAR
6. December 2022
TU Delft, NL

SUSMAGPRO

Sustainable Recovery, Reprocessing and Reuse of Rare Earth Magnets in a Circular Economy

VALOMAG Seminar
6th December 2022, TU Delft

Boris Saje, Kolektor,
Prof. Dr. Carlo Burkhardt, Pforzheim University
(Coordinator SUSMAGPRO)

SUSMAGPRO has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821114.

SUSMAGPRO

- SUSMAGPRO is an industrialisation project **developing and demonstrating innovative pilot plants at TRL 6-7 for the clean and sustainable recycling of permanent magnets from secondary EoL sources in Europe**

Duration	1.6.19-30.05.23
Total budget	14,741,539 €
Funding	12,977,446 €

H2020 Call **CE-SC5-07-2018-2019-2020** on Raw materials innovation for the circular economy: Sustainable processing, reuse, recycling and recovery schemes, specifically part **b) Recycling of raw materials from end-of-life products**.

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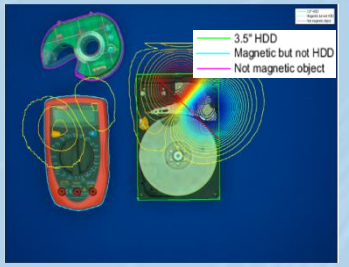
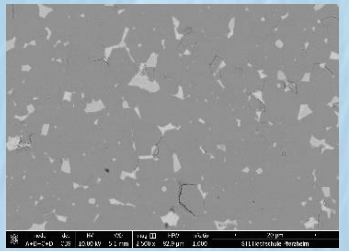
SUSMAGPRO: Concept and Approach

- Applications containing Nd-Fe-B magnets are identified, the components containing Nd-Fe-B magnets are separated from the waste stream
- After separation, the magnets are removed from the housings, glues, mechanical fixtures and coatings
- The magnets are recycled using the IP-protected HPMS short cycle processing route (extracting and re-processing the Nd-Fe-B as an alloy), leading to significant energy and cost savings compared to chemical or pyrometallurgical recycling
- The recycled material is re-processed into new magnets by four different manufacturing routes





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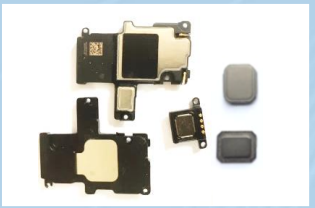
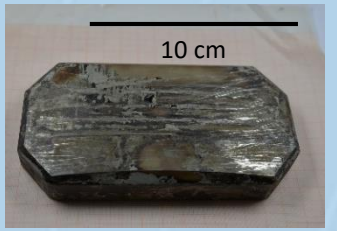
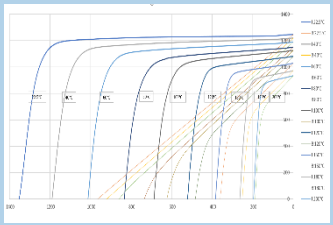
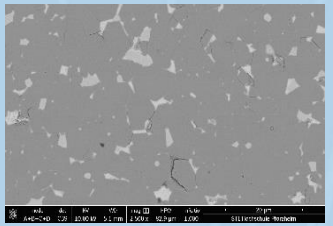
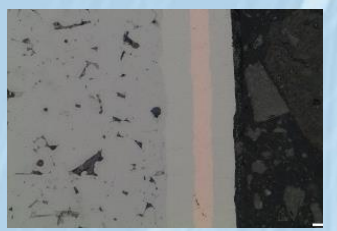
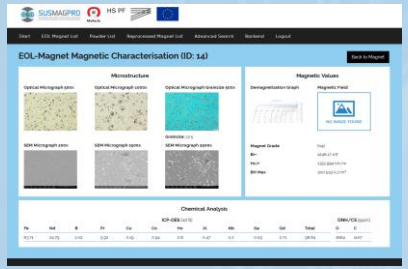
SUSMAGPRO: Assessment of scrap

- So far, over 150 applications have been dismantled and analysed for re-cyclability
- Parameters I: Accessibility, fixation, contaminations […]
- Parameters II: Magnetic properties, microstructure, coatings, chemical composition
- Compilation of a comprehensive database







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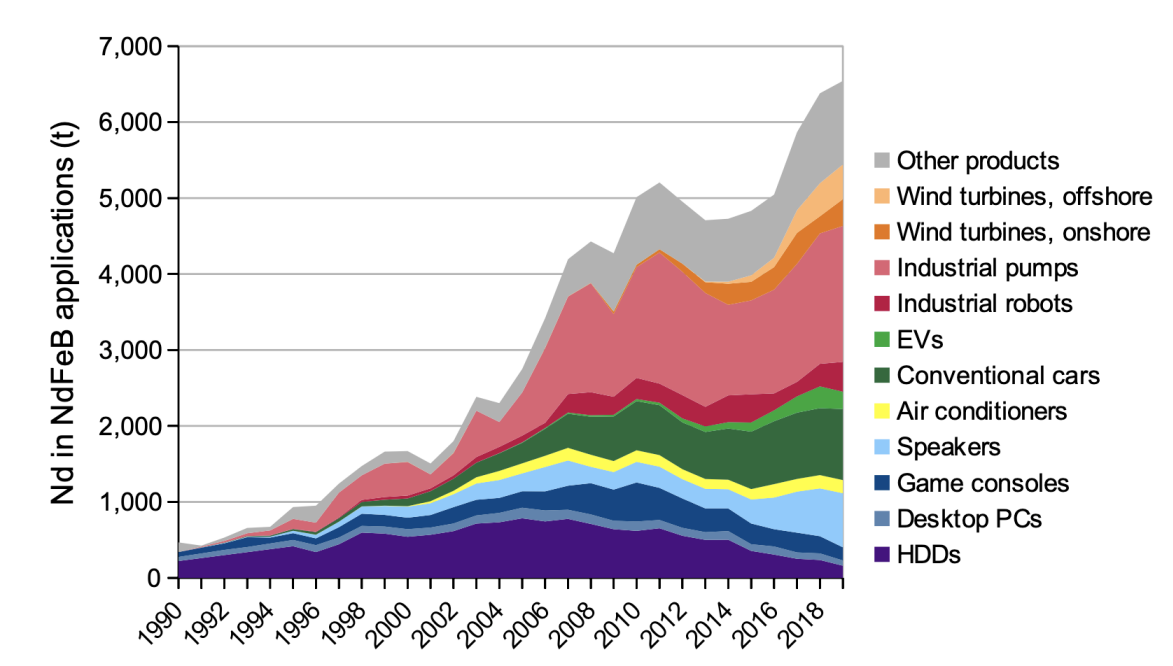
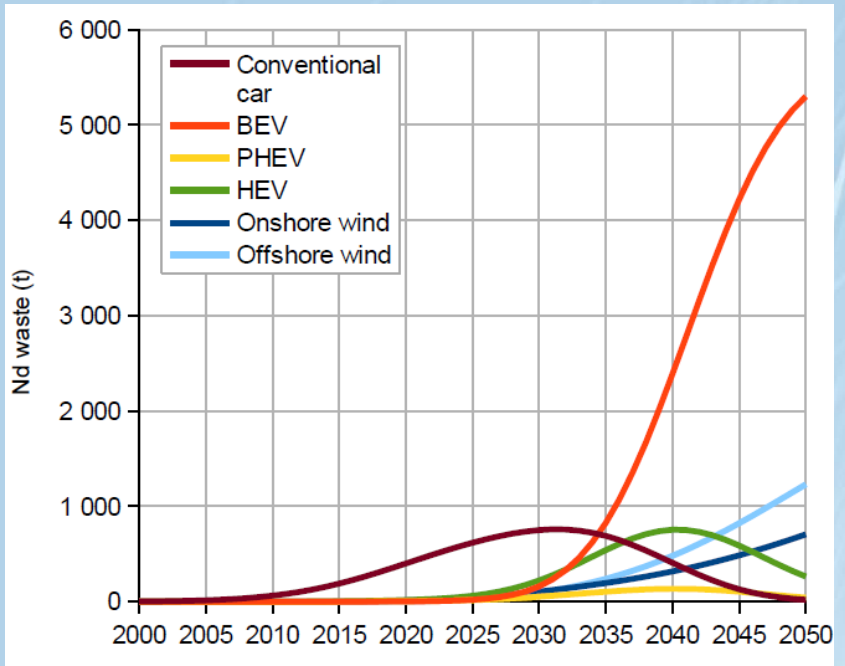
SUSMAGPRO: Assessment of scrap

- Analysis Nd Material flow trends for application types in EU-28 as basis for LCA and TEA





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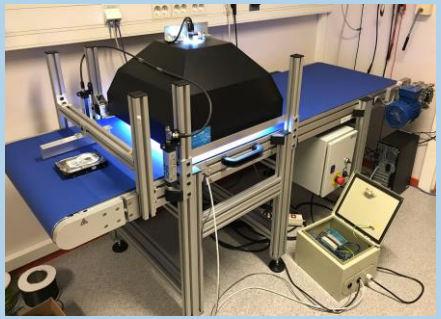
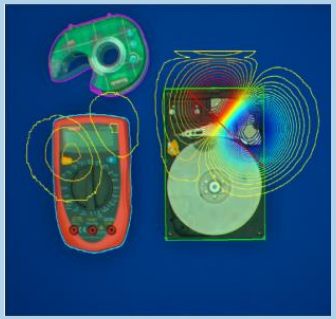
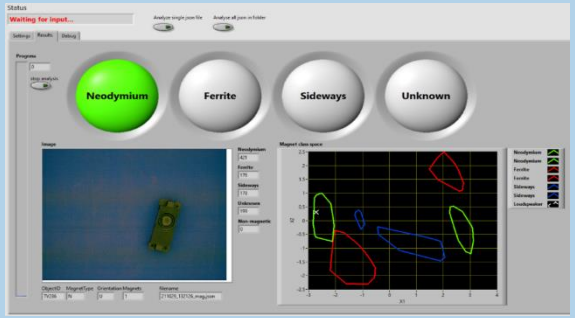
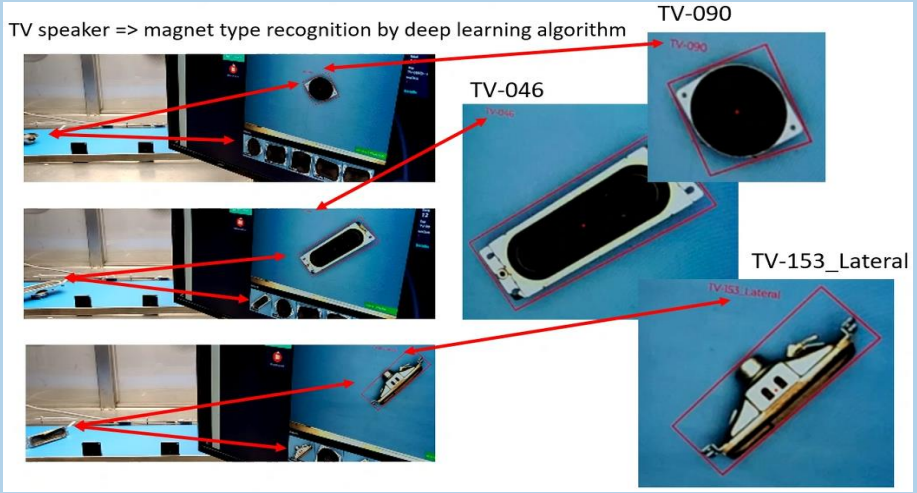
SUSMAGPRO: Automated disassembly

- Design and assembly of pilots for disassembly and magnets extraction









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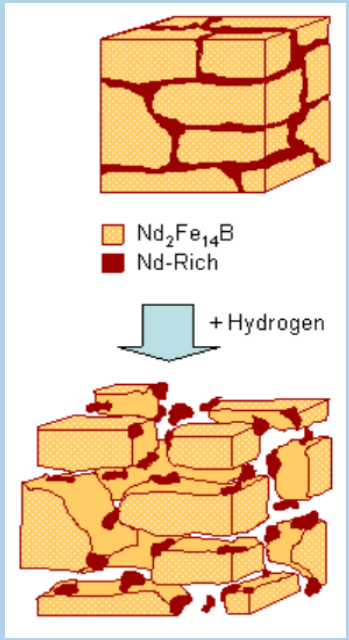
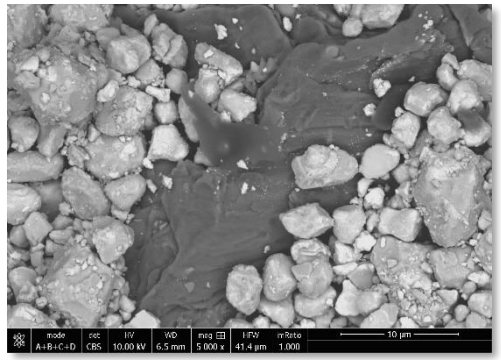
SUSMAGPRO: Recycling

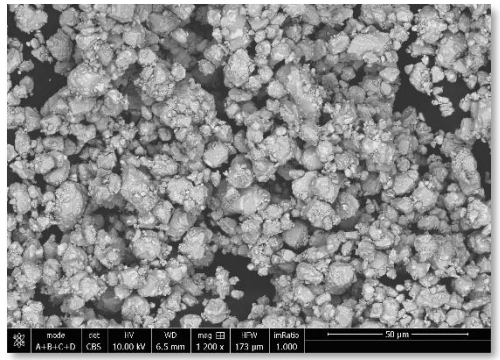
- The HPMS short-loop recycling



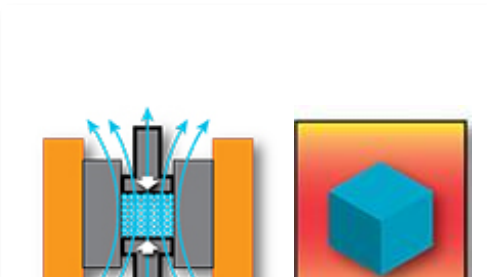
1 HPMS*

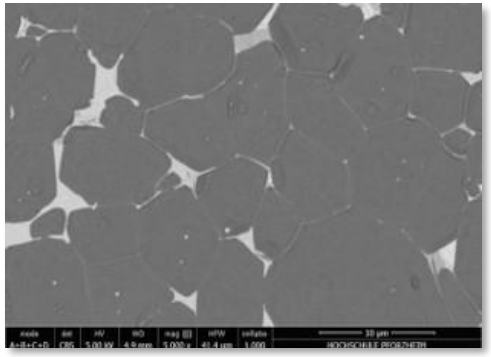


2 Removal of Residues



3 Re-Sintering





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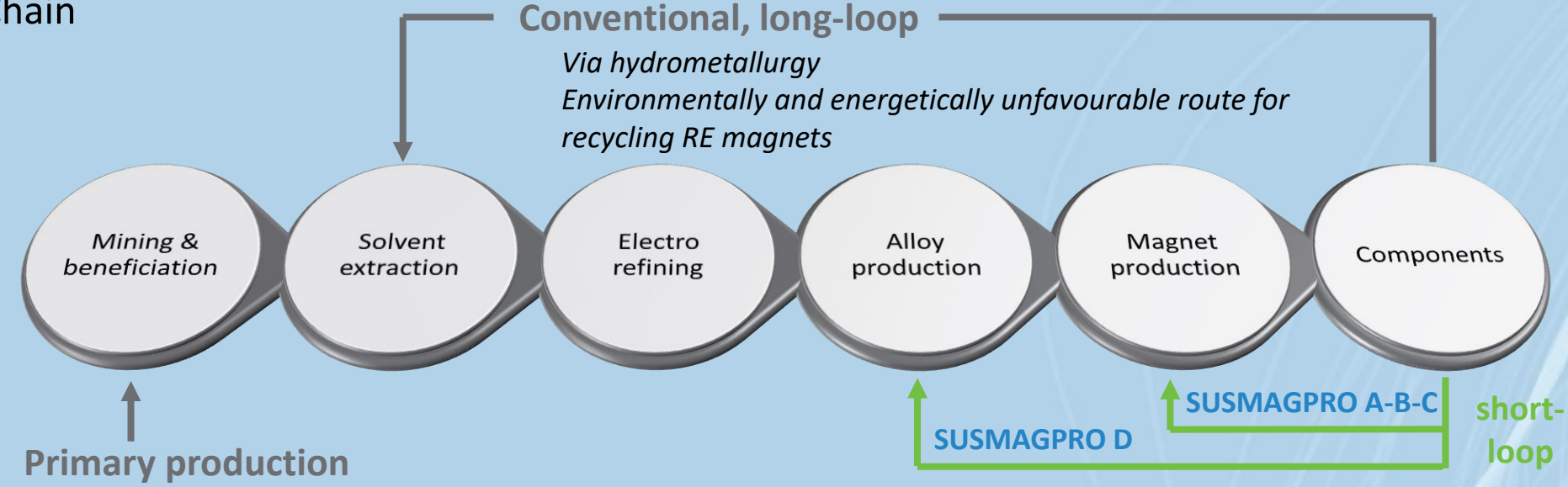
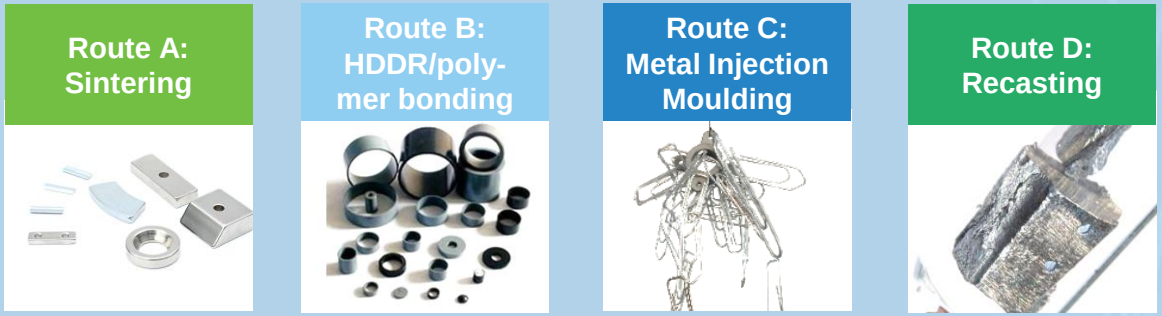
SUSMAGPRO: Processing

- Value Chain





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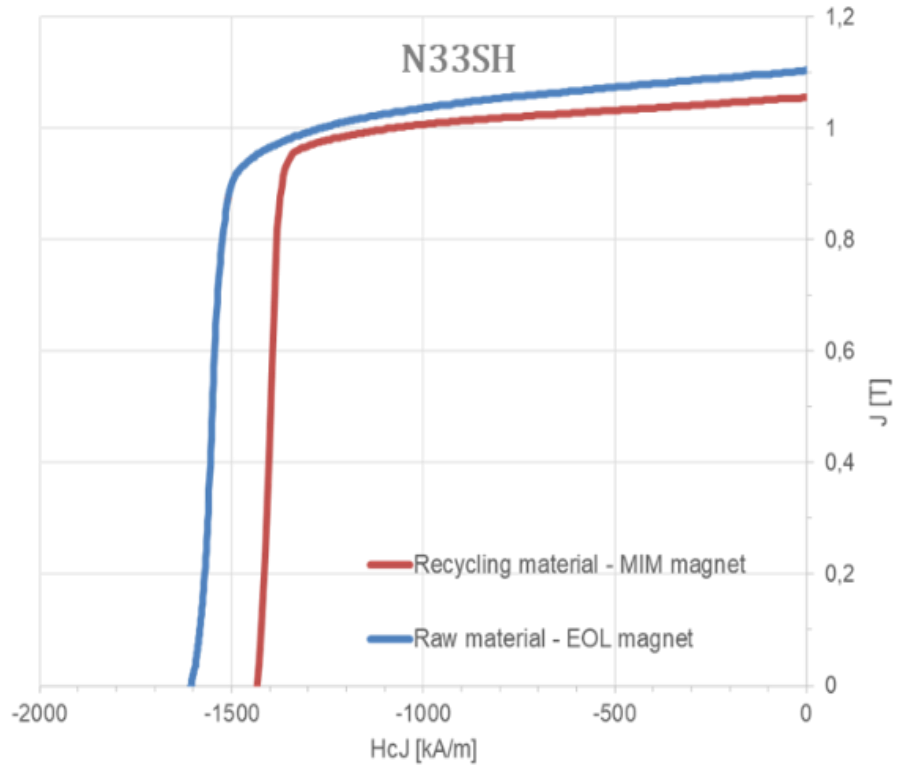
SUSMAGPRO: Magnets production

- Working on a new processes for metal injection and extrusion of sintered net-shape magnets (Route C)

Partner MIMplus develops a process to produce net-shape magnets without need of afterworks (eroding, grinding)

Photo by MIMplus Technologies



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SUSMAGPRO: Magnets production

- Working on a new processes for metal injection and extrusion of sintered net-shape magnets (Route C)

Partner Pforzheim University develops a high-output process to produce anisotropic, net-shape magnetic profiles for motor and generator applications

Photo by MIMplus Technologies

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SUSMAGPRO: Magnets production

- Recasting for purification (Route D)

Partner LCM recasts HPMS powder from contaminated magnets to remove the impurities as slag.
The purified material can be used for re-manufacturing of high performance magnets

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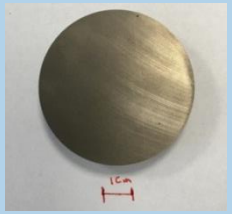
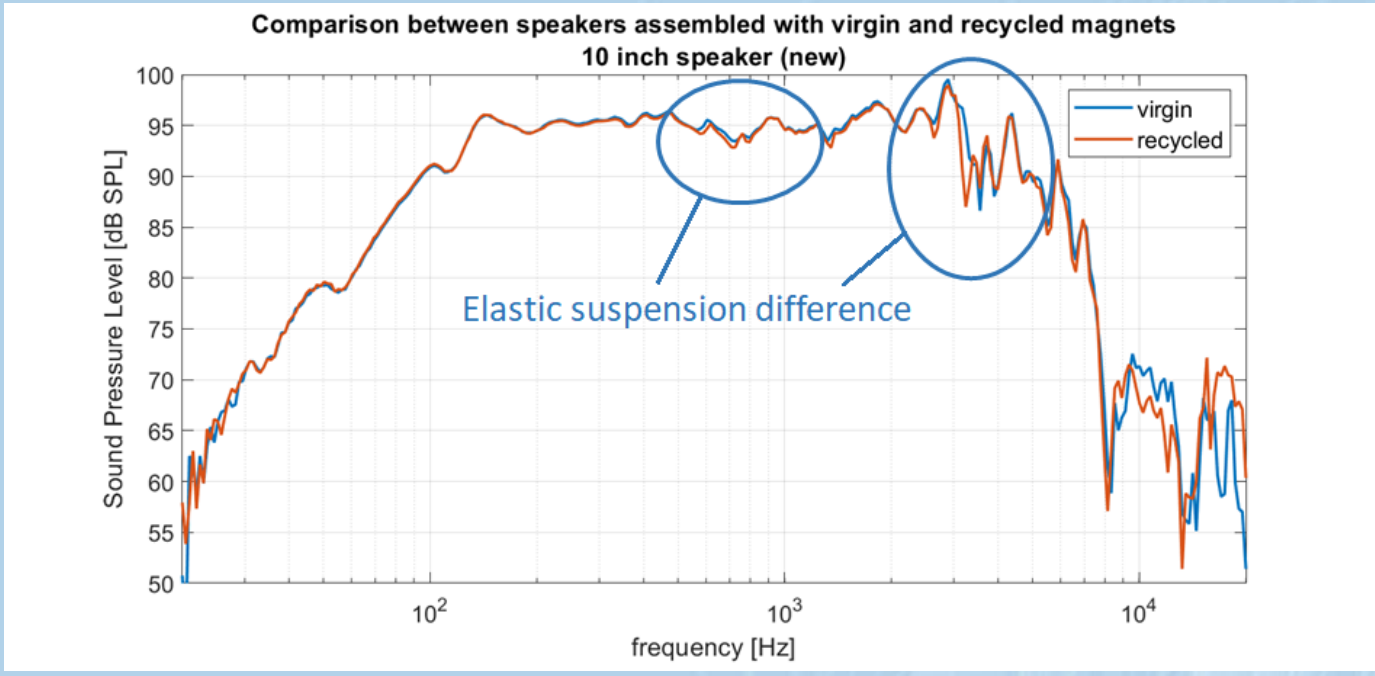
SUSMAGPRO: Demonstrators

- Demonstrators for loudspeaker applications



B_r: 1.23 T
H_{cj} : 1320 KA/m



In the audiolab, no performance differences could be detected between new and recycled magnets.

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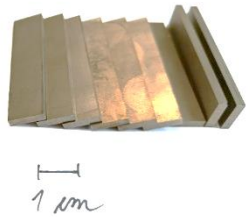
SUSMAGPRO: Demonstrators

- Currently, demonstrators of heating pumps, traction motors and sensors are assembled for test bench performance comparisons

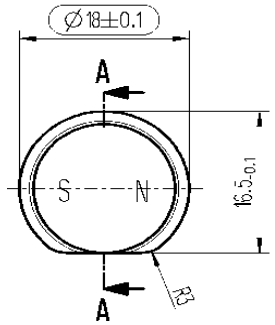
Heating pump demonstrator;

Partners Grundfos and Magneti



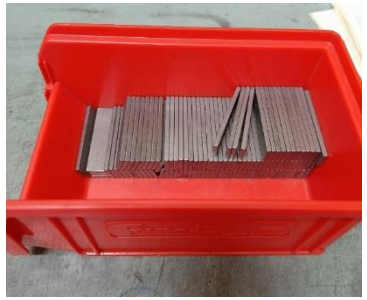
Sensor demonstrator;

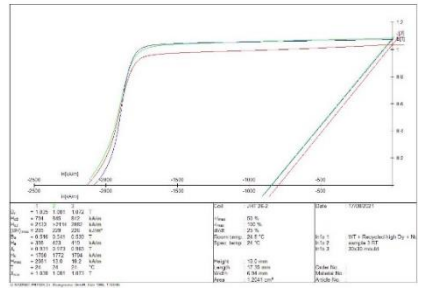
Partners ZF and MIMplus



Traction motor demonstrator;

Partners ZF and University of Birmingham





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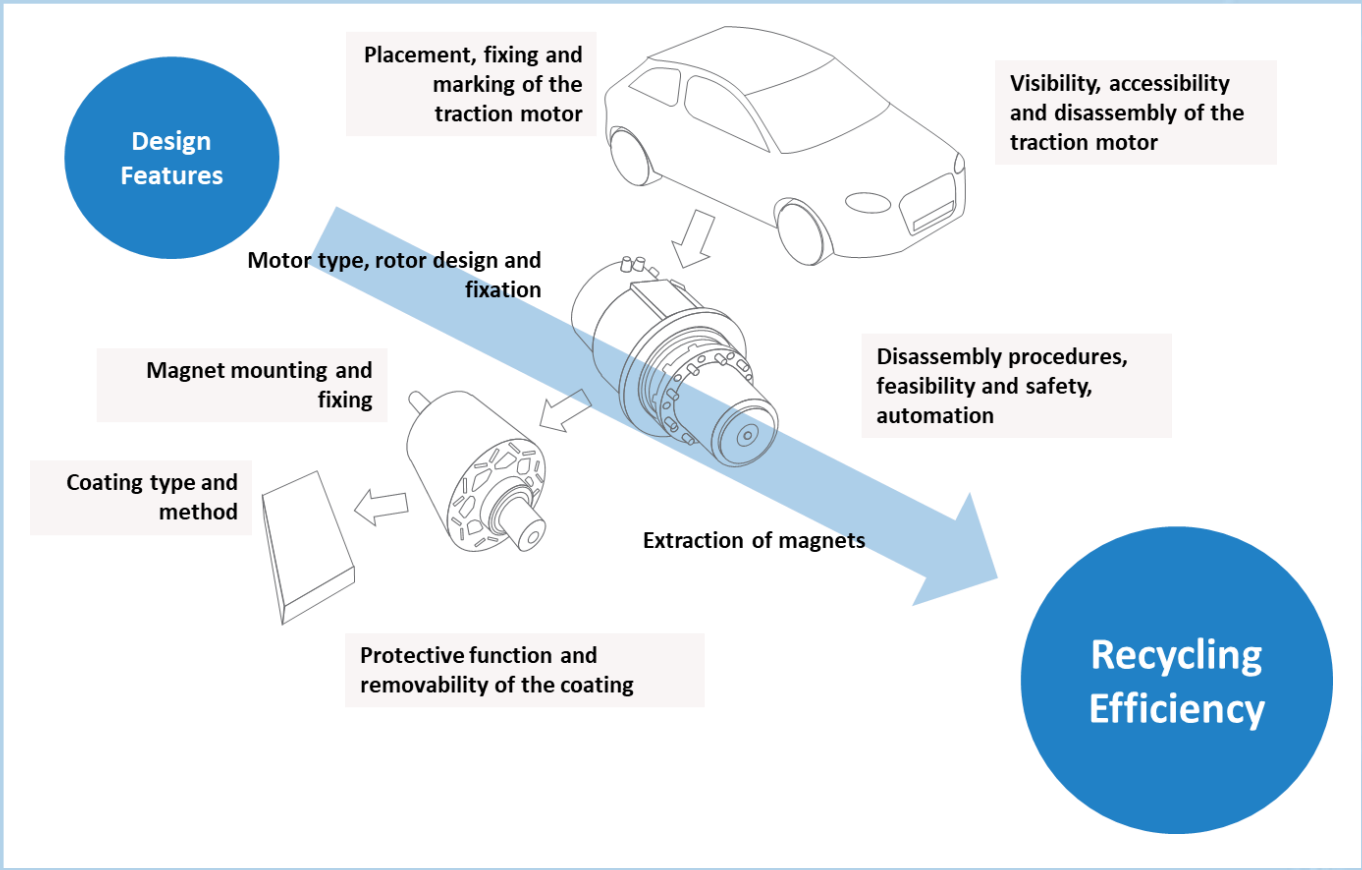
SUSMAGPRO: Design for recycling

- Working on ideas for better recycling of magnets from key applications



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SUSMAGPRO: Roadshow

- Working on ideas for better recycling of magnets from key applications

Past…

1. Slovenian Researchers Night, Dec 2020
2. Pforzheim City Museum, Dec – May 2021
3. Pforzheim University, Sept 2021
4. Ljubljana, Open Door Day Jožef Stefan Institute, March 2022
5. Leiden City of Science, June 2022

Upcoming…

6. Karlsruhe, Science Festival Effekte, Jan 2023
7. Ljubljana, Science on the Street, May 2023
8. Ellesmere Port, Less Common Metals, Sept 2023
9. University of Birmingham, REPM, Sept 2023
10. TBD: Strasbourg or Brussels, 2023

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EU Raw Materials Week
14.-18. November 2022
Le Plaza Hotel, Brussels

Thank you very much for your kind attention!

Prof. Dr. Carlo Burkhardt, Pforzheim University
(Coordinator SUSMAGPRO)

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https://susmagpro.eu

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