

The main impact that MagNEO project aspires to achieve is to replace Rare Earth Elements (REE) for Permanent Magnet (PM) production with REE-free AlNiCo (Aluminium, Nickel, Cobalt) alloys which are most promising due to their higher coercivity at elevated temperatures and develop new recycling strategies. In addition, that is going to reduce Europe's dependence on unstable markets and it will be an extra push for the attainment of green transition.

Project

The MagNEO project will develop new alloy material for permanent magnets, which is REE-free and also develop recycling strategies to allow an efficient reuse of alloys. In addition, MagNEO project will contribute to transition towards renewable energy sources and sustainable mobility. That is going to be achieved with the performance enhancement of AlNiCo and other similar alloys which can be used as materials of PM on batteries for relevant energy and transportation applications as most promising due their higher coercivity at elevated temperatures.



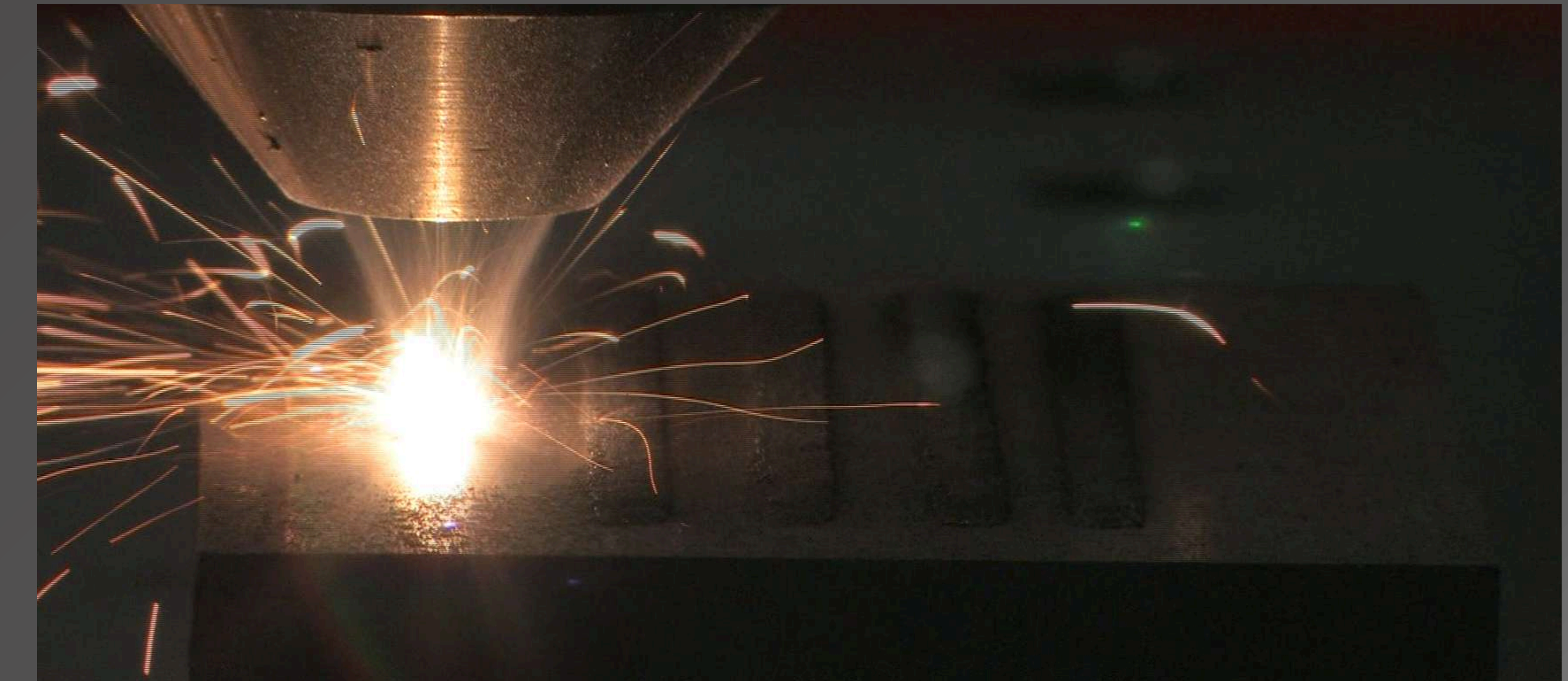
Objectives

- 1 Design and develop three novel magnetic AlNiCo and High Entropy Alloy (HEA) compositions suitable for Additive Manufacturing (AM).
- 2 Develop a multiscale methodology to select compositions and microstructure with optimized fraction.
- 3 Establish and optimise Powder Bed Fusion - Laser Beam (PBF-LB) process parameters and build strategies to process REE-free PMs with controlled grain alignment and orientation due to imposed high thermal gradients.
- 4 Pilot scale production of new AlNiCo and HEA magnets.
- 5 Ensure environmental sustainability by performing a thorough life cycle assessment.
- 6 Ensure economical sustainability by performing Technoeconomic Analysis for manufacturability and production value-chain sustainability.

Methodology

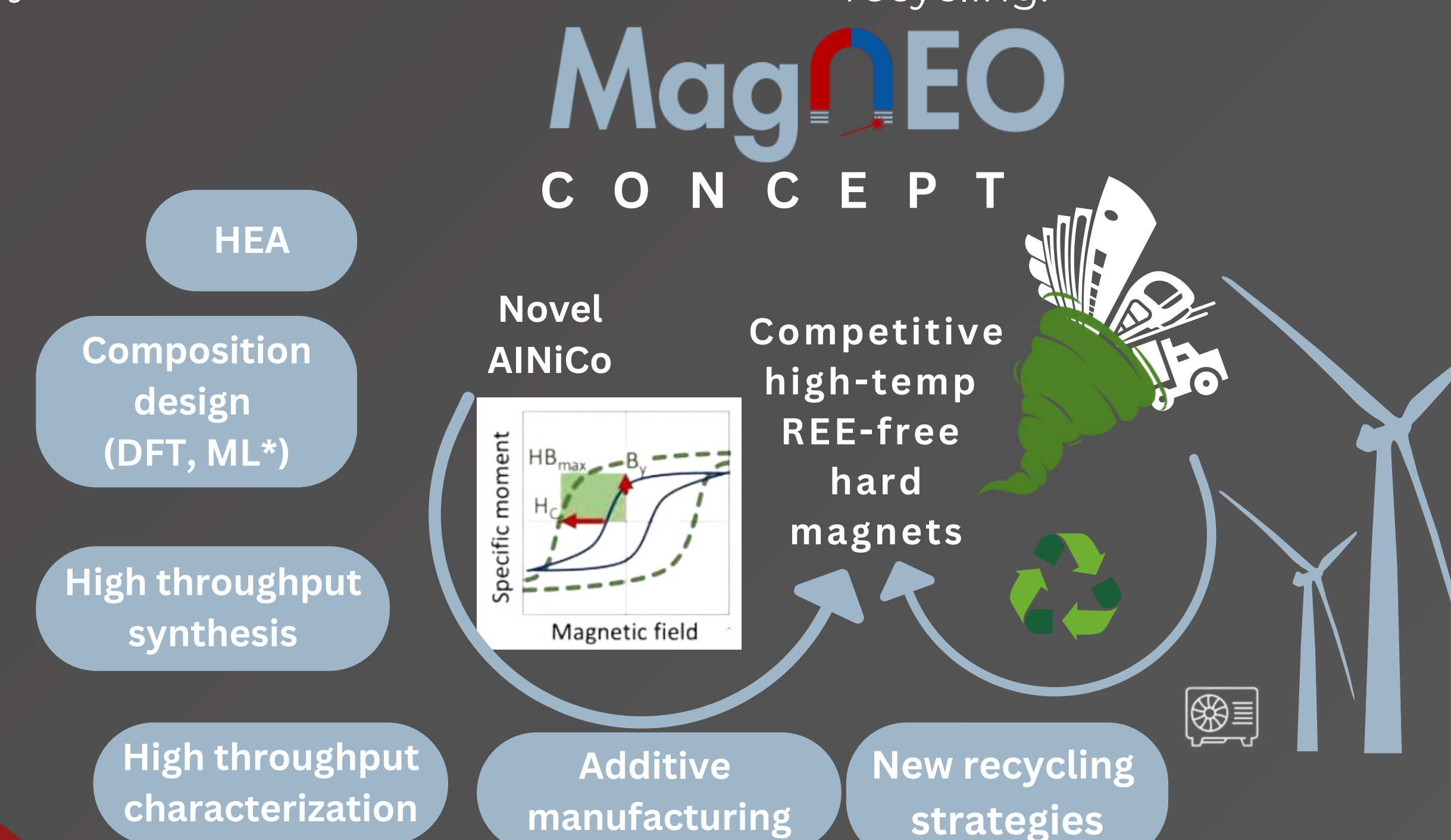
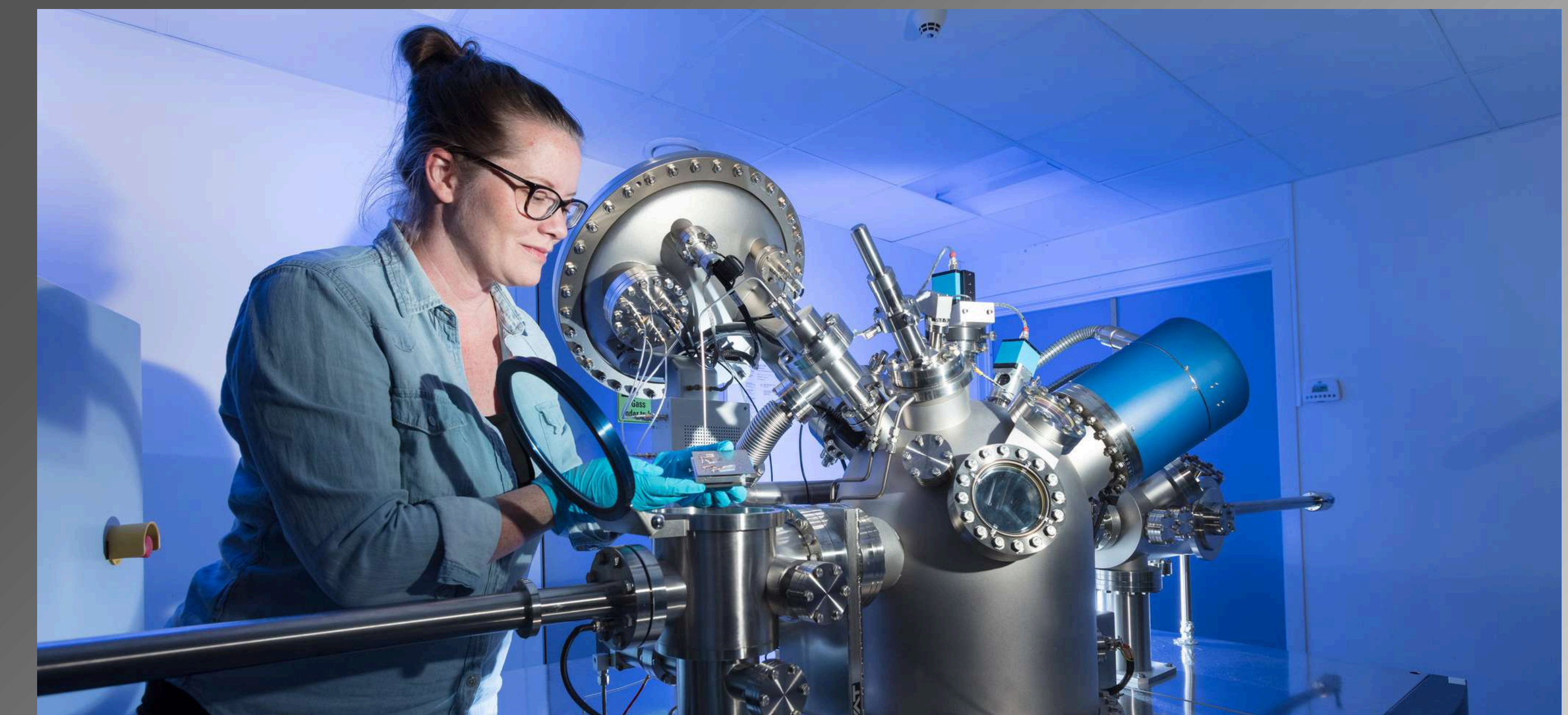
MagNEO methodology is built upon six inter-connected main pillars.

- 1 Replicate this exceptional performance for AlNiCo-5 through AM at both laboratory and industrial scales.
- 2 High-throughput experimental screening will be performed via arc melting.
- 3 Process modelling activities of advanced powder atomization, AM-induced microstructural and process modelling, as well as design via topology and Multiphysics optimization.
- 4 Lab Scale AM, processing conditions for PBF-LB and post heat AM treatment.
- 5 Industrial scale AM and post processing will be scaled up to 150 kg to produce demonstrator magnets $\leq 1\text{Kg}$ in weight and $\leq 350\text{ cm}^3$ in volume each, by large scale AM via PBF-LB.
- 6 Life Cycle Assessment / Technoeconomic Analysis / Socio-Technological Analysis and strategies for recycling.



Outcomes

A holistic methodology enabling the design of new materials, automated & flexible additive manufacturing Powder Bed Fusion - Laser Beam, and quality assessment of high- performance, REE-free & circular PMs, validated in 5 clean energy and transport related applications (3 in bench tests and 2 via Technoeconomic Analysis & simulation). MagNEO encompasses a workflow from design to manufacturing and recycling supported by Life Cycle Assessment / Technoeconomic Analysis / Socio-Technological Analysis, including advanced multi-scale modelling, Machine Learning, enhanced and End of Life strategies (direct & indirect recycling).



*DFT: Density Functional Theory, ML: Machine Learning

Consortium

