NEOdymium-Iron-Boron base materials, fabrication techniques and recycling solutions to HIghly REduce the consumption of Rare Earths in Permanent Magnets for Wind Energy Application

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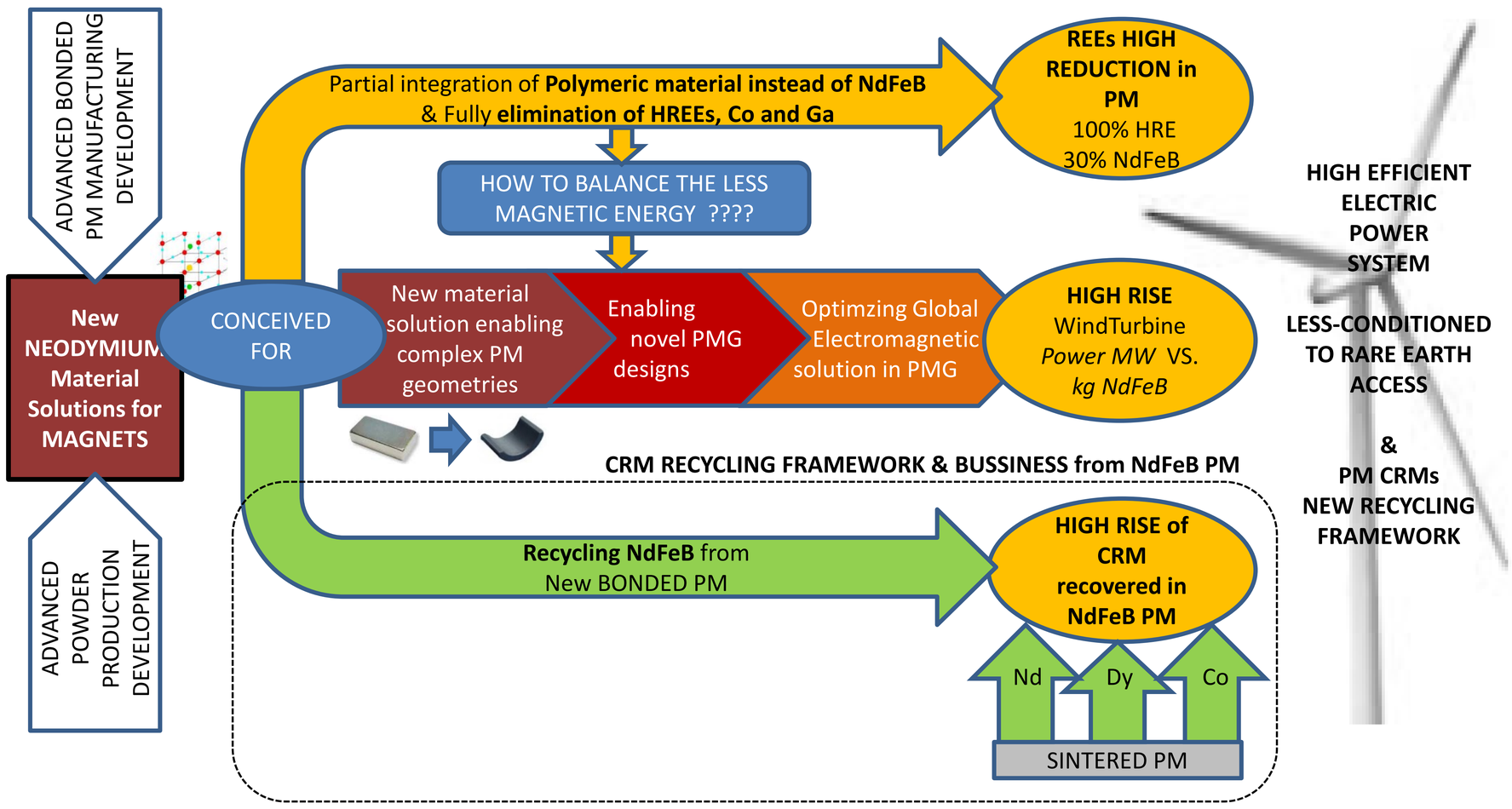
Motivation

- By 2020, up to **20% of the EU electricity** will be produced by **wind energy**
- The application of Permanent Magnets (PM) in large electric generators supposed a **breakthrough**:
  - Increase in **energy efficiency** of Wind Turbine generators (WTG)
  - Rise of energy quality delivered (**better grid connection**)
  - Reduction of maintenance costs and time
  - Rise of the generation unit **reliability**
- **Sintered NdFeB PM** provides the maximum $(BH)_{max}$ up to about 120ºC
- During the last decade, large research efforts were devoted to the development of highly efficient and reliable WTG based on NdFeB PM
- It is still necessary to break through **3 important barriers**:
  - **Strong dependence on China** for supply and high price of Rare Earth Elements (REEs)
  - High difficulty of **substitution of REE** in PM
  - Several challenges have to be overcome for commercially viable, **large-scale REE recycling**

Objectives

- To reduce **the EU external demand** of REE and Critical Raw Materials (CRM) for PM in WTG
- **New bonded NdFeB material solution for WTG:**
  - No HREEs (Dy and Tb)
  - 30 % reduction of LREEs (Nd and Pr)
  - No Co and Ga
- **To ensure the technical feasibility of new PM** (composition, microstructure, magnetic, mechanical & corrosion properties)
- **New electric machine designs** to increase the deliverable electric power **per ton of REE**:
  - New PM shapes
  - New rotor designs
  - Modelling and simulation for optimum design
- To research and develop **recycling processes** for:
  - **Sintered PM** from current WTG
  - **Novel bonded NEOHIRE PM**
- To ensure **economic and technical sustainability** of NEOHIRE NdFeB resin-bonded PM manufacture & recycling technologies
  - Life-Cycle Assessment (LCA) and Life-Cycle-Cost (LCC)
  - Full exploitation plan for the results and dissemination actions for promotion

Concept and approach



Consortium

PARTNER	MAIN ROLE IN THE PROJECT
ceit ik4 research alliance	Project Coordinator Powder production by gas atomisation (spherical particle shape) Microstructural characterization and mechanical testing Design and optimization of different permanent magnet rotor topologies Dissemination task
Universidad del País Vasco / Euskal Herriko Unibertsitatea	Alloy design Magnetic characterization Input magnetic parameters for the simulation and modelling process
UNIVERSITY OF BIRMINGHAM	Alloy design, HDDR process Microstructural and magnetic characterization Recycling by direct alloy routes to convert sintered NdFeB magnets into HDDR powder which is suitable for production of NdFeB resin-bonded magnets
Fraunhofer LBF	Mechanical (cyclic), corrosion fatigue and durability properties analysis and characterization

PARTNER	MAIN ROLE IN THE PROJECT
Foundation cidaut Transport and Energy Research and Development	New electric machine designs Life Cycle Assessment, Life Cycle Costing and Social LCA methodologies
KU LEUVEN	Recover Nd from resin-bonded NdFeB magnets Hydrometallurgical process to recover Nd and Co, and separate Dy from both non-oxidised or partially oxidised NdFeB magnets
AICHI STEEL	Alloy design, HDDR process, grain boundary diffusion annealing Industrial validation of HDDR process
KOLEKTOR KOLEKTOR MAGNET TECHNOLOGY GmbH	Compounding, injection moulding Microstructural, magnetic and corrosion characterization of magnets Exploitation task
FLORENTINA STUDIORUM UNIVERSITAS	Life Cycle Assessment, Life Cycle Costing and Social LCA methodologies
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Beneficiary LOGO

The NEOHIRE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 720838

NEOHIRE