ITELYUM

Giornata della ricerca chimica

Le sostanze abilitanti: materie rare e critiche e il ruolo della ricerca chimica

IL CASO INSPIREE – PROGETTO STRATEGICO EUROPEO

FEDERCHIMICA
CONFINDUSTRIA

ITELYUM has been championing CIRCULAR economy for more than 60 years, driving innovation in the RECOVERY of waste oil, solvents and industrial waste

84% Circularity index (in 2025)

500 000+ tons CO_2 avoided in 2024

Milan, Italy

European operational presence: **Germany, France, Serbia, Croatia**

Founded in **1963**
PE-owned since **2011**

1 850 Professionals

60 000+ customers across **60 countries**

Total revenue: **≈700 Mln €** (FY 2025)

ITELYUM
REGENERATION SOLUTIONS

European leader in the **production of re-refined base oils (RRBO) through regeneration of spent oils**; our RRBO are used by world-class lubricant manufacturers and display **performances** that are **equivalent to those of base oils obtained from virgin materials**

ITELYUM
PURIFICATION SOLUTIONS

European leader in the **purification** of **waste solvents from the pharmaceutical and chemical operations** as well as in the **production of high-purity virgin solvents**

ITELYUM
ENVIRONMENT SOLUTIONS

Italian leader in the **management and recycling of industrial waste**, both **hazardous** and non-hazardous, in the provision of **environmental services**, **remediation** and **water treatment**, as well as in the **environmental management of harbors areas**

ITELYUM 360

ITELYUM
New Businesses

Plastic recycling through depolymerization of **PET** post-consumption

Bio-based products: **bio-fuels, bio-solvents, bio-lubricants and bio-soaps**

Hydro-metallurgic **recovery of rare earth oxalates and oxides from magnets**

Source: Itelyum team

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Project steps: NewRE pilot project completed; INSPIREE ready to scale up



INSPIREE

New-Re

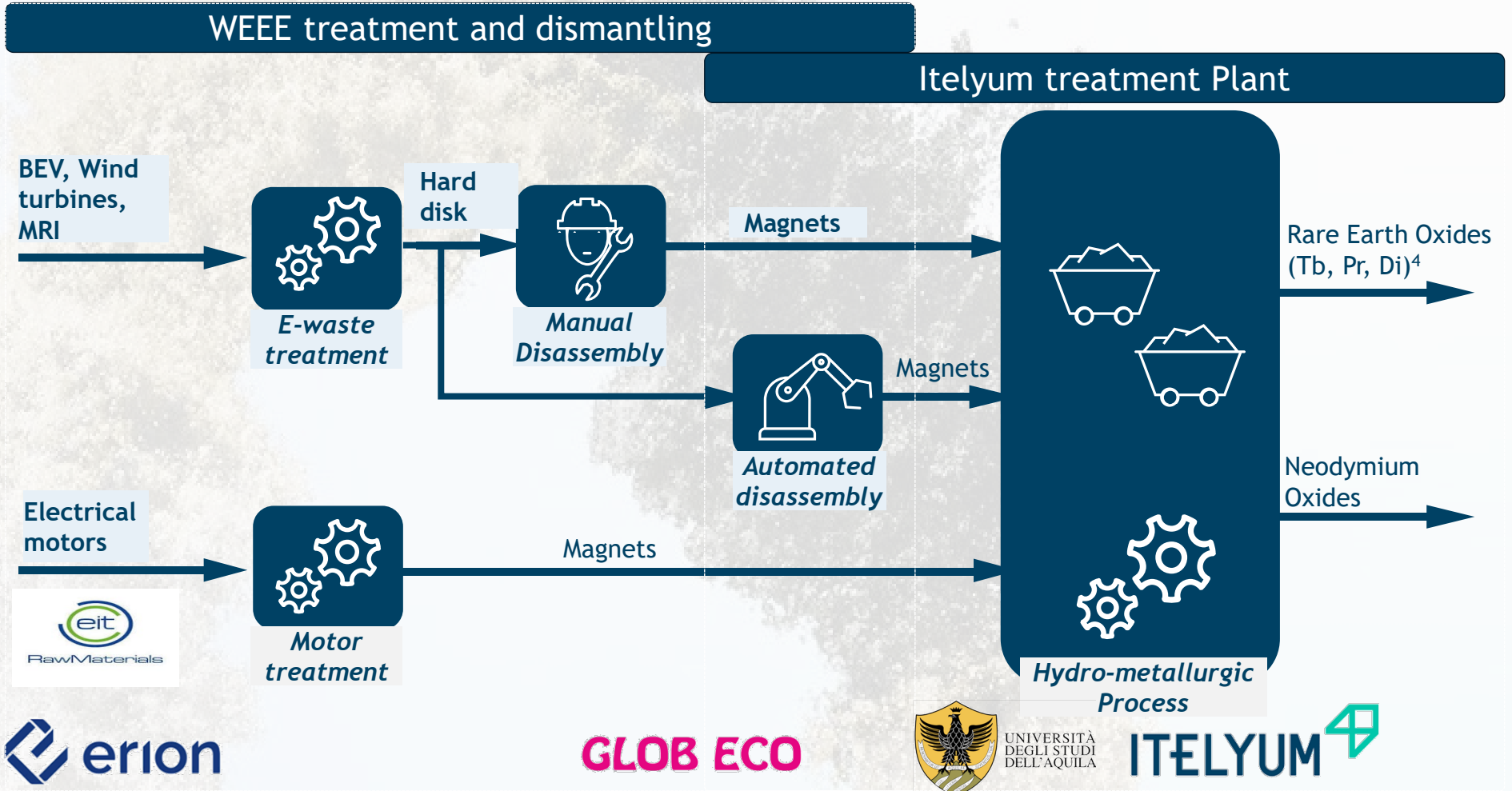
Pilot project (TRL7) successfully completed

Development activities highlighted an extra capex of €10-12M to further improve lines, scale up capacity and reach TRL9 on 100% of components

Need to support the structuring of feedstock through proper value chain activation since feedstock flows of permanent magnets, are limitedly made available in the value chain (limited circular loop)

ITELYUM INSPIREE gathers the key actors to cover the entire value chain, from recovered WEEE[5] to REE oxides

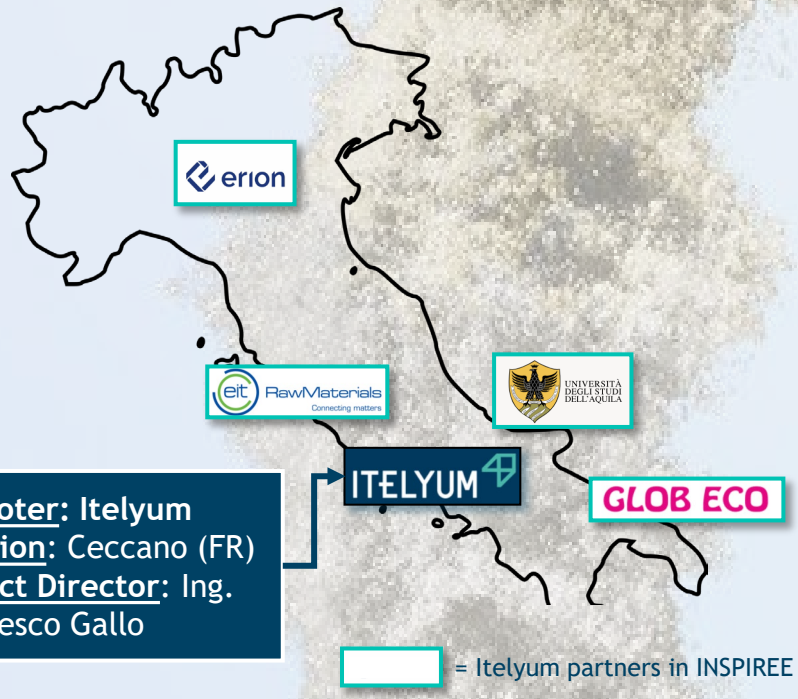
- Target is to recycle REEs[1] from spent PM by scaling up a hydrometallurgical process producing REEs oxides and iron pigment from recovered WEEE at industrial pilot scale (TRL7[2])
- Level I plant at Globeco is set to have capacity in terms of electric rotors disassembly & demagnetization 1000 t/y
- Level II plant at Itelyum with full-scale capacity of 2000 t/y in terms of incoming NdFeB[3] permanent magnets to achieve min 200 t/y REOs
- Milestone: start-up plant 500 t/y PM capacity 30/09/2027 (LIFE project objective).
- The recycling saves significant amounts of energy, chemicals and emissions in the primary processing



Source(s): Itelyum Team analysis | Notes: (1) Rare Earth Elements; (2) TRL = technology readiness level; (3) Neodymium-Iron-Boron Permanent Magnet; (4) Y (Yttrium): Used in white LEDs, lasers, and superconductors; Tb (Terbium): Found in high-performance magnets, color displays, and electronic devices; La (Lanthanum): Used in camera lenses, rechargeable batteries, and catalytic converters; Ce (Cerium): Common in auto catalysts, glass polishing compounds, and display materials; (5) Waste Electrical and electronic equipment

ITELYUM INSPIREE is among the 4 Italian projects appointed by the EU in 2025 to hold a strategic role for a circular value chain in critical raw materials

- **In March 2025**, the **European Commission approved 47 strategic projects in 13 EU countries to boost EU capacities in strategic ('critical') raw materials**
- Life22-Env-It-Inspiree ("INSPIREE") is a project promoted by Itelyum Group and funded by the EC through CINEA (European Climate, Environment and Infrastructure Executive Agency) under the LIFE program for the **first European industrial-scale plant to recover Rare Earths from end-of-life permanent magnets** extracted from hard disks and electric motors
- The project involves disassembling the magnets and recovering the rare earths through hydrometallurgy. INSPIREE builds on the results of successful pilot projects. **Itelyum hydrometallurgical process is patented**



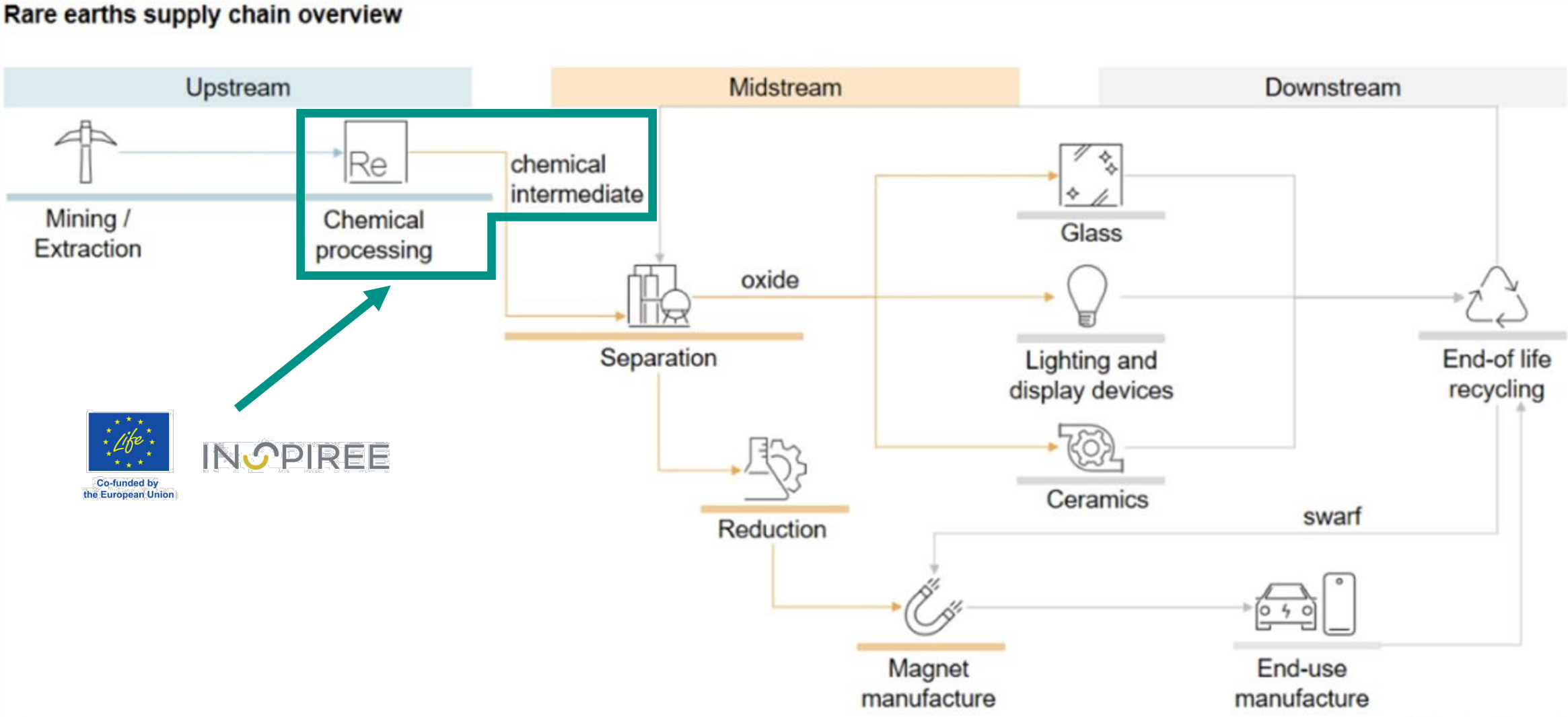
Promoter: Itelyum
Location: Ceccano (FR)
Project Director: Ing. Francesco Gallo

Source: Itelyum analysis

Selected examples of media coverage for Itelyum and other Italian strategic projects

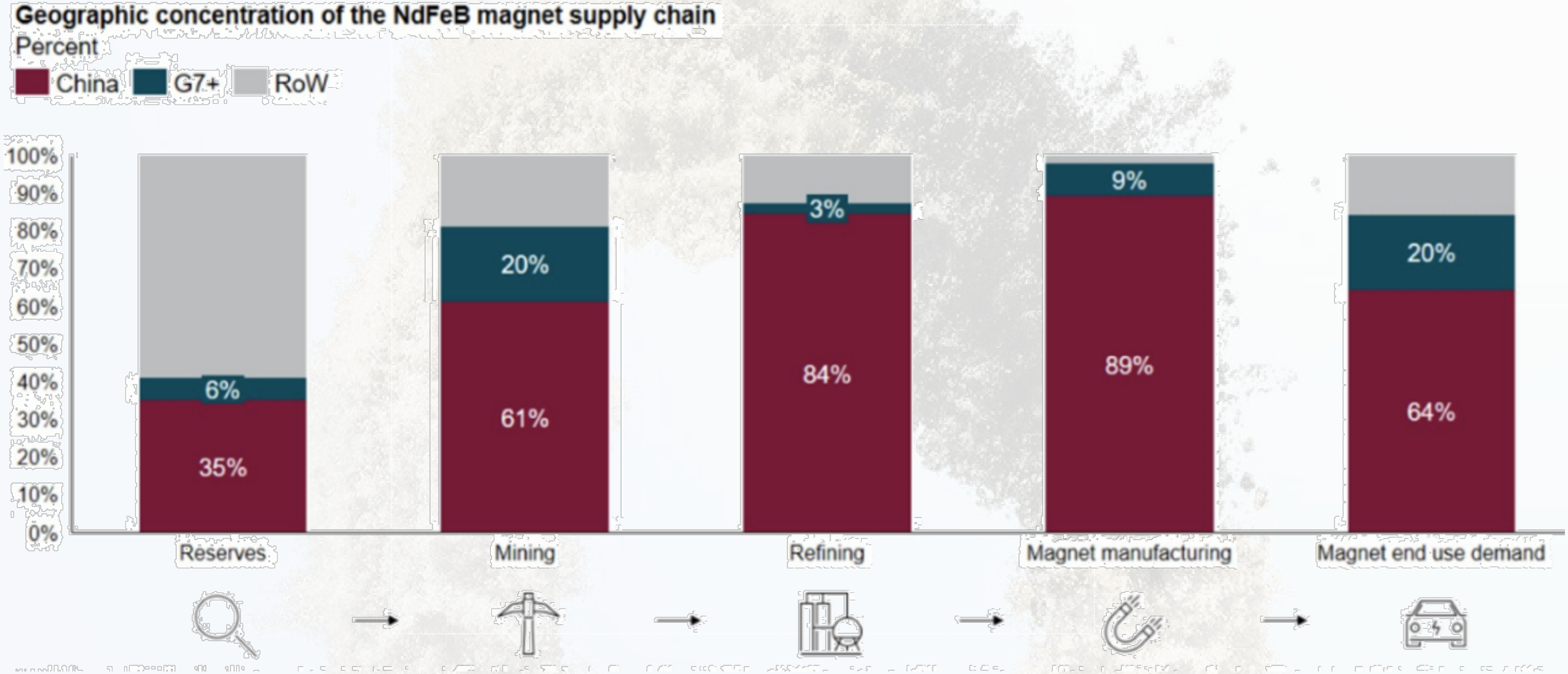


Rare earth concentrates need to undergo separation processes before they can be utilized in the various industries that rely on these materials



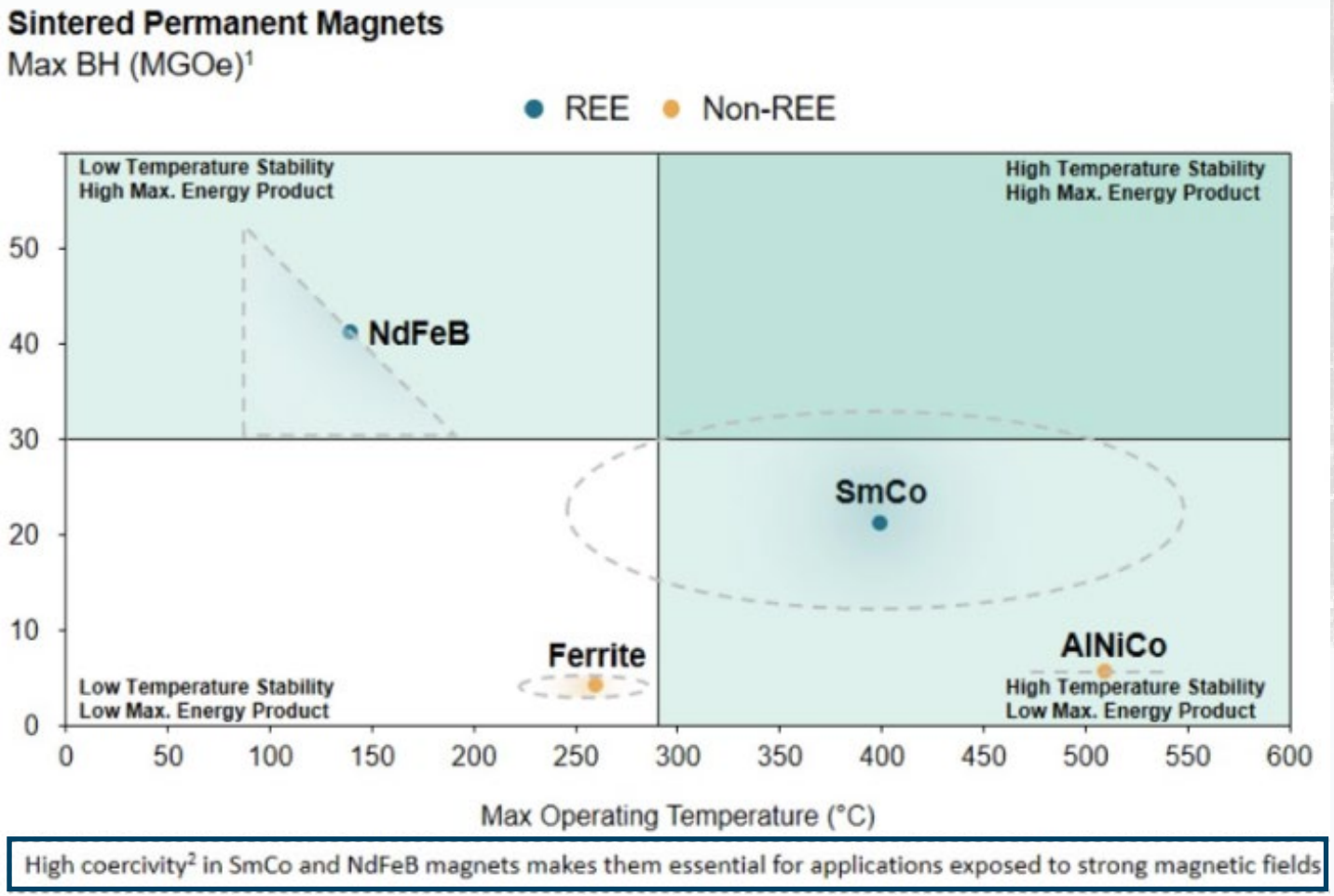
Source: Itelyum team analysis

Geographic concentration increases across the rare earth value chain, with China accounting for 61% of mining, 84% of refining, 89% of magnet manufacturing



Source: Itelyum team analysis

Permanent magnet types differ in composition and properties, with NdFeB offering strongest field and SmCo the stability necessary for high-precision



NdFeB (Neodymium-Iron-Boron)

- **Highest magnetic strength** (BH_{MAX})
- Most produced type of magnet
- Essential for **aerospace, defense and medical** applications

SmCo (Samarium Cobalt)

- High temperature and corrosion resistance, good magnetic strength

AlNiCo (Aluminum-Nickel-Cobalt)

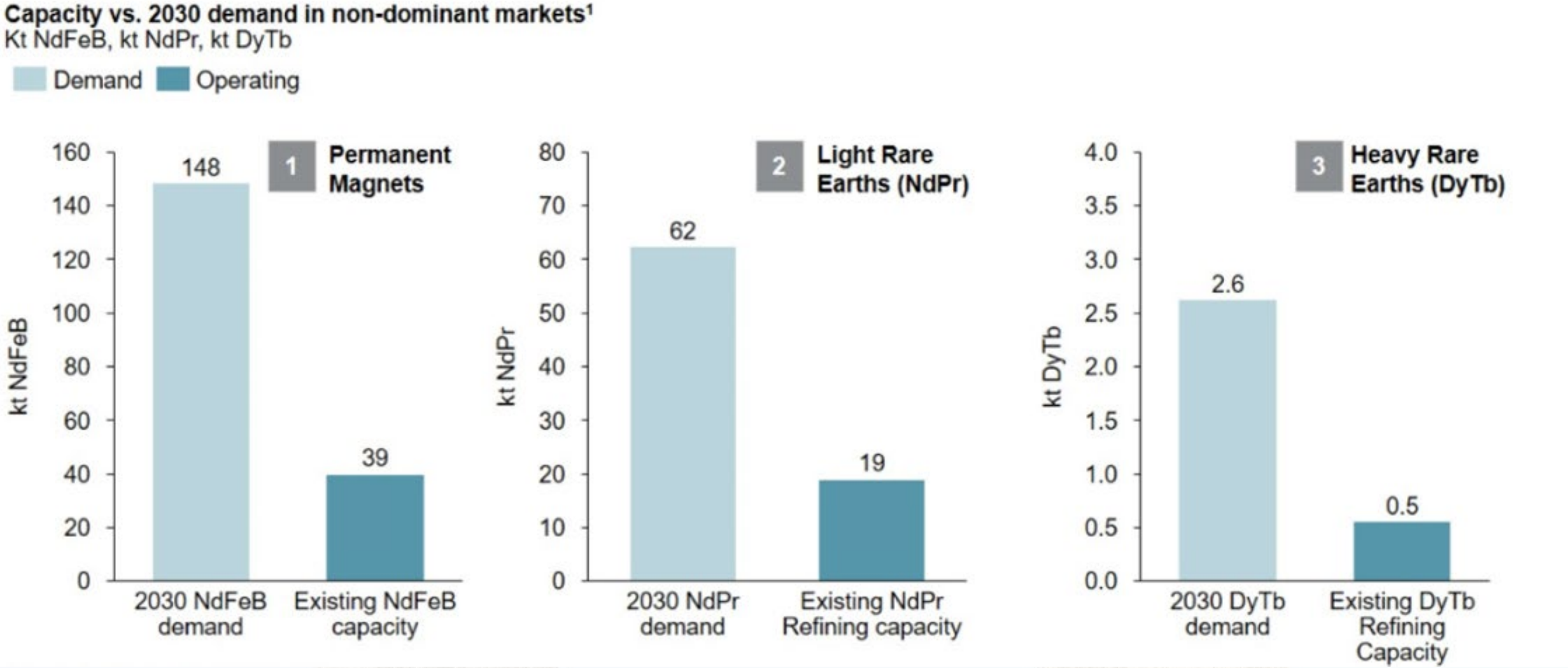
- Highest **temperature resistance**, moderate magnetic strength
- Used in sensors, loudspeakers and automotive components

Ferrite (Ceramic Magnets)

- **Low strength**, low cost of production

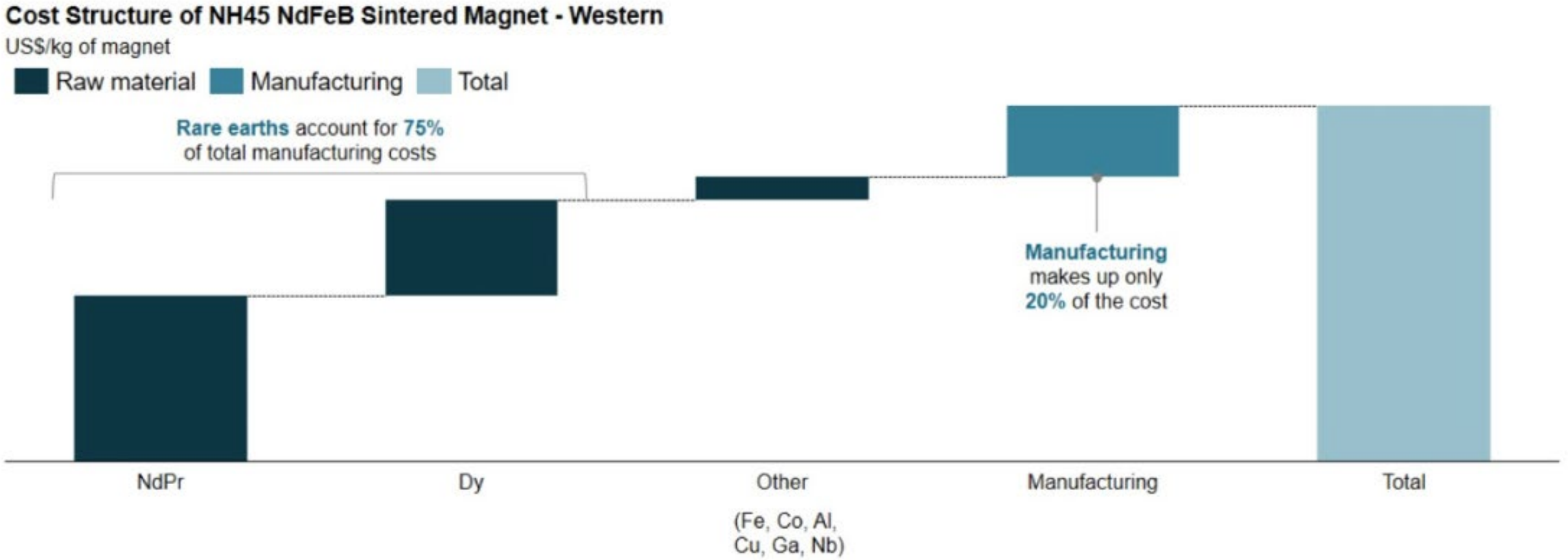
Note(s): 1. BH max, or Maximum energy product is the highest magnetic energy density a magnet can store per unit volume, representing its magnetic strength. Indicates how much magnetic energy is available influencing magnet size and power; coercivity refers to the magnet's ability to withstand an external magnetic field without being demagnetized | Source: Itelyum team analysis

Meeting future NdFeB demand requires coordinated capacity across the entire value chain, not just additional magnet capacity



Note(s): 1. Non-dominant markets refer to markets excluding China | Source: Itelyum team analysis

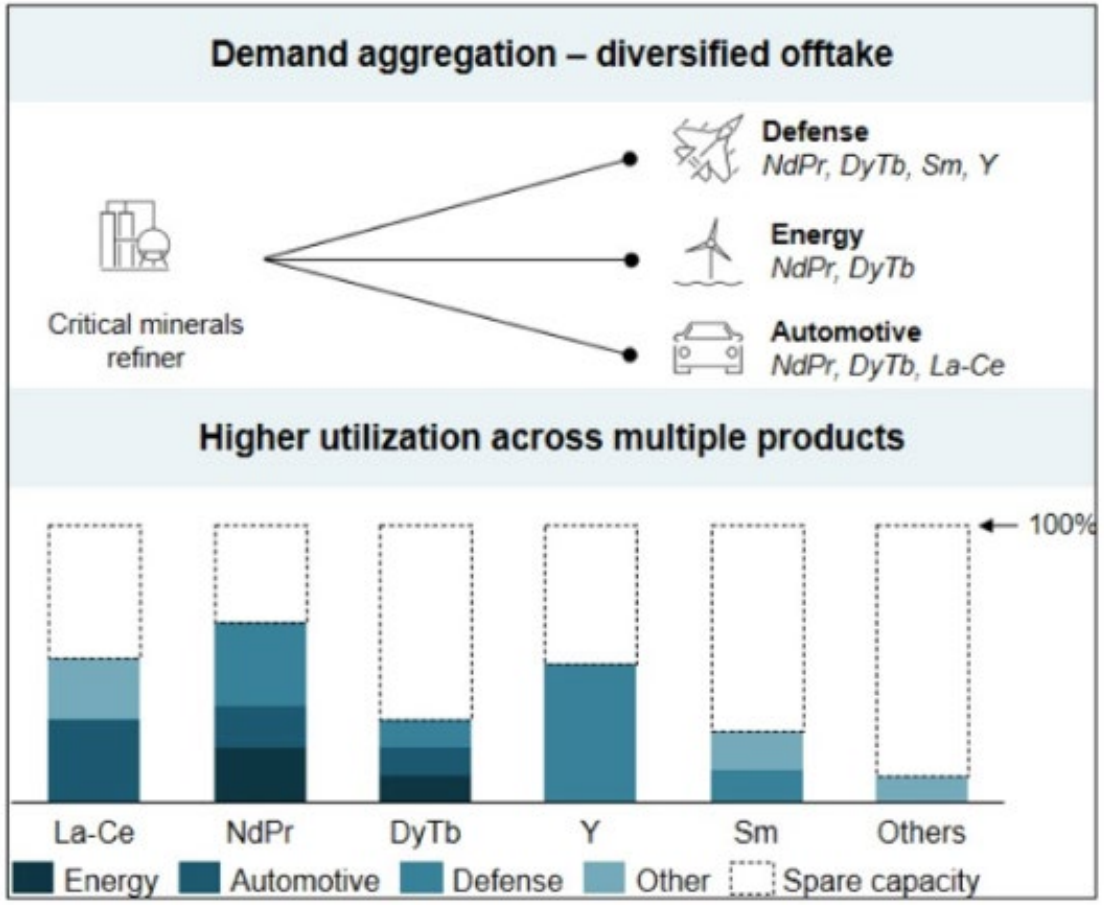
Rare earths account for 75% or more of magnet production costs, making access to a cost-competitive feedstock a key determinant for the value chain

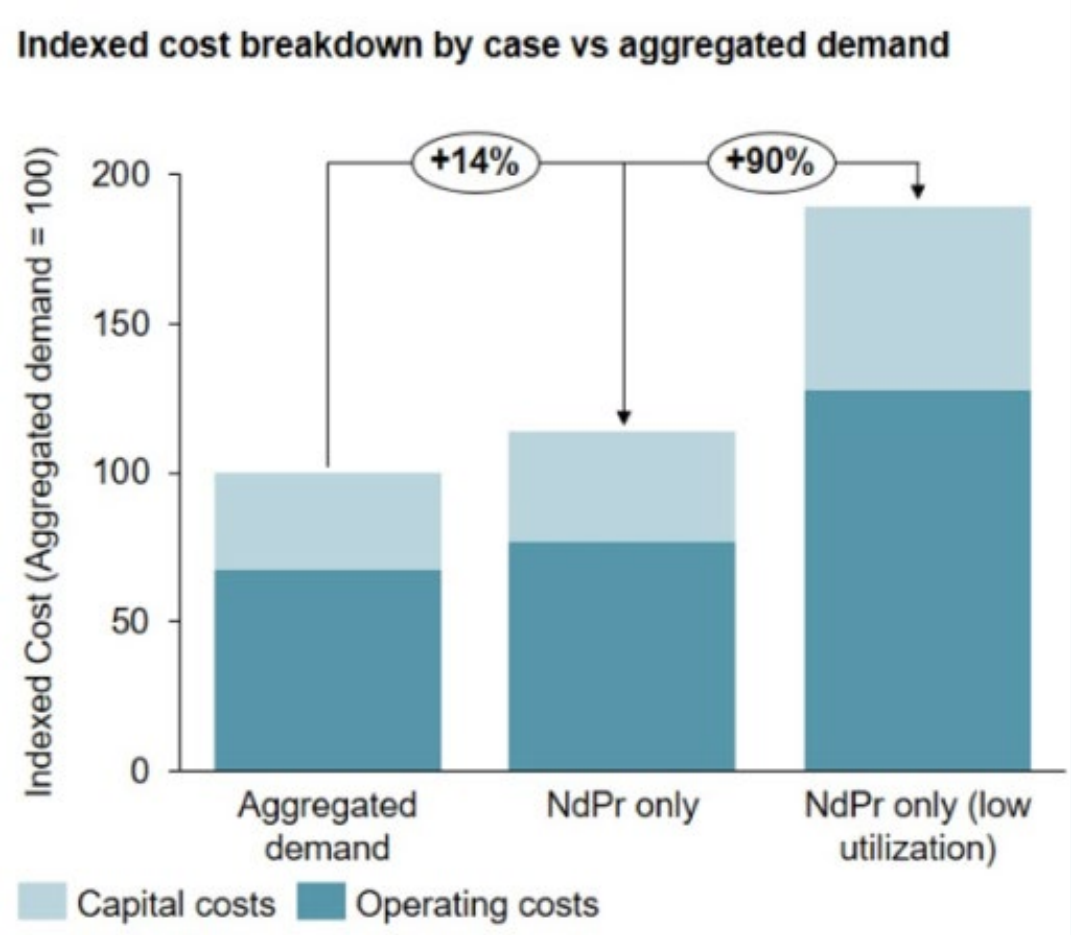


Magnet cost structure vary by grade, through **rare earth feedstock remains the dominant cost component across grades.** Higher-performance grades require more Dy/Tb, increasing feedstock cost exposure.

Note(s): 1. Non-dominant markets refer to markets excluding China | Source: Itelyum team analysis

Demand aggregation can help unlock rare earth project development by improving utilization and revenue certainty





Source: Itelyum team analysis

Demand aggregation can help unlock rare earth project development by improving utilization and revenue certainty



The rare earth market remains highly concentrated throughout the whole supply chain

- China accounts for 61% of mining, 84% of refining, and 89% of magnet manufacturing in the NdFeB magnet supply chain
- Regions outside China also face cost competitiveness challenges, with China's lower production costs and policy-driven market influence continue shape global price dynamics

Market demand is set to grow 6% per year between 2025 and 2035, creating a growing need for new capacity and diversified supply chains

- Current demand is anchored by consumer and industrial applications, with small motors and electronics accounting for 47% of the NdFeB demand
- Future growth is expected to be driven by electrification and automation, supported by rising demand for EVs, wind energy and robotics

Demand aggregation transforms fragmented demand into bankable demand, helping bring new rare earth projects from concept to production

- Higher utilization and broader product sales can lower costs by 14% vs a fragmented market structure
- Diversified customers and end-markets improve revenue certainty and reduce investment risk

Supply chain integration and strategic partnerships are critical to building a more diversified market

- Access to the right feedstock is as important as processing capacity, as feedstock composition directly influences recoverable products, utilization and costs
- Recent acquisitions and strategic investments are accelerating integrated supply chains across reifining/separation, metal production and magnet manufacturing

Source: Itelyum team analysis

The project was developed in phases: with positive aspects and some critical issues encountered

Milestones

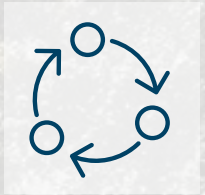
Pilot project (TRL7) successfully completed and available to the Italian system for experimental activities on CRM in the recovery and mining supply chain

Experimental authorization extended for an additional 2 years by the Lazio Region: possible use to test other national projects

Modifications are underway to reconfigure the project to handle other strategic flows, such as black mass from lithium batteries and end-of-life PV panels

Authorization process completed with the support of Lazio Region, with MASE as an additional focal point

Critical issues encountered



Waste containing rare earths is not collected to be sent to national recycling chains



Consequently, to build the industrial plant, an additional investment of 12 million euros is required, also to meet environmental regulations

Note: Carester, a French company operating in the recycling of rare earths, has received €100M in grants from the French government and a further €100M from the Japanese government, for a total of €200M.

Identified choke points: The constraint is not technological, rather regulatory and systemic

The Challenge:

1. **Access to feedstock** (low e-waste collection rates, no regulatory framework currently ensures e-scrap bearing REE is channeled to specialized recycling pathways)

2. **High cost of certain project inputs** (e.g., energy)

3. **Off-take:** revenue profile not yet stabilized (due to commodity price volatility)

4. **Competition in a context of scarcity leads to systemic failure**: among companies / countries as well as technology solutions. In REE space as well as among CRM. Every CRM is a different market

Financing & Regulatory instruments (*hand-in-hand*):

1. **Fin | CAPEX:** EU capital grants, tax credits
2. **Fin | Offtake:** floor-price mechanism, name-plates contracts
3. **Fin | Energy inputs:** CfD (e.g., like Italian ER2.0)
4. **Regulatory |** Support the creation of a mid-stream value chain for permanent magnets
5. **Regulatory |** Ensure the mandatory collection and delivery of magnets, preventing their dispersal into informal channels (specific NC codes)
6. **Regulatory |** link environmental authorization of (e.g.,) wind energy sector to a certified delivery to specialized recycling centers, EV

Sources: literature research, Itelyum analysis

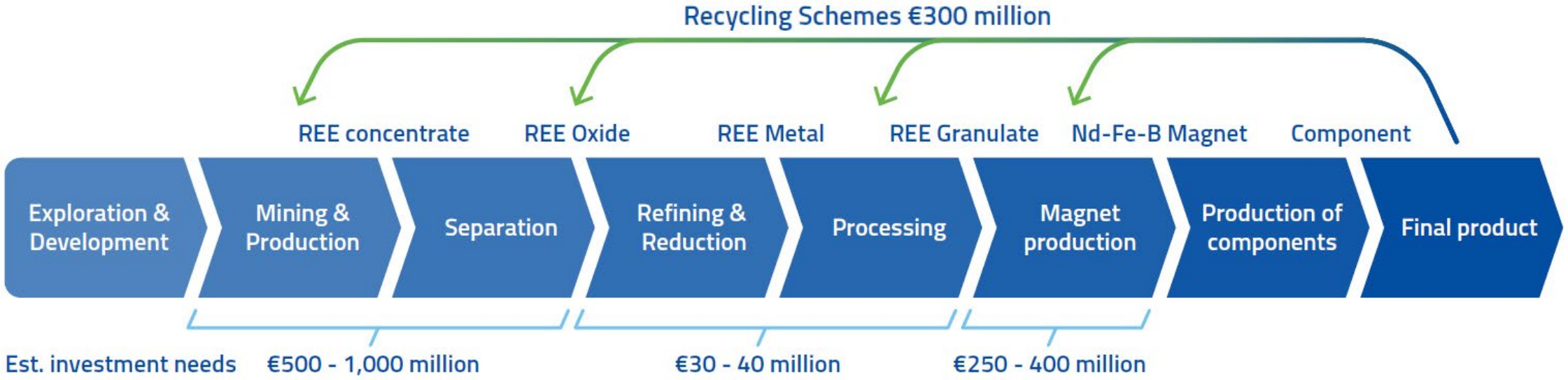
Identified choke points: The constraint is not even money, rather at this stage finding the right level of coordination across the value chain

CHALLENGES UPSTREAM

Lack of investment in Europe ▪ Price volatility ▪ Social License to Operate ▪ Limited R&D capacity compared to Asia ▪ Lack of level playing field in terms of tax schemes and subsidies

CHALLENGES DOWNSTREAM

Costs, performance, environmental footprint ▪ Small, monopolised upstream market ▪ Lack of transparent and sustainable value chains



SOLUTIONS

Risk sharing across the value chain, for instance, by long-term supply contracts / off-take agreements ▪ Diversification of supply chains by investing in European facilities (create options) ▪ Collaborative R&D (e.g. materials processing, reduction of REE content, use of process waste and of recycled material, i.e. closing loops) ▪ Joint Public-Private Investments ▪ Raising of public awareness for REE and permanent magnets


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