ionic technologies

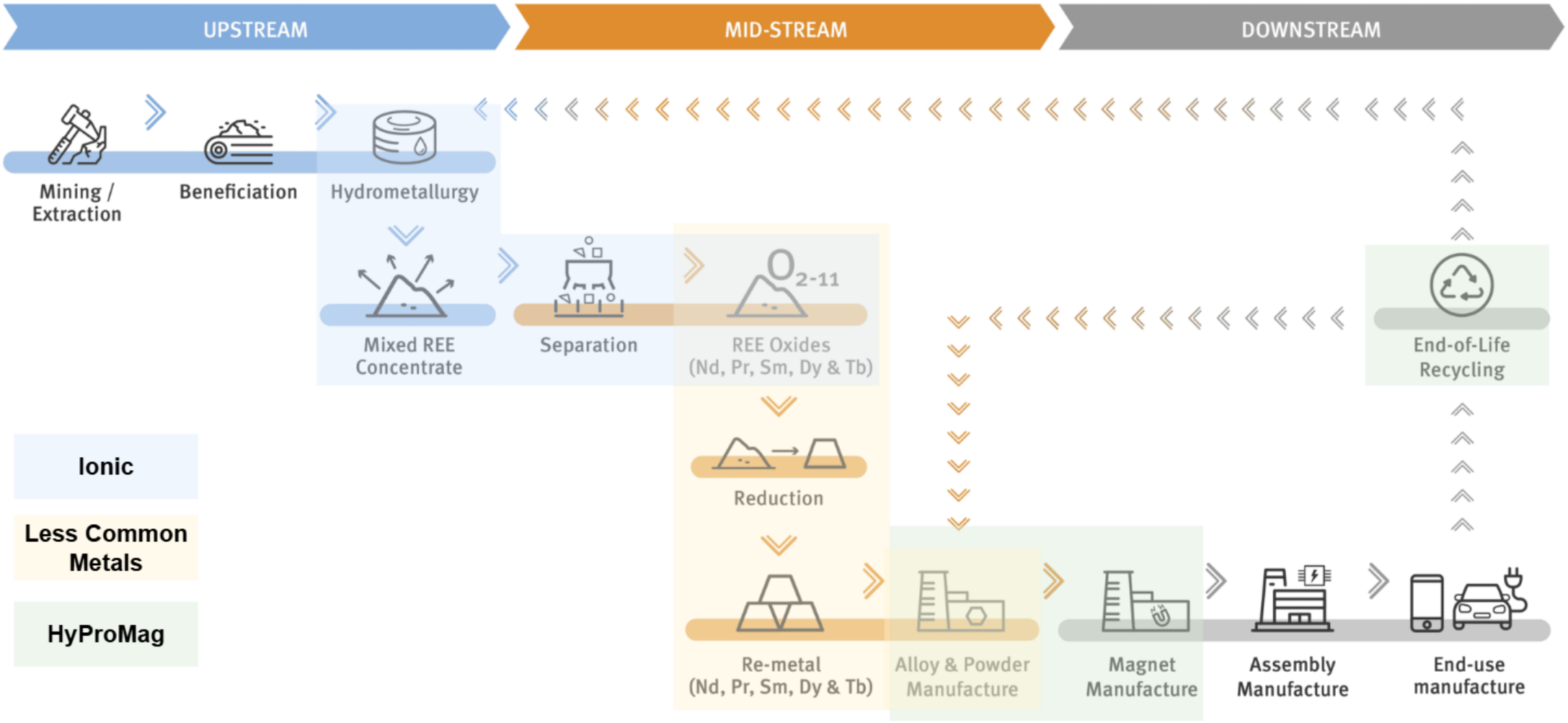
Leading Magnet Recycling and the Circular Economy of Rare Earths

Team Defence

Snack Session

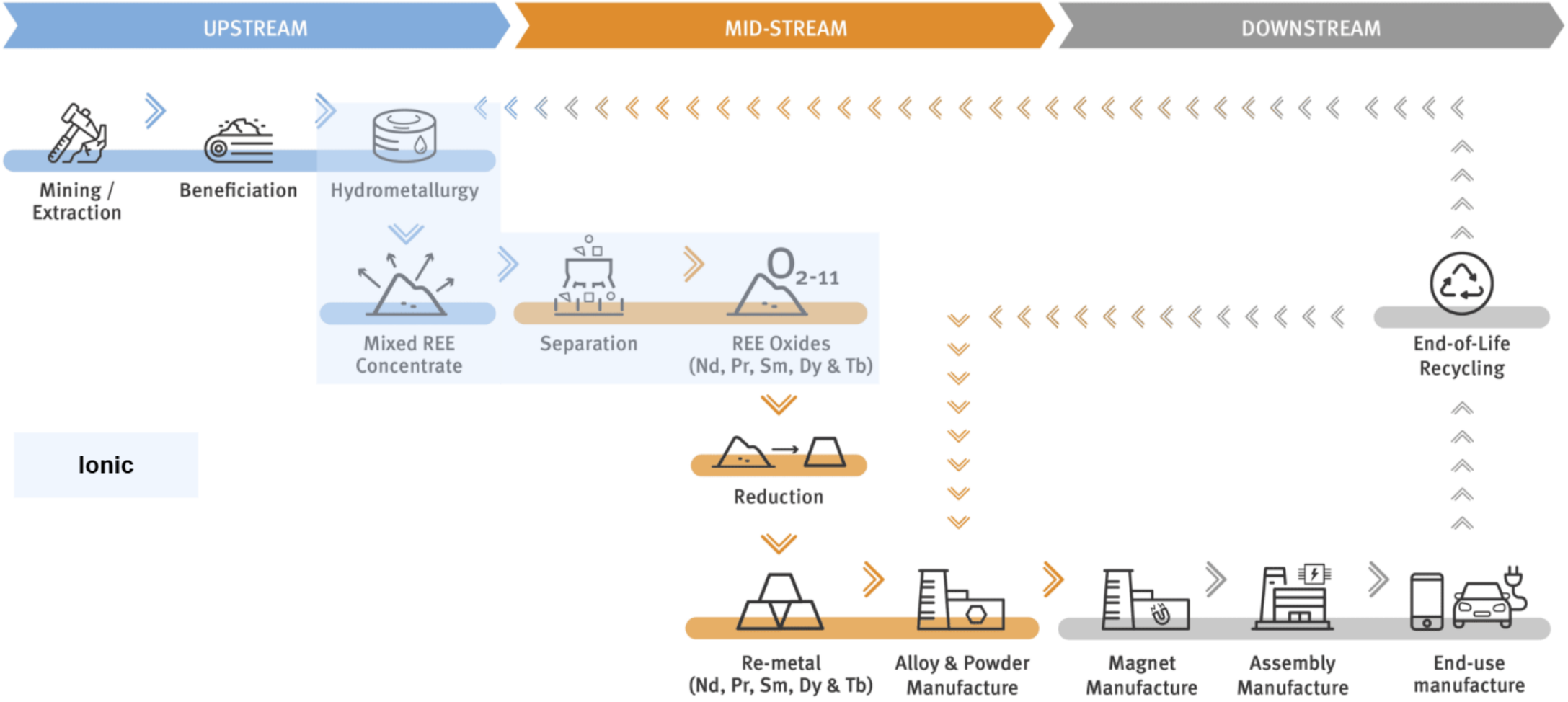
30 September 2025

Rare Earth Supply Chain



Source Argus Media

Rare Earth Supply Chain



Source Argus Media

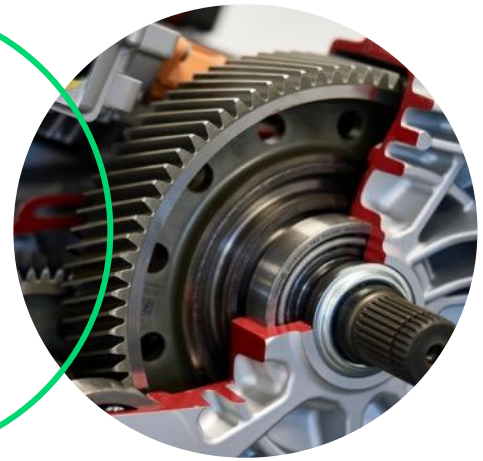
Upcycling Neodymium Permanent (NdFeB) Magnets

Commercialising recycling of End-of-Life (EOL) NdFeB magnets and swarf to high purity magnet REOs

Mixed grades of waste permanent magnets and swarf from existing metal, alloy and magnet manufacturing

100% recycled **separated** high purity (>99.5%) grade magnet rare earth oxides

- ✓ Nd_2O_3
- ✓ Dy_2O_3
- ✓ Pr_6O_{11}
- ✓ Tb_4O_7
- ✓ $(NdPr)_2O_3$
- ✓ Ho_2O_3



High spec permanent magnets for net zero carbon technologies such as EV motors and off-shore wind turbines

Rare Earth Elements in Defence Technologies

Reliance on Rare Earth Content across multiple Defence platforms

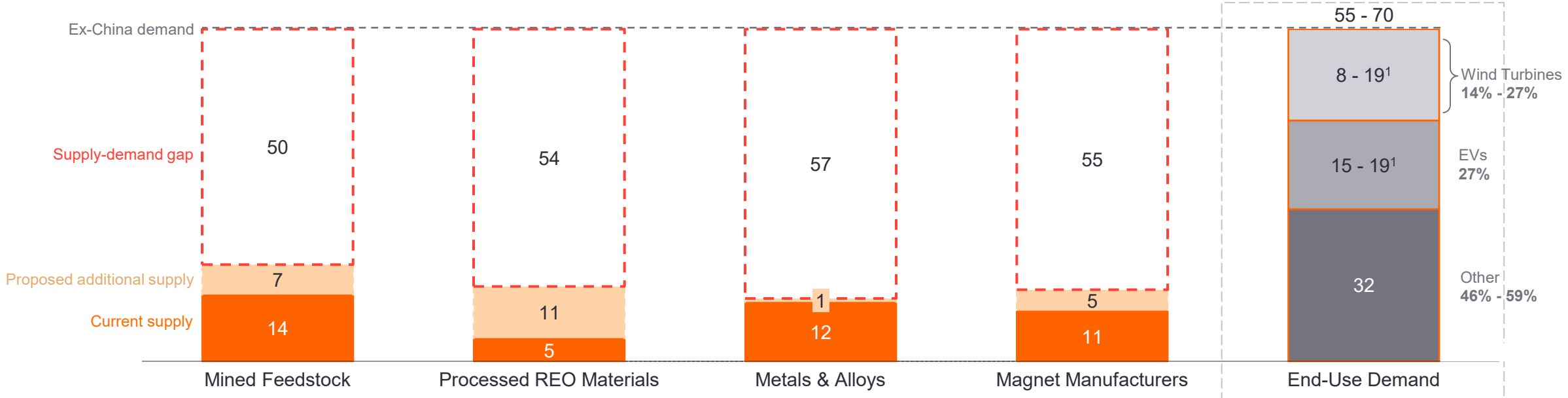
over 70% of U.S. rare earth imports sourced from China

Nd, Pr, Sm, Dy, Tb, Eu, Y	**418 kg**	Guided missiles Targeting lasers Drive motors	**F-35 Fighter Jet**
Nd, Pr, Sm, Dy, Tb, La, Gd, Y	**2,600 kg**	Radar systems Missile guidance systems Propulsion Drive motors	**Arleigh Burke DDG-51 Destroyer**
Nd, Pr, Sm, Dy, Tb, La, Gd, Y	**4,600 kg**	Tomahawk missiles Radar systems Drive motors	**Virginia-Class Submarine**

1. Benchmark Mineral Intelligence

Global demand for Rare Earth Permanent Magnet Supply

Ex-China NdPrDyTb Gap in NdFeB Value Chain Supply 2028 (Kt REO)



11 - 12[2]
Gap in # of Average Mines (Projected supply vs. demand in 2028)

22 - 24[2]
Gap in # of Average REO Separation Manufacturers (Projected supply vs. demand in 2028)

26 - 32[2]
Gap in # of Average Metals & Alloys Manufacturers (Projected supply vs. demand in 2028)

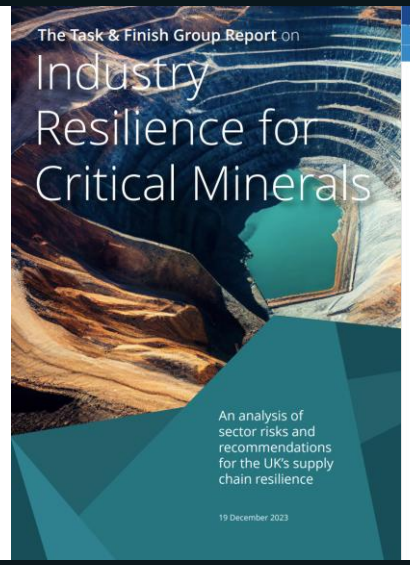
10 - 11[2]
Gap in # of Average Magnet Manufacturers (Projected supply vs. demand in 2028)

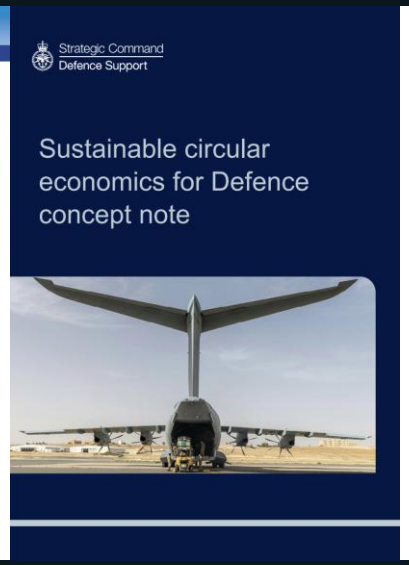
Other Demand:
- Defense Applications
- Electrical Components
- Mechanical Components
- Air Conditioning

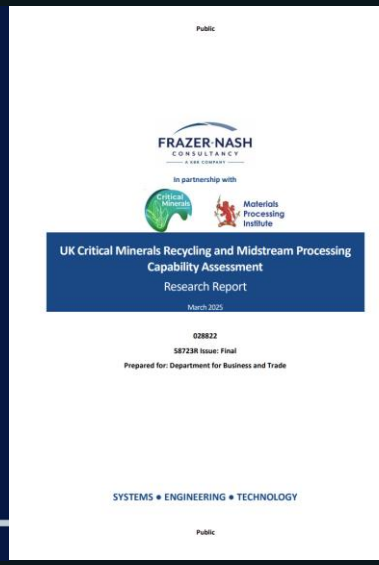
1. International Energy Agency (IEA) forecasted rare earth elements (REE) magnet demand in year 2028
2. Gap in number of mines or manufacturers needed based on IEA forecasted REE magnet demand in year 2028

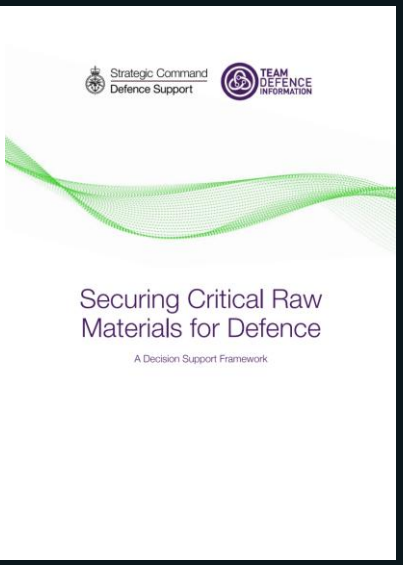
Sources: Argus Direct, WoodMac, US Department of Defense, InspiREs, International Energy Agency, Company Investor Presentations and Financial Reports

Defence Policy Supporting Domestic Capability & Recycling









- ✓ The significance of the role that REEs play in defence supply chains has been recognized across CMIC, UK-Government, Ministry of Defence and NATO
- ✓ The role of recycling has been flagged consistently as a method to secure a resilient and rapid route to obtain REEs for defence applications
- ✓ NATO have recommended strategic stockpiling of material, but this practice is not permissible under export controls

- ✓ Ionic Technologies have been acknowledged as a producer of REEs across multiple publications
- ✓ The Modern Industrial Strategy highlights critical mineral supply chains as fundamental to UK industry, as does the Defence Industrial Strategy
- ✓ The Critical Minerals Strategy and Circular Economy Strategy are expected in 2025

Global REE Status

- ✓ Export controls imposed by China require any heavy REE products to only be exported under license
- ✓ USA DoD invest $500m in MP Materials, setting $110/kg floor price. Several supply chain projects already received significant investment. Numerous executive orders in place to boost domestic production
- ✓ Critical Raw Materials Act in Europe sets recycling target of 25% and single third nation supply target of 65% in an effort to boost domestic production, build resilience and reduce dependency
- ✓ Brazil aiming to develop domestic exploitation of strong natural resources
- ✓ Increasing supply chain activity in Korea, Japan and Vietnam to migrate from China
- ✓ Several producing assets in Australia
- ✓ **Typically 10-15 years to develop and exploit a new mine, Ionic Technologies expect to commercialize recycling REO production in 2 years per plant**

Ionic Technologies Process Flowsheet

Ionic Technologies has developed separation and refining technology that can be applied to the recycling and refining of individual magnet rare earths from used permanent (NdFeB) magnets.

Our hydrometallurgical process is able to deliver high purity separated magnet rare earth oxides no matter the quality and variability in composition of magnet feedstock.

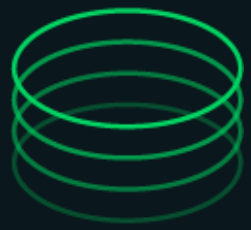
Magnet crushing / grinding

Digestion

Separate base metals (Fe, Mn, Al, Ni, Cu, B)

Intake flexibility

Unlike other recycling processes, our technology can recycle any form of mixed waste magnets and production swarf regardless of type, age or coatings. We are not reliant on a single feedstock stream.



Nd, Pr, Dy, Tb solvent separation (15 stages)

Individual oxides precipitation

Ionic Technologies Demonstration Plant

Our Demonstration Plant, production of magnet REOs now!

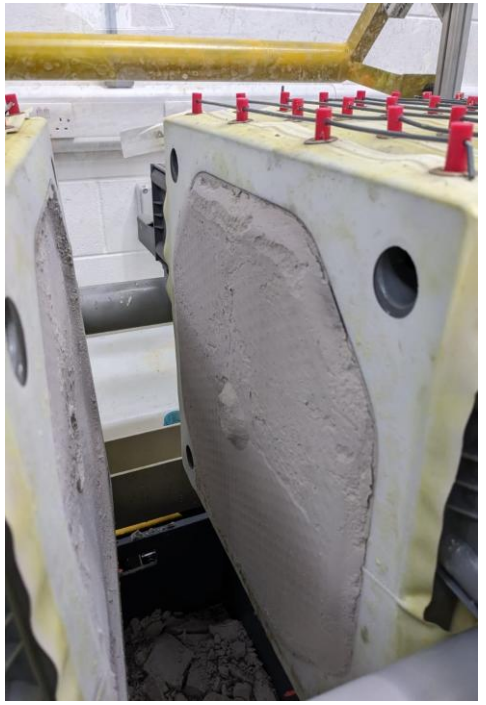
Ionic Technologies process both end of life magnets and swarf, to recover, separate and refine high-purity magnet Rare-Earth Oxides (REOs) using our sustainable technology.

Current plan is to process 30 tonnes of NdFeB magnet feedstock, producing over 10 tonnes of separated magnet REOs.

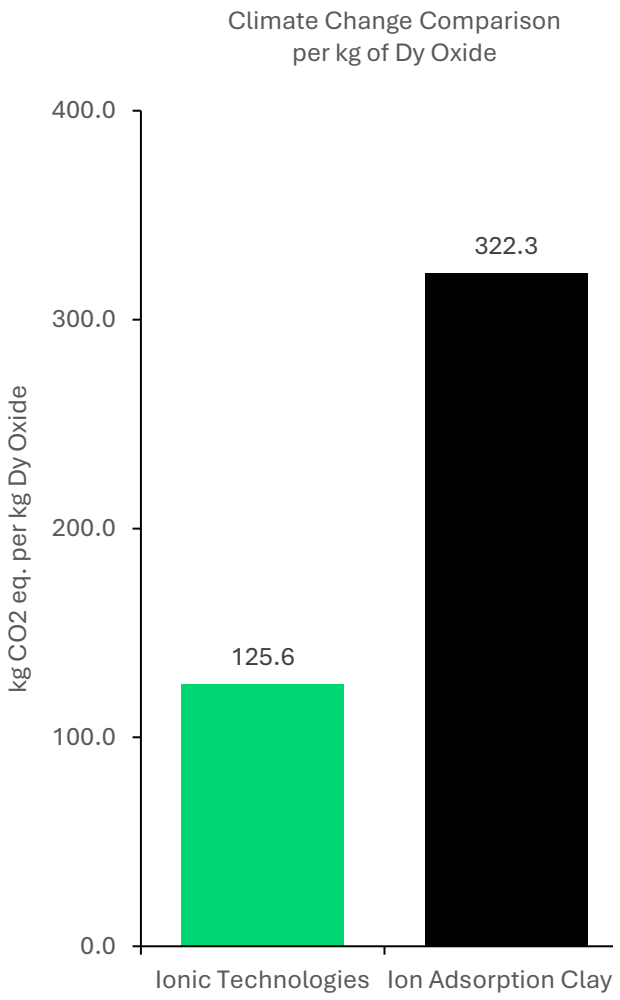


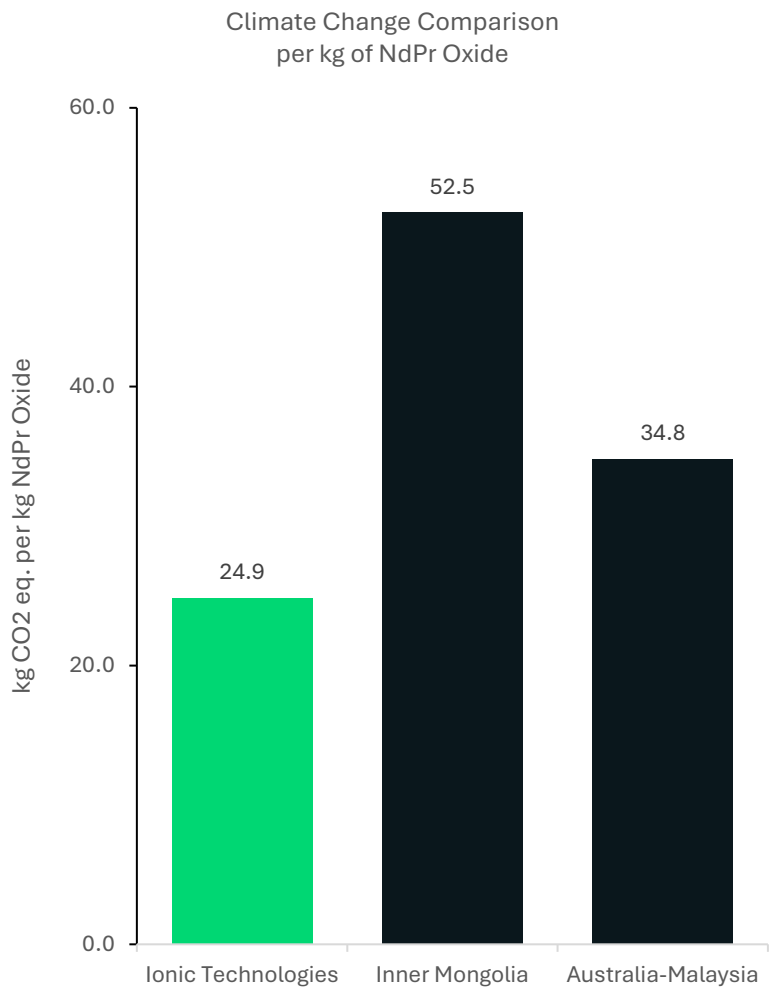




Product Carbon Footprint





- ✓ Reduction in CO_2 compared to conventional primary REE supply
- ✓ Secondary REE material is interchangeable with primary material
- ✓ No radioactive waste
- ✓ No sulfur dioxide
- ✓ No toxic waste
- ✓ Minimal water consumption
- ✓ Recovery of a finite resource

✓ 61% CO_2 reduction on Dysprosium Oxide (Dy_2O_3)

✓ Up to 53% CO_2 reduction on NdPr Oxide ($(NdPr)_2O_3$)

creem™
CircularReeconomy

CirculaREEconomy

- ✓ Announced 13 July 2025
- ✓ Commenced 01 September 2025
- ✓ 36 Months Project
- ✓ £11million Project
- ✓ Leading Collaborate project, part of the UK Government's DRIVE35 launch
- ✓ Up to 62 R&D jobs created/safeguarded,161 Manufacturing jobs created/safeguarded
- ✓ Quantifies/reduces CO_2 and costs
- ✓ Supports renewables and defence businesses
- ✓ Establishes North of Ireland and North-West of England REE Magnet Cluster
- ✓ Compliments UK's existing REE capacity

ADVANCED PROPULSION CENTRE UK · BGS British Geological Survey · emr · Ford · ionic technologies · LCM less common metals · WRIGHT

Path to Commercialisation

ionic technologies

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Technical Developer Accelerator Programme

QUEEN'S UNIVERSITY BELFAST

2022
Lab Scale

2022
Pilot Scale

ADVANCED PROPULSION CENTRE UK

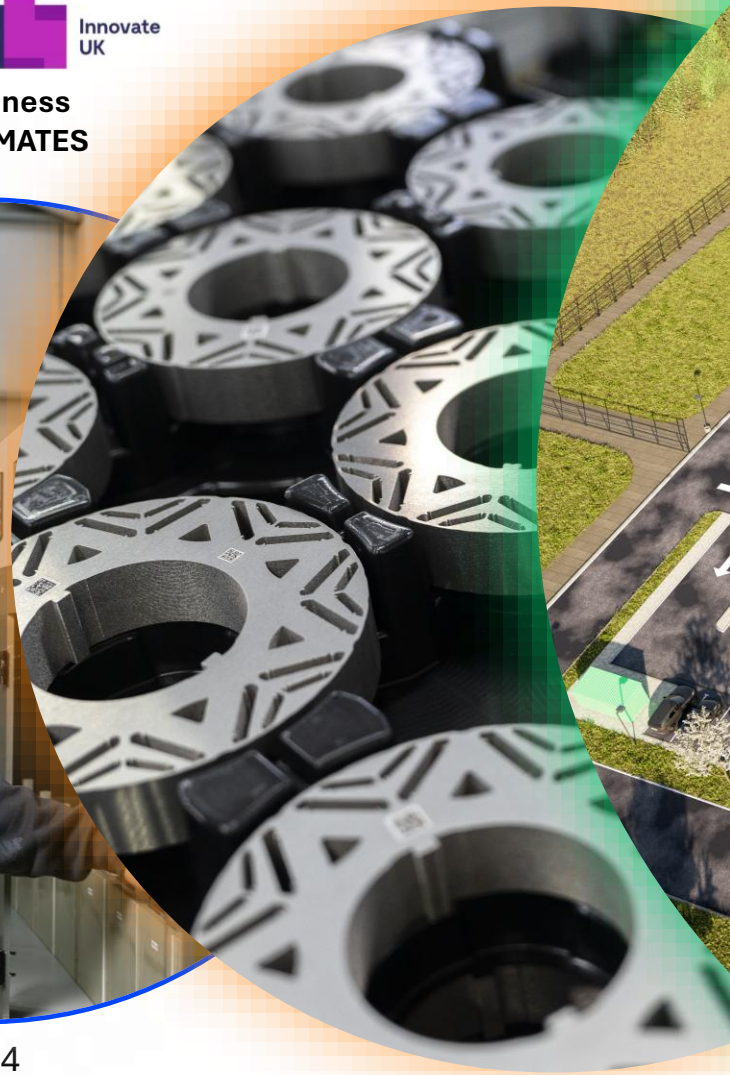
UKRI Innovate UK

Scale-Up Readiness Validation & CLIMATES

2023/24
Demonstration Plant
10tpa REO capacity

ADVANCED PROPULSION CENTRE UK

DRIVE35 Collaborate CirculaREEconomy



2025/28
Supply Chain Validation

2027/28
Commercial Plant
400tpa REO capacity

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technologies

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