

The first cluster: Rare Earth Magnets & Motors. Development and outcomes

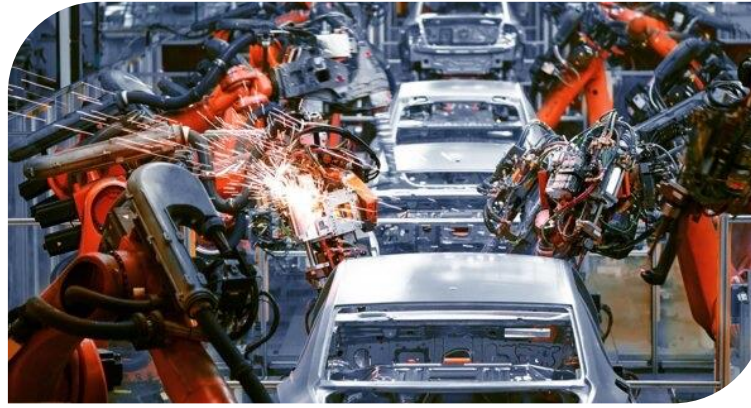
Roland Gauß, Senior Advisor



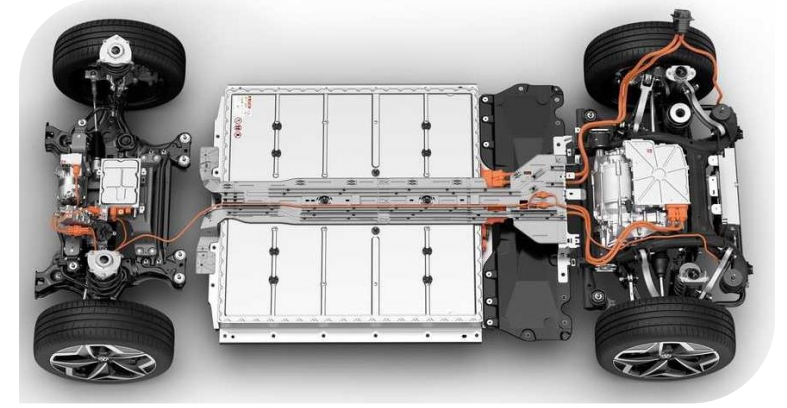
THE RARE EARTH VALUE CHAIN IS OF HIGHEST IMPORTANCE FOR SEVERAL EUROPEAN INDUSTRIAL ECOSYSTEMS. EXAMPLES



Wind turbines use up to 4 tonnes of Nd-Fe-B (particularly offshore)



PM servo motors are essential for industrial machinery and robots



95% of EVs use permanent magnet motors (e.g. VW ID3)

Sources: Siemens; VW; VAC

PRODUCTION IN THE RARE EARTH VALUE CHAIN IS HIGHLY CONCENTRATED IN ONE COUNTRY WHICH RESULTS IN A HIGH SUPPLY RISK AND SPECULATION (2019 DATA)

Rare Earth Oxides Mining



Rare Earth Oxides Refinement



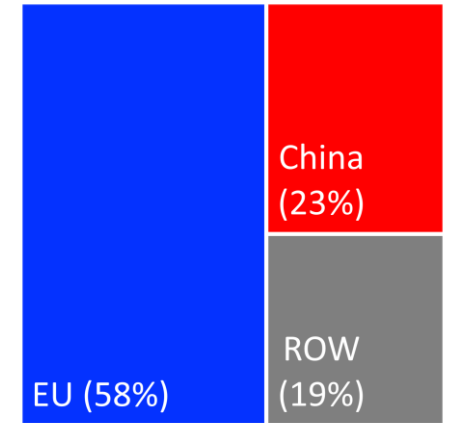
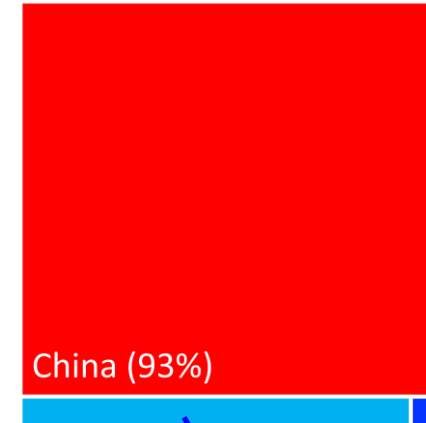
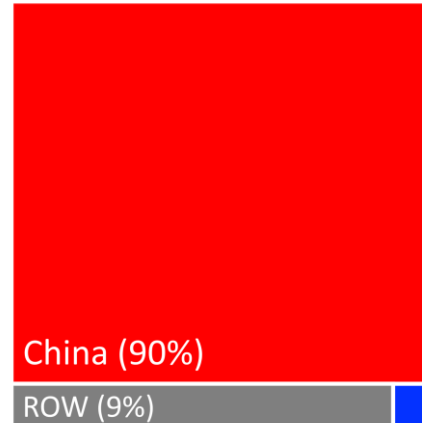
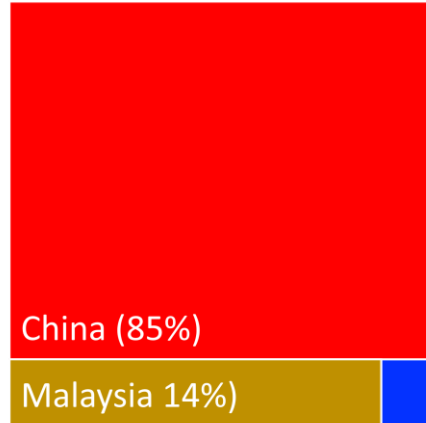
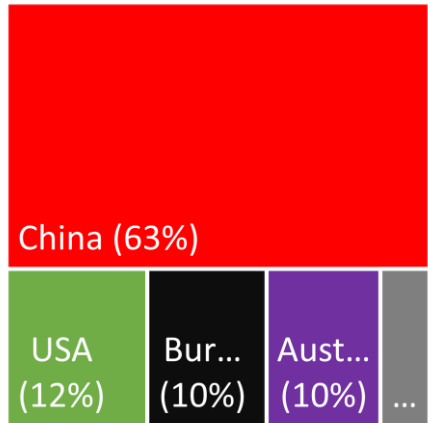
Rare Earth Metals



Permanent Magnets



Example: Wind Turbines



EU (2%)

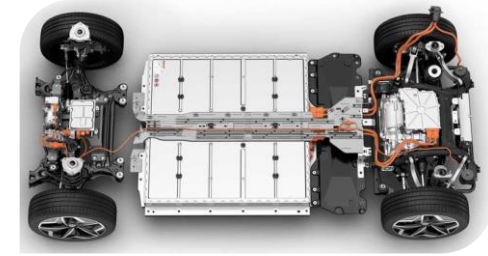
EU (< 1%)

Japan (14%)

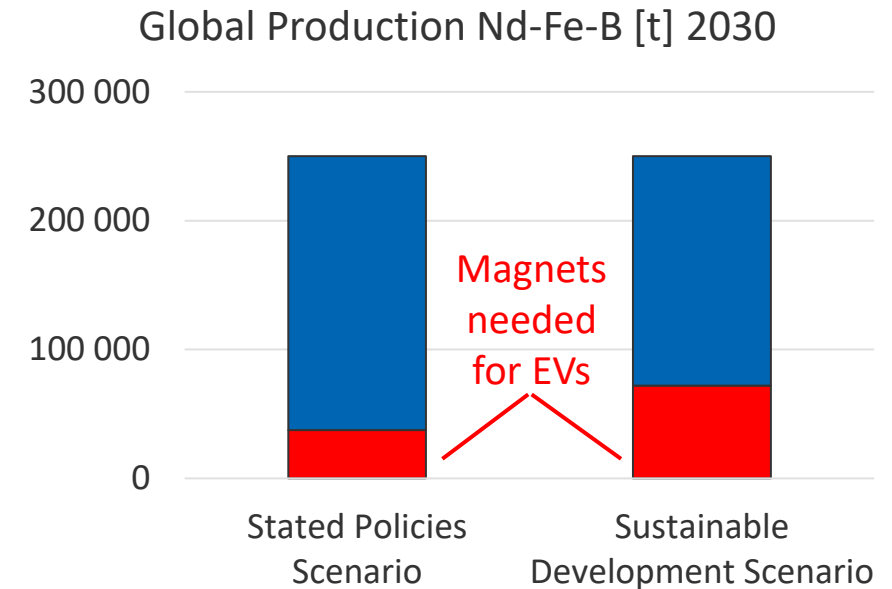
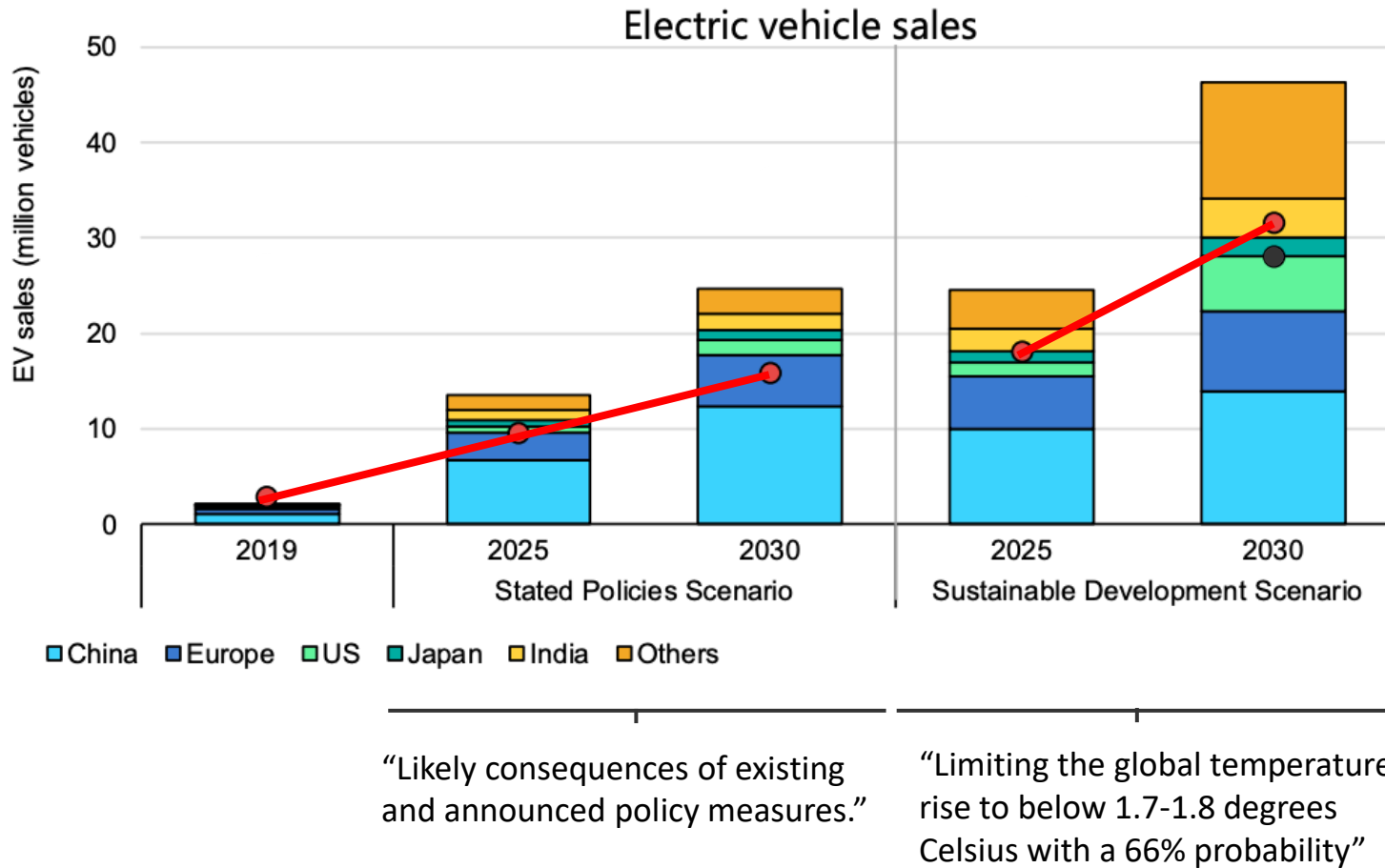
EU (< 1%)

Sources: USDA; USGS; JRC 2017; JRC 2020; Adamas Intel 2019

THE RARE EARTH VALUE CHAIN IS OF HIGHEST IMPORTANCE FOR SEVERAL EUROPEAN INDUSTRIAL ECOSYSTEMS



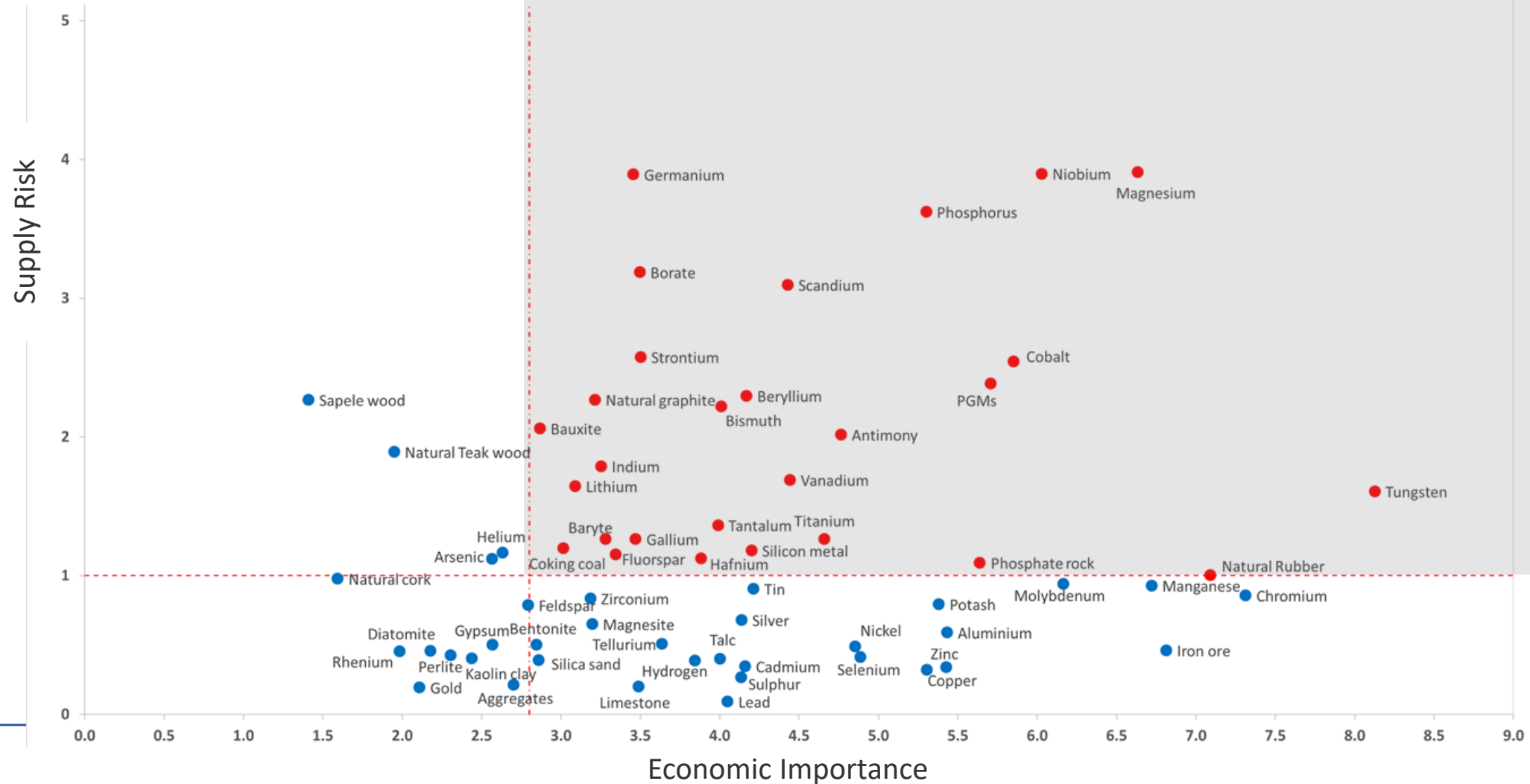
95% of EVs use permanent magnet motors (e.g. VW ID3)



Sources: IEA 2020; VW

RARE EARTHS ARE CONSIDERED
RESOURCE CRITICAL BY THE EUROPEAN
COMMISSION – SINCE 2010

Critical Raw Materials List 2020

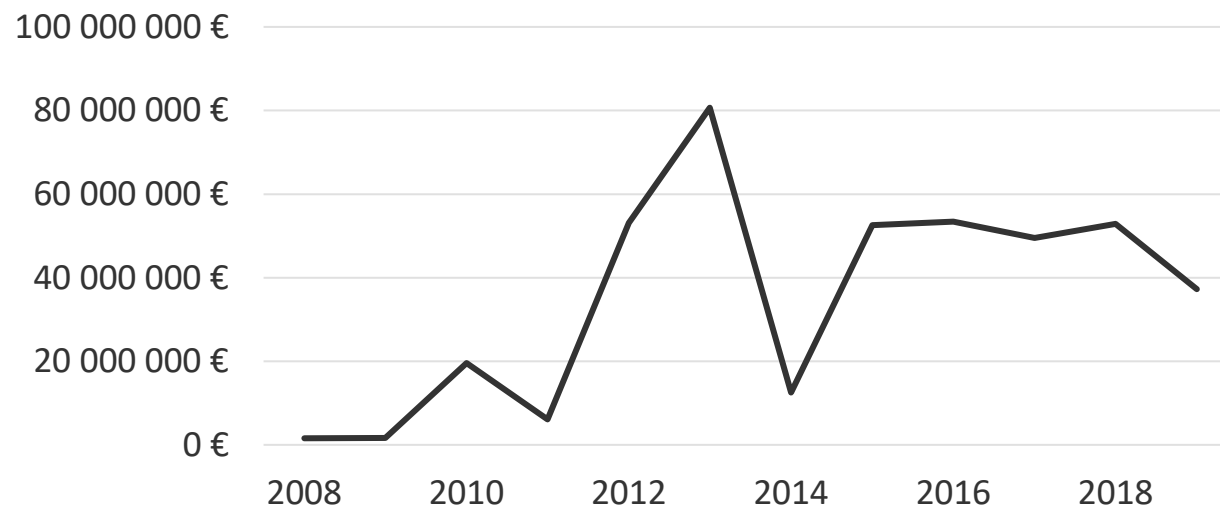


Source: EC 2020

EUROPE CAN BECOME A LEADER IN THE RESPONSIBLE PRODUCTION OF RARE EARTH MATERIALS

- Europe is a leader in sustainability and wants to lead the Clean Tech revolution – Green Deal
- Rare Earths R&D and engineering has always delivered major innovation breakthrough
 - ➡ PAST: gas lamp, colour television, catalyst, aerospace, speciality glasses
 - ➡ PRESENT: permanent magnets in electronics, robots, domestic appliances, EVs, renewable energy; LED
 - ➡ FUTURE: magnetocaloric cooling, optoelectronics,

Capitalize EU R&D projects in rare earths. 10 years total spending: €373 m



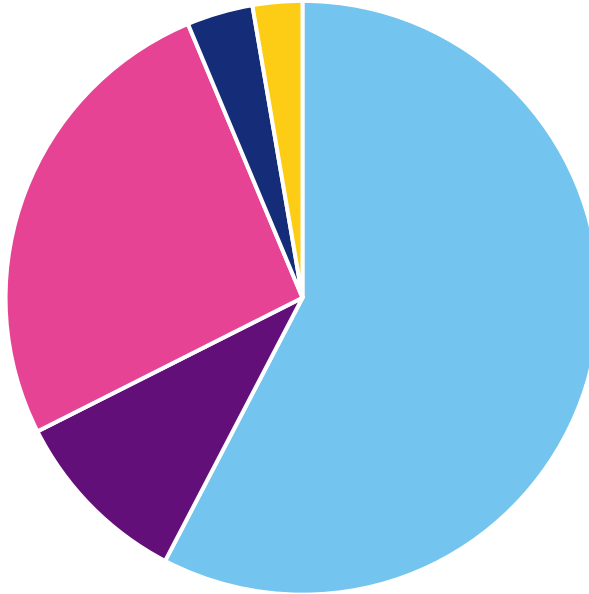
Cordis: Approved budgets per year. Major research fields considered: metallurgy, magnets, optical fibres, electronics, LED, OLED, sensors, speciality glasses, e-motor and generator designs.



New approach needed: Bring together stakeholders from across value chain and society to develop holistic solution.

98 ORGANISATIONS AND 115 PEOPLE HAVE SIGNED UP WITH THE ERMA CLUSTER RARE EARTH MAGNETS AND MOTORS

REE Cluster Network

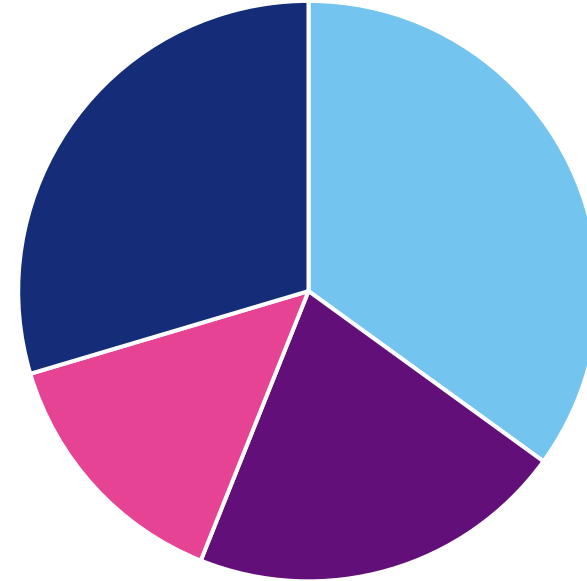


- Industry
- University & Research Organisation
- Financial Institution
- Association
- National Authority & Ministry

Industry partners include:



Value Chain Distribution of REE Cluster



- Primary Raw Materials
- Advanced Materials & Intermediate Products
- Finished Products
- Recycling

WORKSTREAM I: STAKEHOLDER CONSULTATION TO IDENTIFY AND ADDRESS REGULATORY BOTTLENECKS AND TO PROMOTE COLLABORATION

Objectives:

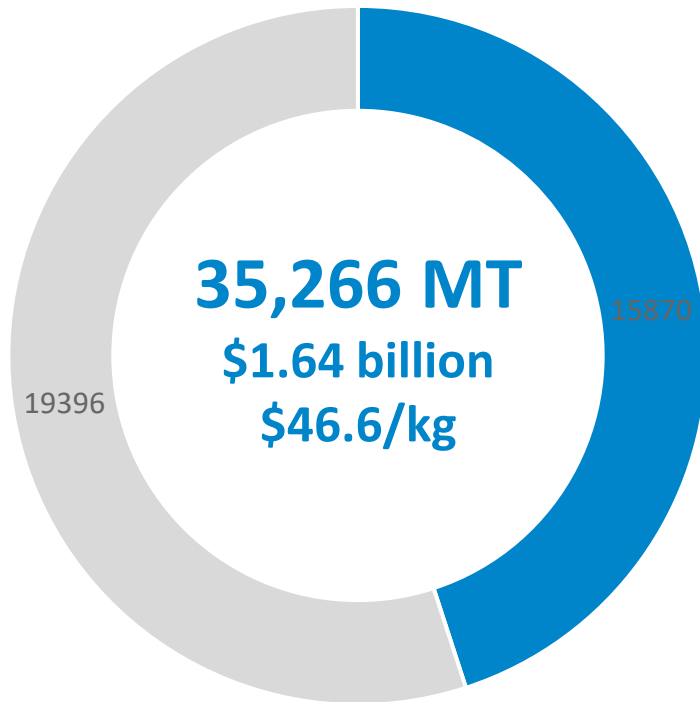
- i) **Implement specific cross value chain measures to regain a Level-Playing-Field with Asian competitors, raise awareness, and to promote EU driven sustainable Rare Earth supply chains for the Green Deal.**
- ii) **Secure access to sustainably produced Magnet Rare Earths at reasonable costs from primary and recycled sources**

Taskforce groups:

- **Facilitate access to finance** for rare earth projects across the value chain
- **Licenses and intellectual property:** Create clarity and transparency regarding key technologies in the rare earth value chain
- **Sustainability:** Define standards and certification schemes for the making of sustainable rare earth magnets and motors
- **Competitiveness:** Get a clear understanding of the cost structure of the rare earth value chain to be able to justify an EU price premium (if necessary) and to identify better innovation needs.
- **Raise awareness** for the importance of rare earth, that the materials can be produced sustainably, and that they are needed to design clean tech.
- **Promote innovation capacity** via Horizon Europe and Member States' funding programs.
- **Identify sources of rare earth raw materials** – primary and secondary

CHINA SUBSIDIZES DOMESTIC RARE EARTHS MAGNETS PRODUCTION WITH VAT REFUNDS ON EXPORTS OF \$226 MILLION, ANNUALLY.

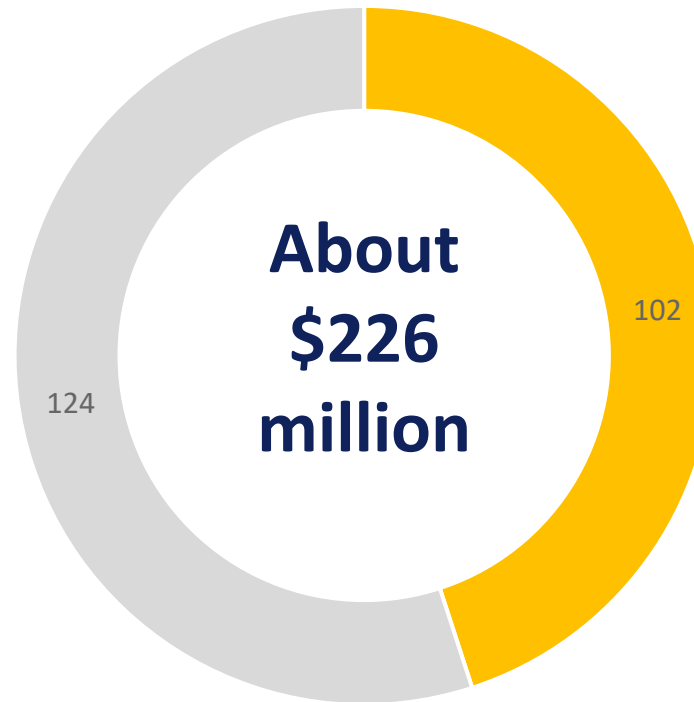
**Chinese 2019 Export Volume
Rare Earth Permanent Magnet**



■ Europe ■ Non-Europe

Source: Chinese Custom
HS: 8505.1110
45% exported to EU

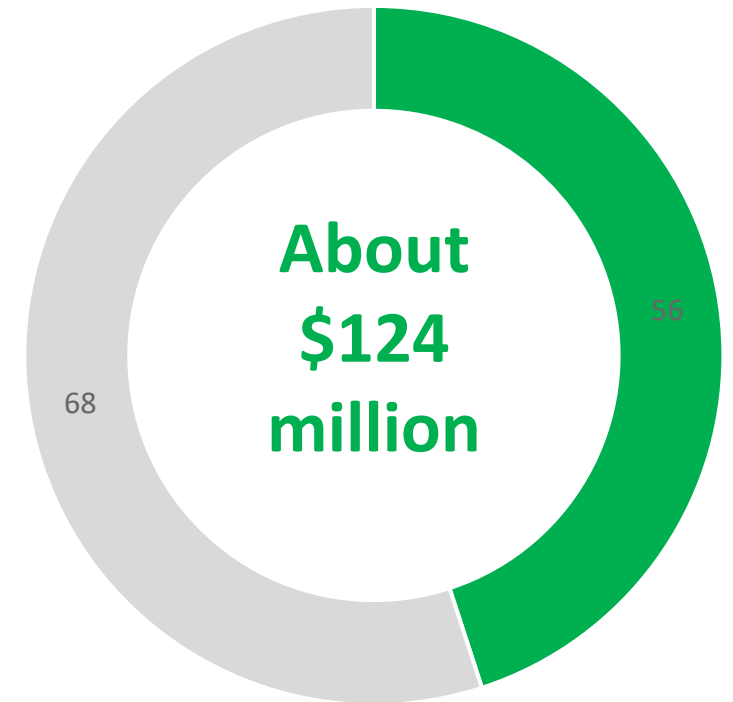
**Export Rare Earth Magnet VAT Refund
by Chinese Government**



■ Europe ■ Non-Europe

16% VAT from Jan-Mar/2019
13% VAT from Apr-Dec/2019
*Average 13.75%

**Export Rare Earth VAT Refund
by Chinese Government**



■ Europe ■ Non-Europe

*Estimated there is ~58% raw materials value,
and ~95% Rare Earth value in raw materials

WORKSTREAM II: IDENTIFICATION OF INVESTMENT CASES

From mine to magnet: Europe has the potential to develop a full rare earths value chain that is competitive



Sources: USDA; USGS; JRC 2017; JRC 2020; Adamas Intel 2019; CEA