Si&Mex
TRANSFORMING CHALLENGES IN OPPORTUNITIES

Si&Mex Solutions GmbH

17TH ASIA METAL
RARE EARTH ELEMENT CONFERENCE

May 19–21, 2026 Xiamen, China

Analysis of Supply and Demand in European Rare Earth Market

Data-driven Insights. Strategic Perspectives.
Resilient Supply Chains.

Market Overview
Supply, Demand and Price Trends

European Outlook
Demand Growth Across Key Applications

Supply Security
Diversification, Recycling & New Projects

Strategic Pathways
Building a Competitive European Ecosystem

OUR COMMITMENT
Delivering clarity on Europe's rare earth landscape to empower informed decisions and long-term value.

FOCUS APPLICATIONS
e-Mobility · Wind Power · Elevators & Escalators · Robotics & Automation · Consumer Electronics

Your Partner for Rare Earth Intelligence & Strategic Solutions

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ASIAN METAL
亚洲金属网

Si&Mex
TRANSFORMING CHALLENGES IN OPPORTUNITIES

(Silicon & Metals Excellence)

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Commercial Register Number: HRB192392

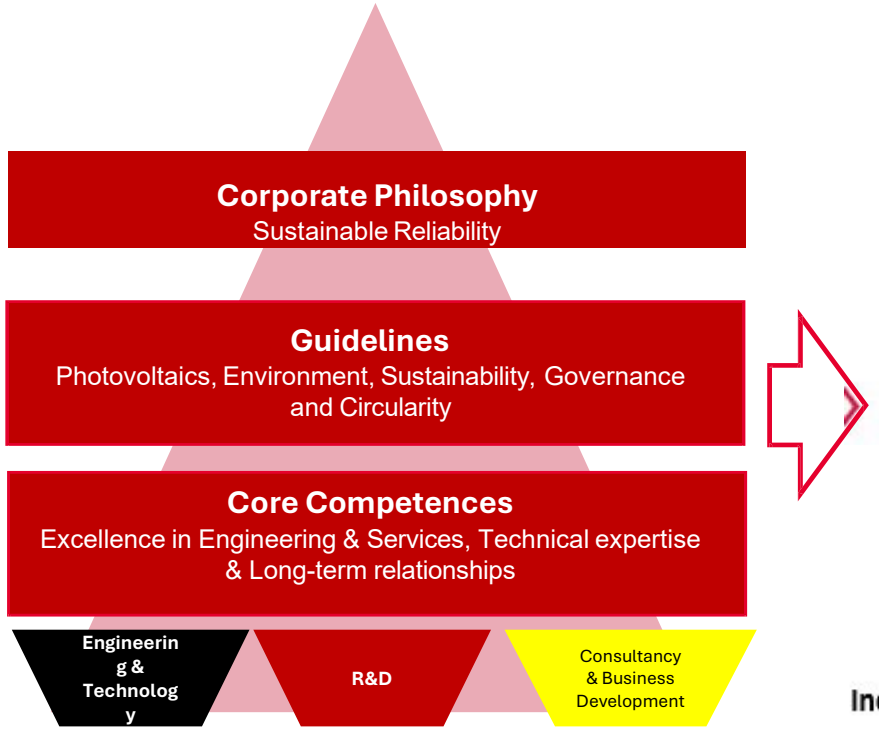
Management Board:

M.Sc. Dipl. Ing. Valdiney Domingos

1 Si&Mex Solutions GmbH

Si&Mex Solutions: Silicon & Metals Excellence | *From Engineering & Technology to Markte & Development*

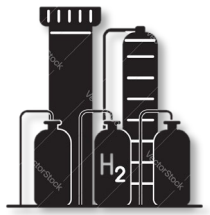
Si&Mex Solutions GmbH seeks excellence in all professional and personal relationships. The company continues to implement Sustainable Reality through our core business activities in the photovoltaic industry. In Design, Project Execution, Manufacturing and Recycling initiatives to support the 1.5oC target based on our Guidelines and Core Competencies.



Metallurgical Silicon

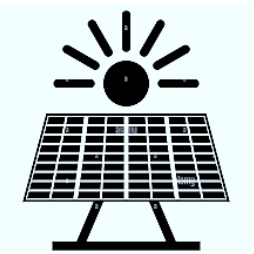
Industrial Furnaces and Related Products

Semiconductors/Kerf Recycling



Hydrogen

Polysilicon



Photovoltaics

Energy Systems

Business Prospection

Smelting and Lining

REEs

Si&Mex Solutions supports the world in the energy transition towards a more sustainable life for humanity and in the fight against climate change.

Deploying national market, the main objective is to support Sustainable revolution against the Climate Changing – focus on Photovoltaics, Semiconctors, Hydrogen, Battery Systems, ESG, Recycling/Circularity, AI applied to new materials development, Energy Transition and CO2 footprint revolution in manufacturing.

Corporate motors are **Engineering & Technology**, **Research & Development**, Consultancy & Business Development.

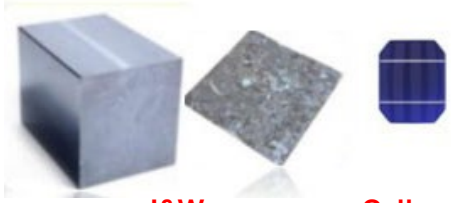
Comprehensive, Strategic and Unique Positioning in the Market (hands-on)


Consultancy


Engineering

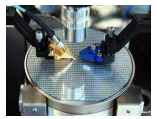

Ferroalloys


MG-Si Poly-Si


I&W Cells


Modules


I&W Semi


Testing


Packaging

Engineering | Design | Operations | Quality | Technology | Processes | Integration | ESG Complete Engineering Integrated Technology & Equipment package Raw Material | Consumables | Final Product | Equipment | Maintenance | Transfer of Know-How

- Silicon 5.0 ® Si&Mex (Including OE and PMC for Solar Glass Manufacturing)
- Feasibility Studies Technical Financial Economics & Complete Engineering (FEL 1 – FEL 6 and FEED)
- Consulting and Technical Support in addition to Complete Process,
- Engineering and Operation Solution Packages
- Assisted Operation with Knowledge and Technology Transfer with ESG Implementation and high Circularity in Processes Technical,
- Quality, Operational, Safety, Health and Environmental Audits
- Components, Systems, Equipment and Factories (Lean Manufacturing)
- ESG Operational Excellence Diagnostics in the Photovoltaic chain
- Management and Execution of Industrial Projects with Plant Design and Layouts focused on Silicon 5.0 ® solution
- Installation, Commissioning, Start-up, Ramp-up and passing of the baton Project – Process
- Implementation of Upgrade, Retrofitting and Optimization Programs
- Strong market team with technical-commercial support and interaction (pre- and post-sales)

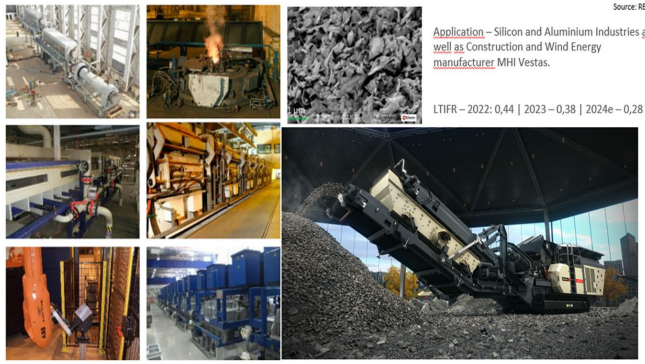
In-house expertise covering entire PV Supply Chain

Si&MEx
BRASIL FOTOVOLTAICO

Capability Matrix

Team	Background	Discipline (Major)	Nationalities	Board Member	Plant Area / Coverage: Business Unit — Solar Glass	MG-Si	PolySilicon	Ingot & Wafer PV	Ingot & Wafer Sem	Solar Cells	Solar Modules	Utilities	Integration	Semiconductors	Plant/Process — Business Prospec	Management	Operations	Process	Quality	Equipment	Admin & HR	ESG-HSE	Project Manageme	Engg. / Support	Legal	Lobby	Experience
AG	Construction	CIV																									43
VD	M.Sc. Dipl. Ing	Chemical Engg																									25
MF	MBA Dipl. Ing	Electrical Engg																									25
JN	Att	Att																									35
RF	Dipl. Ing.	Electrical Engg																									29
AR	Dipl. Ing	Mechanical Engg																									35
LK	Dipl. Ing	Process																									30
AC	Dipl. Ing.	Process																									38
JH	Dr.	Physics																									37
DS	M.Sc. Dipl. Ing	Chemical Engg																									34
EL	Dipl. Ing	Chemical Engg																									24
LF	PhD	Chemical Engg																									38
LB	Dipl. Ing	Mechanical Engg																									41
DK	PhD	Mechanical Engg																									36
NS	Dipl. Ing	Civil Engg																									11
OZ	Dipl. Ing	Process																									30
GM	Dipl. Ing	Commercial																									26
DF	Dipl. Ing	Civil Engg																									30
SL	Dipl. Ing	Mechanical Engg																									25
EY	Dipl. Ing / Physicyst	Mechanical Engg																									26
TC	Dipl. Ing	Chemical Engg																									25
HL	M.Sc. Dipl. Ing	Safety Engg																									36
PM	Dipl. Ing	Env. Engg																									21
BL	Dipl. Ing	Chemical Engg																									31
KD	Dipl. Ing	Metalurgist																									19
EU	Dipl. Ing	Chemical Engg																									18
MC	Dipl. Ing	Mechanical Engg																									35
DG	Dipl. Ing	Chemical Engg																									34
CY	Dipl. Ing	Chemical Engg																									19
WL	Dipl. Ing	Chemical Engg																									25
SR	Dipl. Ing	Process																									16
AT	Dipl. Ing	Automation Eng																									42
ML	Dipl. Ing	Automation Eng																									25
GB	Dipl. Ing	Automation Eng																									25
IB	Dipl. Ing	Chemical Engg																									16
																									Total		1001

Some references:

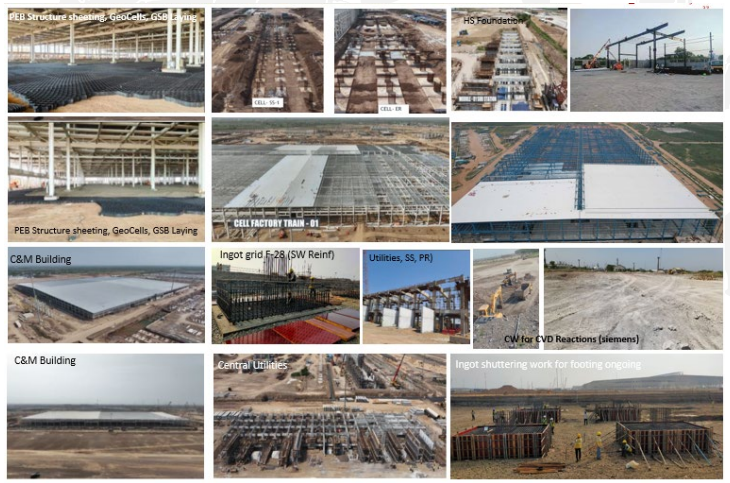


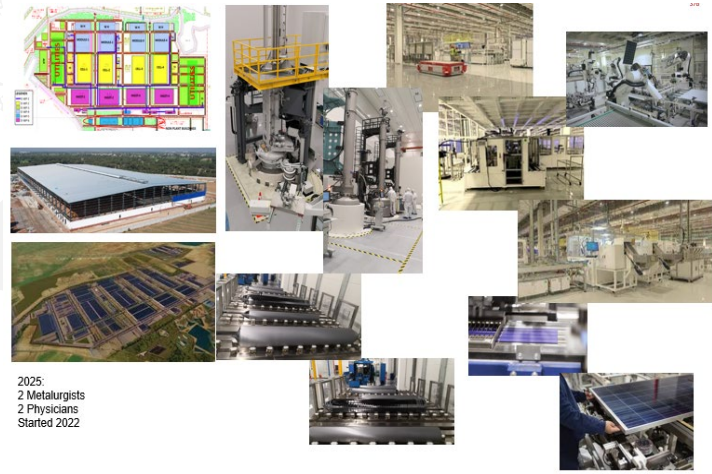
Source: REC Emea GmbH

Application – Silicon and Aluminium Industries as well as Construction and Wind Energy manufacturer MHI Vestas.

LTIFR – 2022: 0,44 | 2023 – 0,38 | 2024e – 0,28

Operation of 8.000 tons per year Recycling Plant for Kerf Silicon and PV Manufacturing wastes – Main equipment: Shredder (Metso), Magnetic Separator (Eriez), Shear (Rawmec), Rotary Kilns system (KHD Humbolodt), Camfil Conveyor System, Submerged Arc Furnace (Elkem), Refining system (Vatvedt).





2025:
2 Metalurgists
2 Physicians
Started 2022

More than 1 Millenium in Expertise of the Project Team, not considering the Consortium Expertise that Si&Mex will be engaging as Owner´s Engineering Representative, Local Construction Companies, EPCMs, Consultancies.

Comprehensive, Strategic and Unique Positioning in the Market (hands-on)

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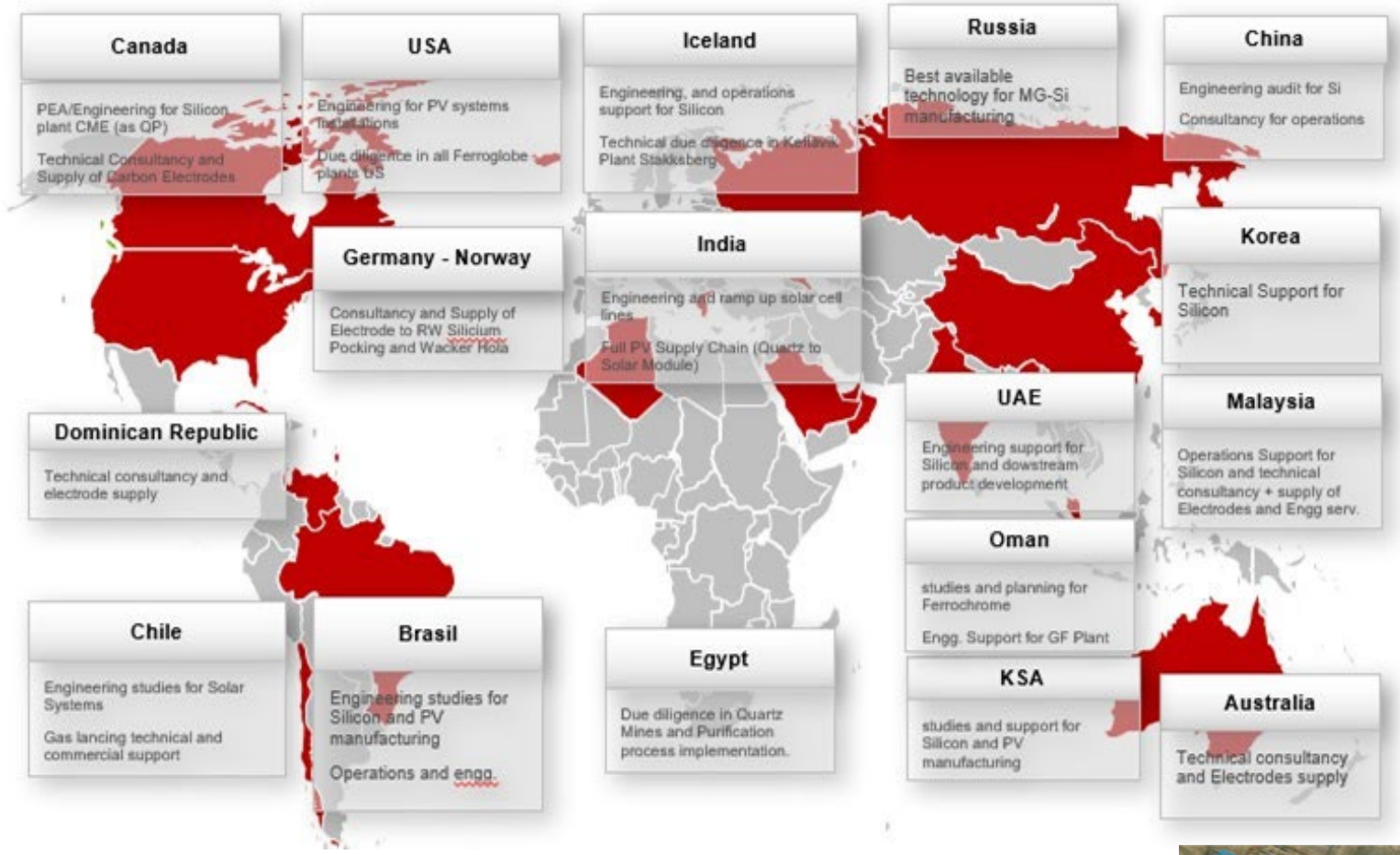
TRANSFORMING CHALLENGES IN OPPORTUNITIES



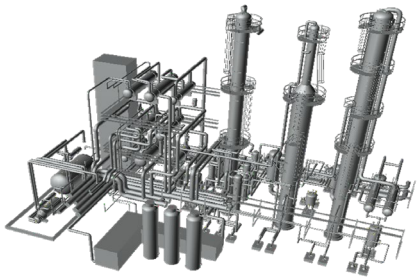
AETHER ALLOYS LLP

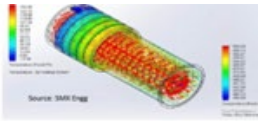
SNC

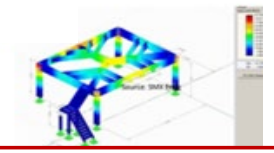
SHANKARANARAYANA CONSTRUCTIONS PVT LTD

Nation Builders Since 1960

APPCPL







2 Market Overview

Global NdFeB Magnet Production & Demand Outlook

Historical Development (2016–2024) and Forecast (2025–2030)

Global NdFeB magnet production is expected to continue increasing and surpass demand from 2028 onward.
The gap between supply and demand will widen through 2030.

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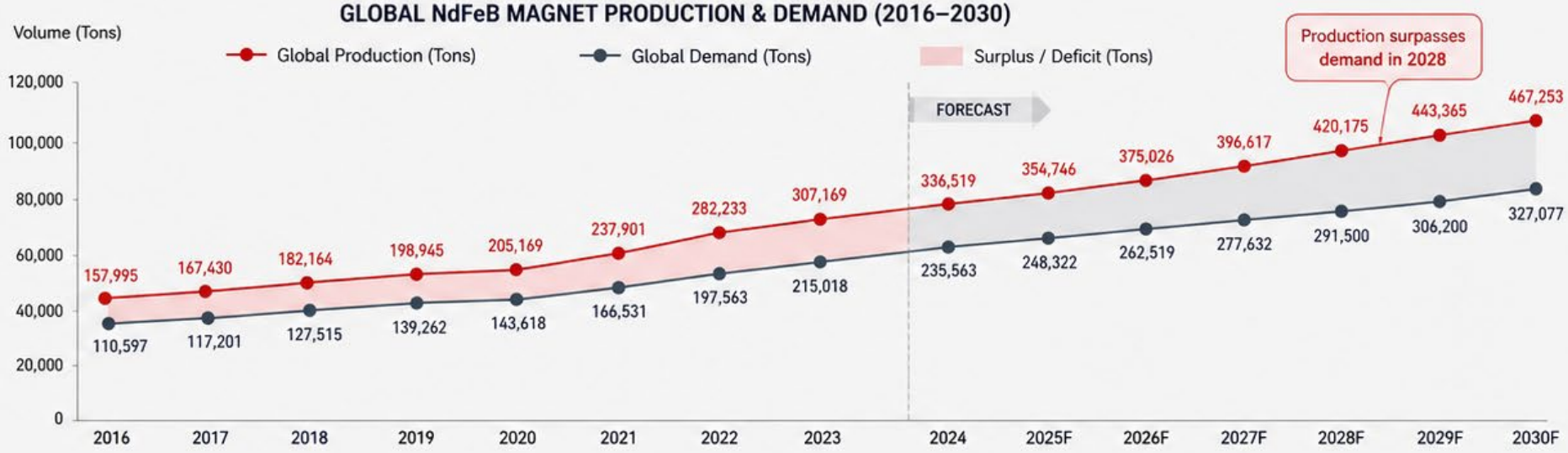
GLOBAL NdFeB MAGNET PRODUCTION & DEMAND (2016–2030)



Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025F	2026F	2027F	2028F	2029F	2030F
Global Production (Tons)	157,995	167,430	182,164	198,945	205,169	237,901	282,233	307,169	336,519	354,746	375,026	396,617	420,175	443,365	467,253
Global Demand (Tons)	110,597	117,201	127,515	139,262	143,618	166,531	197,563	215,018	235,563	248,322	262,519	277,632	291,500	306,200	327,077
Surplus / Deficit (Tons)	+47,398	+50,229	+54,649	+59,683	+61,551	+71,370	+84,670	+92,151	+100,956	+106,424	+112,507	+118,985	+128,675	+137,165	+140,176
Production Growth (YoY)	6%	6%	9%	9%	3%	16%	19%	9%	10%	5%	6%	6%	6%	6%	5%
Demand Growth (YoY)	6%	6%	9%	9%	3%	16%	19%	9%	10%	5%	6%	6%	5%	5%	7%

F = Forecast

Note: Minor differences due to rounding.

MARKET DEVELOPMENT SUMMARY

HISTORICAL GROWTH
Strong production growth from 157,995 tons in 2016 to 336,519 tons in 2024 (CAGR ~10.7%).

FORECAST OUTLOOK
Production continues to grow at ~5–6% CAGR through 2030, driven by capacity expansion and new projects.

DEMAND OUTLOOK
Demand grows steadily at ~5–6% CAGR, supported by EVs, wind power, robotics and industrial applications.

SUPPLY–DEMAND BALANCE
Sustained surplus from 2028 onwards ensures a healthier market balance and more resilient supply chain.

KEY TAKEAWAYS

- Global NdFeB magnet production continues to grow strongly, reaching ~467,000 tons in 2030.
- Demand grows steadily with low single-digit YoY increases, reaching ~327,000 tons in 2030.
- Production surpasses demand in 2028 and the supply gap widens through 2030.
- By 2030, surplus is forecasted at ~140,000 tons (+43% vs. 2024).

2030 FORECAST SUMMARY

Global Production	96,560 Tons
Global Demand	93,660 Tons
Surplus (Production – Demand)	2,900 Tons

The market remains in surplus after 2028, supporting price stability and supply security.

Source: Lynas Rare Earths – Market data & forecasts (May 2024)

Global NdPr Market Overview

SUPPLY – DEMAND BALANCE & OUTLOOK (2016–2030F)

After a period of oversupply through 2023, the NdPr market moved to near balance in 2024.
With growing non-Chinese supply, recycling expansion, and new projects, the market is expected to tighten from 2027 onward.

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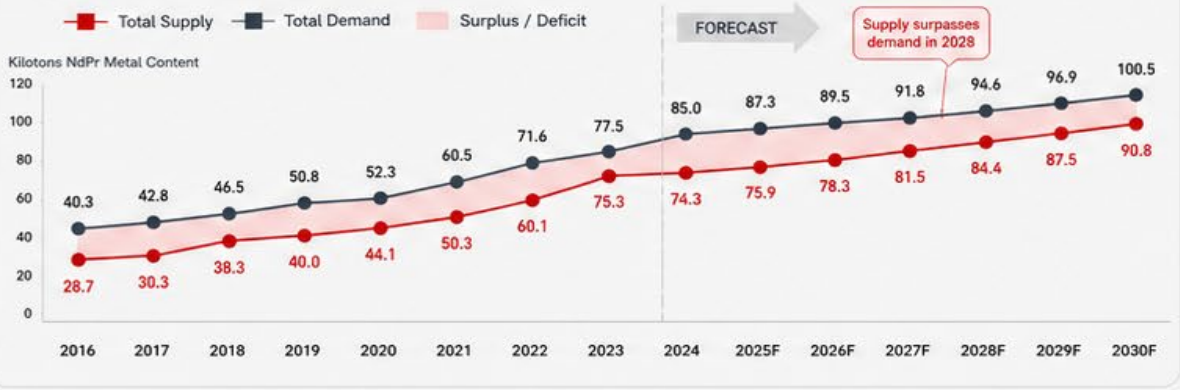
NdPr SUPPLY BALANCE (FRESH OXIDE BASIS) – KILOTONS NdPr OXIDE

Kilotons NdPr Oxide	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025F	2026F	2027F	2028F	2029F	2030F
China (NRE)	12.7	12.7	14.3	14.6	15.1	20.7	29.2	36.8	38.9	40.0	41.0	42.5	44.0	45.5	47.5
Other Chinese	10.3	10.3	11.8	10.3	10.9	11.1	11.2	12.2	12.9	13.0	13.2	13.5	13.8	14.2	14.6
Myanmar (ionic clay)	0.3	1.2	3.2	4.0	4.9	4.0	4.2	12.0	9.0	8.5	8.0	7.5	7.0	6.5	6.0
MP Materials (USA)	0.2	0.1	2.5	4.2	6.5	6.9	7.0	6.1	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Monazite	0.3	0.2	0.5	0.8	1.3	1.9	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.5
China Total	**23.7**	**24.5**	**32.3**	**33.9**	**38.8**	**44.5**	**53.3**	**68.9**	**67.6**	**69.0**	**71.0**	**73.6**	**76.0**	**78.5**	**81.2**
Non-China Total	5.0	5.8	6.0	6.0	5.3	5.8	6.8	6.5	6.7	6.9	7.3	7.9	8.4	9.0	9.6
GLOBAL TOTAL SUPPLY	**28.7**	**30.3**	**38.3**	**40.0**	**44.1**	**50.3**	**60.1**	**75.3**	**74.3**	**75.9**	**78.3**	**81.5**	**84.4**	**87.5**	**90.8**

NdPr DEMAND FOR MAGNETS (METAL BASIS) – KILOTONS NdPr METAL

Kilotons NdPr Metal	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025F	2026F	2027F	2028F	2029F	2030F
China (25% NdPr content)	35.3	37.0	40.5	44.5	46.5	54.1	65.2	73.3	79.9	82.0	84.0	86.0	88.5	90.5	93.7
Rest of World (30% NdPr content)	5.1	5.8	6.0	6.3	5.8	6.4	6.4	4.3	5.1	5.3	5.5	5.8	6.1	6.4	6.8
GLOBAL TOTAL DEMAND	**40.3**	**42.8**	**46.5**	**50.8**	**52.3**	**60.5**	**71.6**	**77.5**	**85.0**	**87.3**	**89.5**	**91.8**	**94.6**	**96.9**	**100.5**
NON-MAGNET DEMAND	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SUPPLY – DEMAND BALANCE	**-12.6**	**-13.5**	**-9.2**	**-11.8**	**-9.2**	**-11.2**	**-12.5**	**-3.2**	**-11.7**	**-12.3**	**-12.2**	**-11.3**	**-11.1**	**-10.4**	**-9.7**

GLOBAL NdPr SUPPLY vs DEMAND (Kilotons NdPr Metal Content)



SUPPLY – DEMAND BALANCE

Kilotons NdPr Metal Content

KEY TAKEAWAYS

- Serious oversupply until 2023 due to strong Chinese output and demand slowdown.
- Market improved to near balance in 2024 with reduced oversupply.
- From 2028, supply surpasses demand and the market turns to surplus, which may support price stability.
- Non-Chinese supply and recycling expansion will play a key role in bringing more transparency and resilience to the market.

2030 FORECAST SUMMARY

Total Supply (Metal Content)	90.8 ktons
Total Demand (Metal Content)	100.5 ktons
Supply – Demand Balance (Deficit)	-9.7 ktons
Supply Growth (2024–2030)	~3.2% CAGR
Demand Growth (2024–2030)	~3.1% CAGR

Source: Lynas Rare Earths – Market data & forecasts (May 2024)

This report is provided by **Si&Mex Solutions GmbH** *– Your Partner for Market Intelligence in Advanced Materials*

Global Market Concentration & Distribution – Supply Chain

ALONG THE SUPPLY CHAIN

NdPr supply chain is highly concentrated in China across all stages, from mining to magnet production.
Downstream applications such as EVs and wind turbines also rely heavily on China's NdPr value chain.

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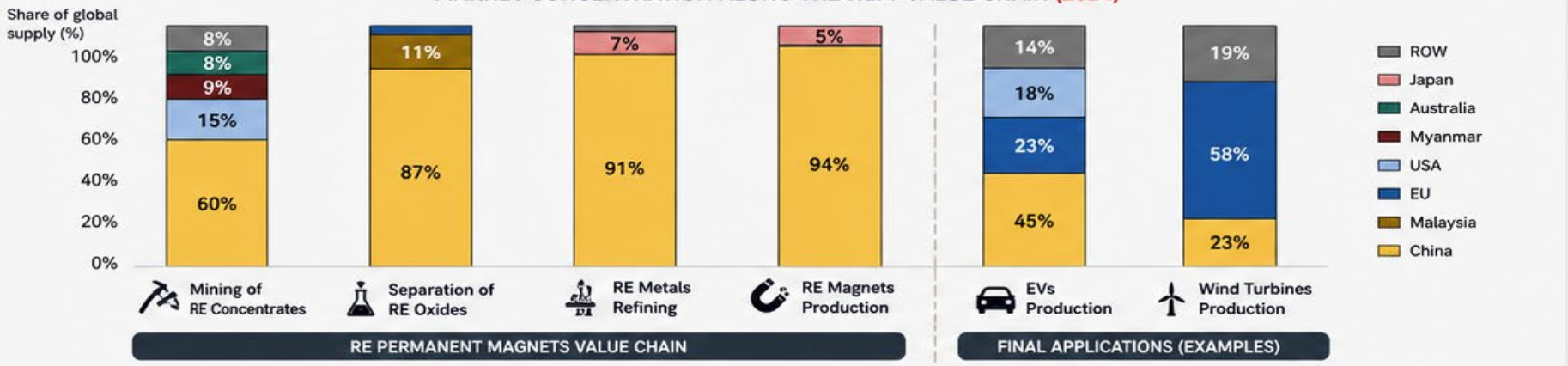
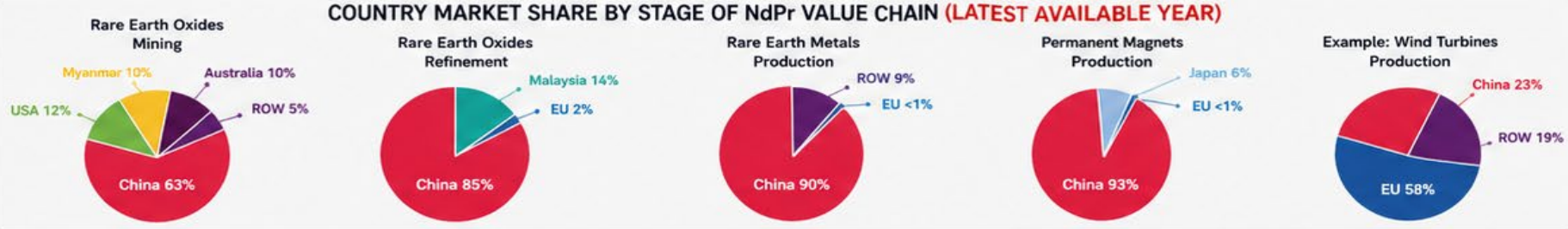
MARKET CONCENTRATION ALONG THE NdPr VALUE CHAIN (2024)



NdPr SUPPLY OUTLOOK FROM OPERATING & ANNOUNCED PROJECTS (BASE CASE)

COUNTRY MARKET SHARE BY STAGE OF NdPr VALUE CHAIN (LATEST AVAILABLE YEAR)



Note: Top 3 share includes China plus the next two largest countries in each category.

Source: Lynas Rare Earths, Roskill, Adamas Intelligence, IEA, Company Reports, Si&Mex Solutions GmbH Analysis (May 2024)

KEY TAKEAWAYS

- China dominates the NdPr supply chain across all stages, controlling 87–94% of value chain before final applications.
- Downstream industries (EVs, Wind) remain dependent on China's NdPr magnets and components.
- Non-Chinese supply is growing but still insufficient to reduce market concentration in the short term.
- Supply diversification and recycling expansion are critical for long-term resilience and energy security.

OUTLOOK 2024–2030

- Non-Chinese projects will increase supply outside China from 2027 onward.
- ROW share in mining to reach ~25–30% by 2040, but China remains dominant.
- New separation & refining capacity outside China remains limited until late 2020s.
- Recycling will gradually contribute more NdPr supply, improving transparency and sustainability.

Diversify. Secure. Sustain.
Building a resilient NdPr supply chain for the future.

Supply Chain Perspective – from Materials through Technologies and Sectors

Powering the Energy Transition and Advanced Technologies

NdPr is a critical enabler for a wide range of clean energy, e-mobility and digital technologies.
Supply risk varies by material, impacting different technologies and sectors across the value chain.

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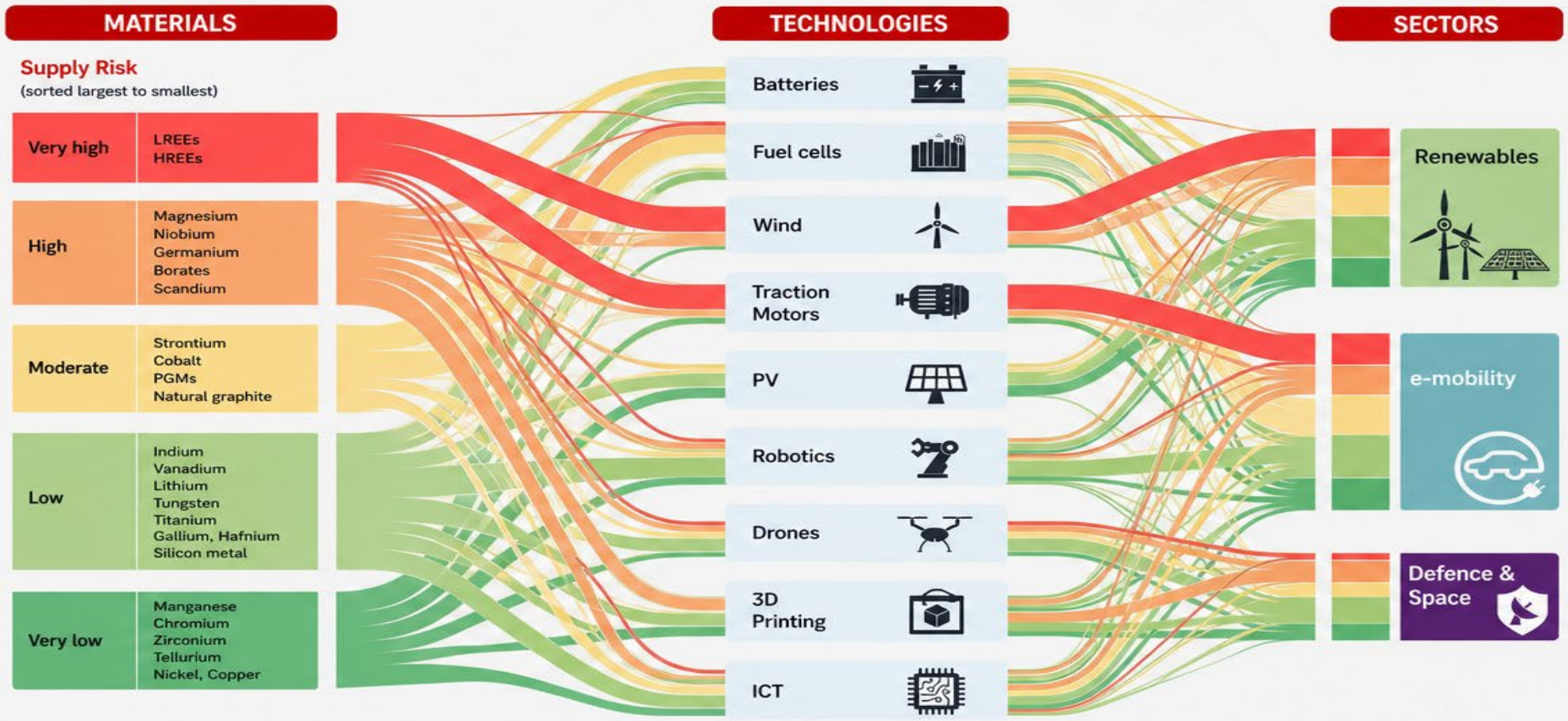


KEY TAKEAWAYS

- NdPr is essential across a broad range of strategic technologies and future-facing sectors.
- High supply risk materials (LREEs, HREEs) are critical for batteries, motors, wind and advanced technologies.
- Diversified supply and recycling are key to reducing risks and ensuring long-term resilience.
- Technological innovation and substitution can help reduce dependency over time.

WHY IT MATTERS

- Enables the energy transition and decarbonization.
- Supports electrification and sustainable mobility.
- Drives automation, industrial competitiveness and productivity.
- Strengthens strategic autonomy in defence and space.

HOW TO READ THIS DIAGRAM

Left (Materials): Critical minerals ranked by supply risk from very high to very low.

Middle (Technologies): NdPr and other critical materials flow into key technologies that power the future.

Right (Sectors): These technologies enable essential sectors that drive economic growth and sustainability.

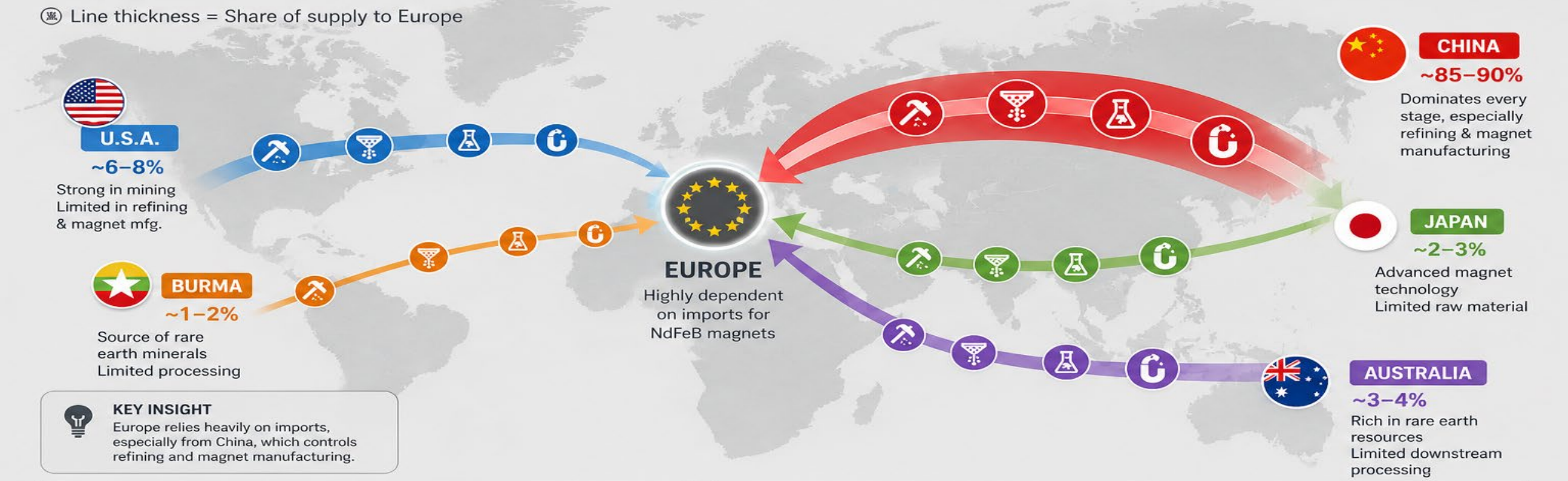
SUPPLY RISK LEGEND: Very high · High · Moderate · Low · Very low

Source: IEA, Adamas Intelligence, USGS, Roskill, Company Reports, **Si&Mex Solutions GmbH** Analysis (May 2024)

GLOBAL SUPPLY CHAINS OF SINTERED NdFeB MAGNETS

Geographical concentration of supply chain stages for Europe

Line thickness = Share of supply to Europe



KEY INSIGHT
Europe relies heavily on imports, especially from China, which controls refining and magnet manufacturing.

SUPPLY CHAIN STAGES

1. **MINING** — Extraction of rare earth minerals from ores
2. **SEPARATION** — Oxide separation and concentrate processing
3. **REFINING** — Rare earth oxide refining and metal production
4. **MAGNET MFG.** — Sintered NdFeB magnet manufacturing

Value Added Increases →

ESTIMATED SHARE OF SUPPLY TO EUROPE BY STAGE

Country	Mining	Separation	Refining	Magnet Mfg.	Overall Share
China	60–70%	85–95%	90–95%	90–95%	85–90%
U.S.A.	10–15%	5–10%	<5%	<5%	6–8%
Burma (Myanmar)	5–10%	<5%	<5%	<5%	1–2%
Australia	10–15%	<5%	<5%	<5%	3–4%
Japan	<5%	<5%	<5%	<5%	2–3%
Other Countries	<5%	<5%	<5%	<5%	2–3%

Note: Shares are approximate and may vary by source and methodology.

Source: Various industry reports, USGS, BM, IRENA, company disclosures.

European Snapshot – REEs & NdFeB Magnets overview

SUPPLY CHAIN DYNAMICS, APPLICATIONS & MARKET OUTLOOK TO 2030

Europe depends heavily on external supply for rare earths and NdFeB magnets, while demand is driven by the energy transition, e-mobility and advanced technologies. Strategic diversification and recycling are key to balancing the market.

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THE NdPr VALUE CHAIN: FROM RAW MATERIALS TO APPLICATIONS

APPLICATIONS (EXAMPLES)

NEW CAPACITY & MARKET SHARE (2023)

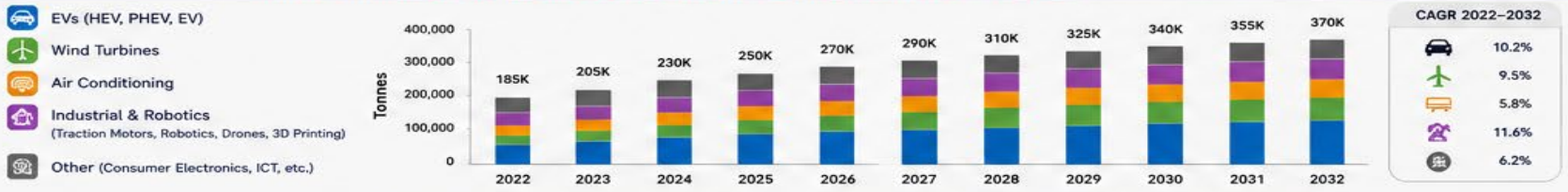
Note: e = estimate. Source: GWEC Market Outlook 2024

EUROPE NdPr MARKET BALANCE & OUTLOOK (METAL BASIS)

Kilotons NdPr Metal	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025F	2025F	2026F	2028F	2029F	2030F
Total Supply (Metal Content)	40.3	42.8	46.5	50.8	52.3	60.5	71.6	77.5	85.0	87.3	89.5	91.8	94.6	96.9	100.5
Total Demand (Metal Content)	53.5	56.3	59.5	61.0	61.5	63.2	66.4	82.0	85.0	87.3	89.5	91.8	94.6	96.9	100.5
Balance (Supply – Demand)	-13.2	-13.5	-13.0	-10.2	-9.2	-2.7	+5.2	-4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

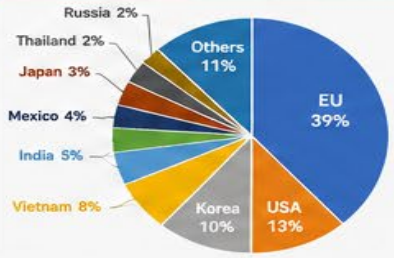
Market moves from deficit to near balance in 2024. From 2028 onward, supply is expected to surpass demand.

NdFeB MAGNET CONSUMPTION OUTLOOK BY APPLICATION (GLOBAL) – TONNES



Demand driven by EVs and wind energy. EVs are expected to represent >45% of NdFeB magnet consumption by 2030.

CHINA RARE EARTH PERMANENT MAGNET (REPM) EXPORTS 2024
TOP 10 DESTINATIONS BY QUANTITY



Europe is the largest importer of Chinese REPMs, accounting for 39% of total exports in 2024.

Source: China Customs, 2024

EUROPE xEV PRODUCTION OUTLOOK (PASSENGER CARS & VANS)

Source: APC UK, Q1 2024

KEY DEMAND DRIVERS

Electric Vehicles
xEV production in Europe expected to reach 18M units by 2030.

Wind Energy
Onshore & offshore installations growing at ~9% CAGR.

Elevators & Escalators
Market size to reach USD 170.6B by 2032 (CAGR 4.4%).

Industrial Automation
Robotics, traction motors and drones increase NdFeB magnet demand.

Electronics & ICT
Rising adoption of high-performance magnets in electronics.

KEY TAKEAWAYS

- China dominates the NdPr value chain across all stages (85–93%) before final applications.
- Europe remains heavily import-dependent despite growing demand.
- Supply diversification and recycling are critical to strengthen market resilience.
- Demand growth outpaces supply until 2023, turning to surplus from 2028.
- Strategic actions today will secure Europe's access to critical technologies tomorrow.

STRATEGIC PRIORITIES FOR EUROPE

- Diversify supply sources (US, Australia, Malaysia, etc.)
- Invest in separation, refining and magnet manufacturing
- Scale up recycling of NdFeB magnets
- Strengthen innovation & substitution where possible
- Secure long-term offtake and strategic partnerships

Sources: Lynas Rare Earths, IEA, GWEC, APC UK, Precedence Research, China Customs, Company Reports, Roskill, Adamas Intelligence, Si&Mex Solutions GmbH Analysis (May 2024)

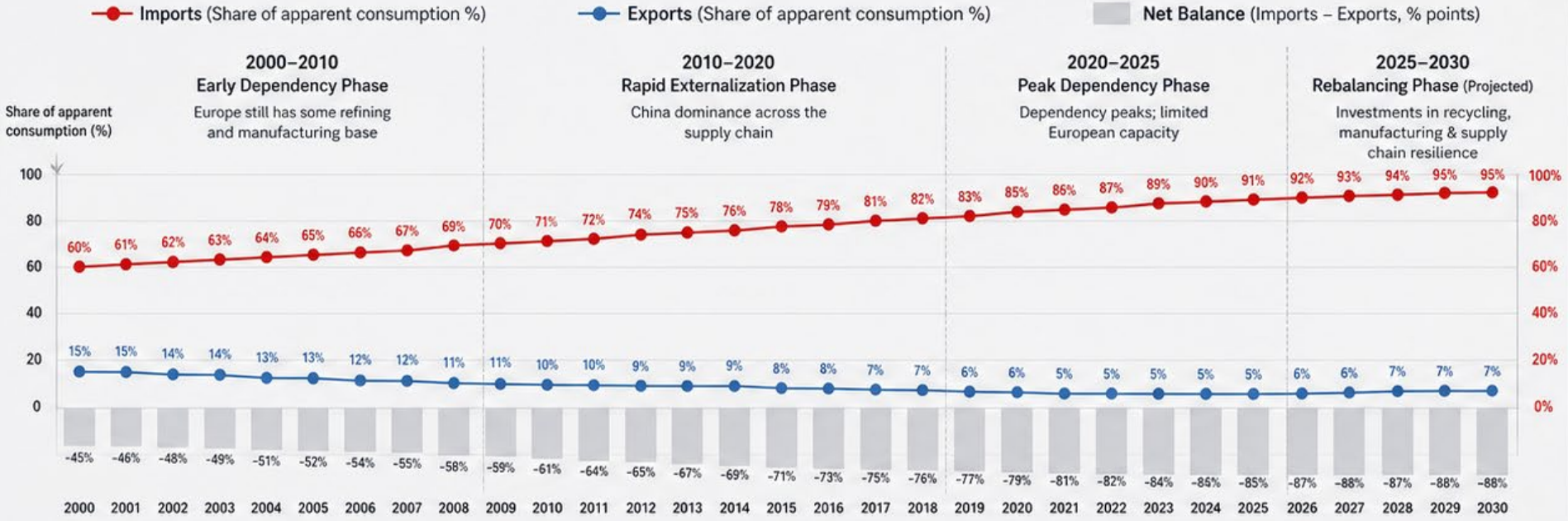
3 European Domestics

NdFeB European Market and Forecast (2000 to 2030)

IMPORTS VS EXPORTS AND SUPPLY CHAIN EVOLUTION

Europe remains highly import-dependent for NdFeB magnets. While exports grow slowly, strategic investments in recycling and manufacturing are expected to reduce dependency by 2030.

EUROPE NdFeB MAGNETS TRADE BALANCE (IMPORTS vs EXPORTS)



Note: Shares may not add up to 100% due to rounding.

EUROPE NdFeB MAGNET SUPPLY CHAIN – ESTIMATED EUROPEAN DOMESTIC SHARE (% OF GLOBAL SUPPLY)

MINING (Rare Earth Ores)

2000	2020	2030*
≈1%	≈2%	≈5–10%

Limited domestic resources; new projects in Sweden, Finland and Greenland could increase share.

SEPARATION & CONCENTRATION

2000	2020	2030*
≈5%	≈10%	≈30–45%

New separation capacity under development in Europe to reduce dependence on Asia.

REFINING (REE Oxides & Metals)

2000	2020	2030*
≈10%	<5%	<10%

Refining remains the biggest gap in Europe's supply chain.

MAGNET MANUFACTURING (NdFeB Magnets)

2000	2020	2030*
≈15–20%	≈2–3%	≈20–25%

New magnet factories in Estonia, Germany and other countries will increase local production.

RECYCLING (Scrap & End-of-Life)

2000	2020	2030*
≈0%	≈2%	≈10–20%

Recycling expected to grow significantly and become a key secondary source.

Sources: Eurostat, USGS, Adamas Intelligence, Project Blue, Company Reports, Industry Publications

KEY INSIGHTS

- Europe imports 90–95% of NdFeB magnets throughout most of the period.
- Exports remain low (5–10%), focused on specialized and high-value magnet applications.
- Recycling is the fastest growing source of domestic supply and key to reducing dependency.
- Manufacturing capacity is expected to increase gradually towards 2030.

MARKET OUTLOOK 2030*

Imports Share	~85–90%
Exports Share	~10–15%
Net Balance	~ 75 to -80 pp
Recycling Contribution to Apparent Consumption	~10–15%

*2030 values are projections based on announced projects, policy targets and industry forecasts.

Source: SMX - Si&Mex Solutions GmbH

NdFeB Sintered Magnet Production Process – European focus

Dual Pathways: From Raw Materials to High-Performance Magnets

Sintered NdFeB (Neodymium-Iron-Boron) magnets deliver the highest energy density among permanent magnets. They are essential for e-mobility, wind power, industrial automation, robotics and countless high-tech applications.

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1 TRADITIONAL MANUFACTURING ROUTE
From Natural Resources

MINING (100%)

Extraction of rare earth ores (Bastnäsite, Monazite)

1 MINING REEs (~1% REO)

Crushing, grinding and beneficiation to produce concentrate

2a HARVESTING

Hydrometallurgical processing to extract rare earth elements

2b DEMAGNETIZATION

Oxidation treatment to remove residual magnetism

2c CLEANING

Leaching and purification to prepare feed materials

2 MAGNET-TO-MAGNET RECYCLING ROUTE
Circular & Sustainable Alternative

2 STRIP CASTING

Alloy preparation and strip casting (rapid solidification) to produce NdFeB alloy strips

3 HYDROGEN DECREPITATION


Hydrogenation and decrepitation of alloy strips into powder

DOWNSTREAM MANUFACTURING – COMMON TO BOTH ROUTES

4 JET MILLING

Powder milling to achieve precise particle size distribution

5 ALIGNING & PRESSING IN MAGNETIC FIELD

Powder alignment in a magnetic field followed by compaction

6 ISOSTATIC PRESSING

Cold Isostatic Pressing (CIP) to increase green density and mechanical strength

7 SINTERING

High temperature sintering in vacuum/inert atmosphere to achieve full density

8 ANNEALING

Heat treatment to optimize magnetic properties

HIGH-PERFORMANCE NdFeB SINTERED MAGNETS

- High Energy Density
- High Coercivity
- Excellent Temperature Stability
- Critical for a Sustainable Future

KEY BENEFITS OF RECYCLING ROUTE

RESOURCE SECURITY
Reduces dependence on mined raw materials

ENVIRONMENTAL IMPACT
Lower CO_2 emissions and energy consumption

CIRCULAR ECONOMY
Closes the loop and extends material life cycle

COST EFFICIENCY
Reduces material and supply chain costs

Source: SMX - Si&Mex Solutions GmbH

NdFeB European Supply Chain Build-Up (2024-2030)

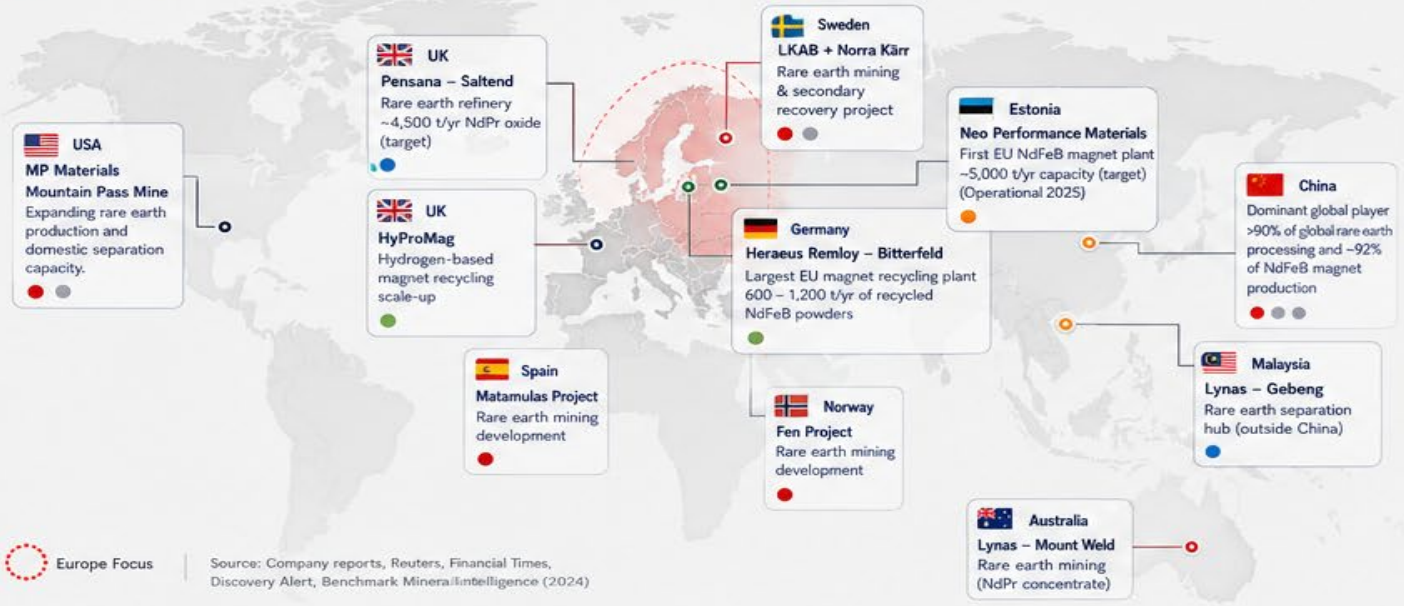
Strategic Projects Powering Europe's Rare Earth & NdFeB Magnet Ecosystem

Europe is accelerating the development of a resilient and sustainable NdFeB supply chain to reduce import dependency, strengthen industrial competitiveness and enable the energy transition and advanced technologies.

Si&Mex Solutions GmbH
www.siemex.solutions

1 GLOBAL PROJECT LANDSCAPE – NEW RARE EARTH & NdFeB PROJECTS

Mining · Separation / Refining · Magnet Manufacturing · Recycling · Other / Development



Europe Focus

Source: Company reports, Reuters, Financial Times, Discovery Alert, Benchmark MineralIntelligence (2024)

2 NdFeB MAGNET APPLICATIONS & DEMAND DRIVERS

EV Motors — High performance traction motors drive demand

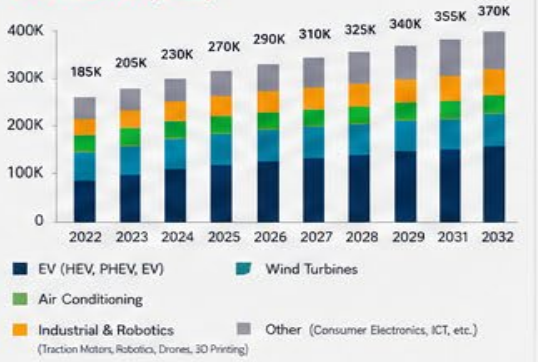
Wind Turbines — Several tons of NdFeB per turbine, especially offshore

Elevators & Escalators — Permanent magnet motors improve efficiency

Robotics & Automation — Precision magnets critical for motion control

Consumer Electronics — Miniaturization increases magnet intensity

GLOBAL NdFeB MAGNET CONSUMPTION OUTLOOK BY APPLICATION (Tonnes)



NEW INSTALLATIONS OUTLOOK GLOBAL (GW)

Note: e = estimate. Source: GWEC Market Outlook 2024

3 EUROPE NdFeB SUPPLY CHAIN EVOLUTION

	Mining	Separation	Refining	Magnet Manufacturing	Recycling
EU Status 2024	negligible	limited	very limited	< 2% global production	early stage
2030 Outlook	small but growing	significant expansion	improving capacity	scaling (Estonia)	strong growth
Key European Projects	LKAB (SE) Sokli (FI) Matamulas (ES) Fen (NO)	Solvay (FR) Lynas (UK) Other EU initiatives	Pensana Saltend (UK) Solvay (FR) EU projects pipeline	Neo (EE) Expansions in planning	Heraeus Remloy (DE) HyProMag (UK/DE) EU recycling projects
EU 2030 Target*	~10%	~40%	~40%	~25%	~25%

*Targets aligned with EU Critical Raw Materials Act strategic benchmarks for 2030.

4 EU MILESTONES TIMELINE

- **2024** Ecosystem fragmented, heavy import dependence (>90%)
- **2025** Solvay separation restart (FR), Neo magnet plant ramp-up (EE)
- **2026** Heraeus recycling plant scale-up (DE), HyProMag expansion (UK/DE)
- **2027** Pensana refinery commissioning (UK), refining capacity growth
- **2028** Supply-demand gap begins to narrow, projects reach steady state
- **2030** **Partial supply chain autonomy achieved (~20–30% of EU demand covered)**

EU STRATEGIC TARGETS FOR 2030

- 10% of EU annual consumption from EU mining
- 40% from EU processing (separation & refining)
- 25% from EU recycling
- Reduce import dependency and strengthen resilience

5 KEY TAKEAWAYS

HIGH DEPENDENCY — Europe imports ~90–98% of rare earths and NdFeB magnets today, mainly from China.

BUILDING CAPACITY — Multiple projects across the value chain are coming online between 2024–2030.

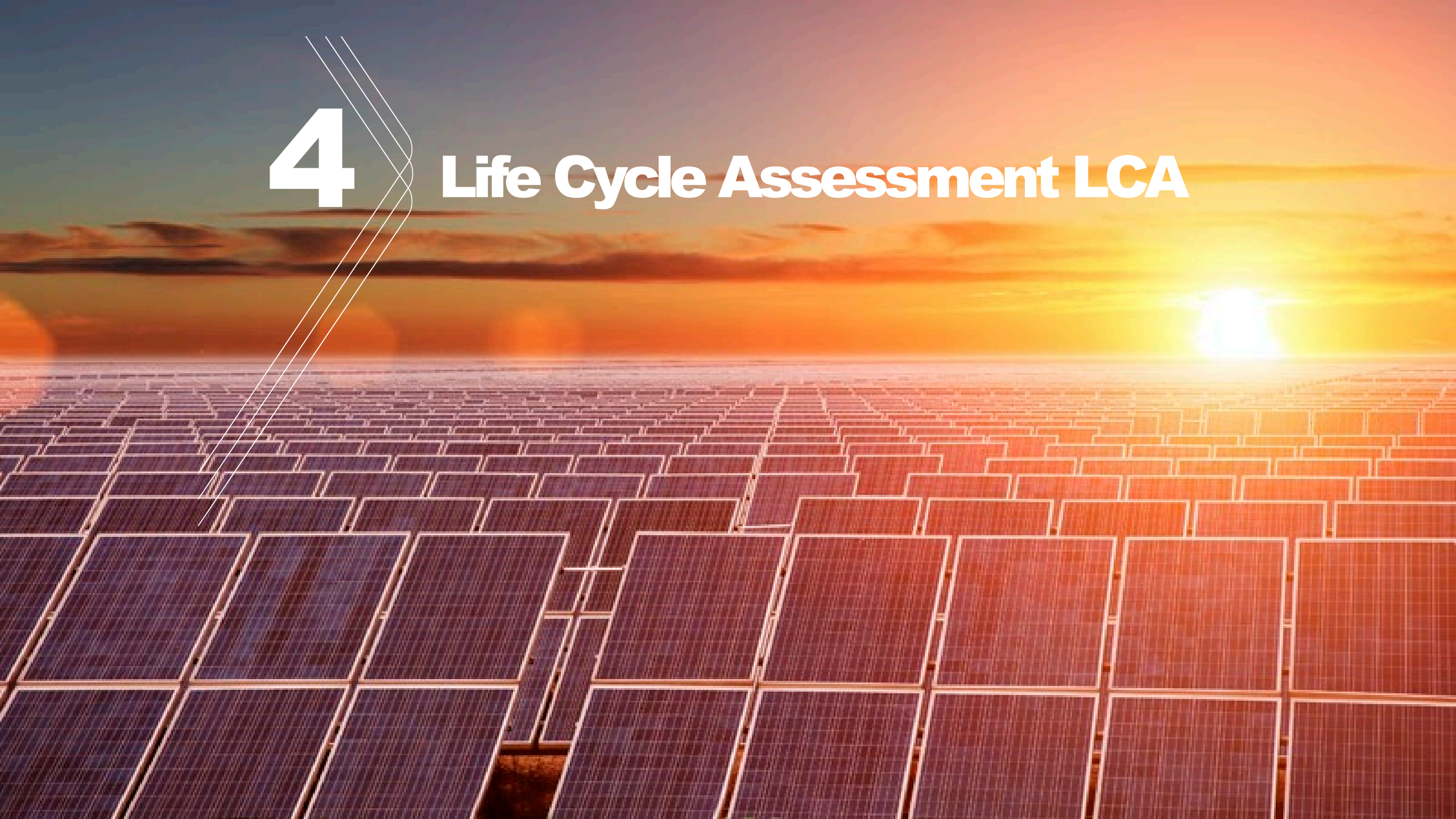
RECYCLING IS KEY — Recycling can deliver faster results and strengthen long-term supply security.

DEMAND OUTLOOK — EV and wind growth will drive >45% of NdFeB magnet demand by 2030.

STRATEGIC PRIORITY — A resilient NdFeB supply chain is critical for Europe's industrial competitiveness and energy transition.

STRATEGIC PRIORITIES FOR EUROPE

- Diversify supply sources
- Invest in separation, refining & magnet manufacturing
- Scale up recycling of NdFeB magnets
- Strengthen innovation & substitution where possible
- Secure long-term offtake and strategic partnerships



4 Life Cycle Assessment LCA

Life Cycle Assessment LCA – overview on NdFeB magnets

COMPREHENSIVE CO_2-eq FOOTPRINT ACROSS THE ENTIRE VALUE CHAIN

Cradle-to-Gate and Cradle-to-Grave assessment of NdFeB sintered magnets including all upstream, core production and downstream processes. Results expressed in kg CO_2-eq per kg of finished magnet.

Data-Driven Insights | Sustainable Solutions | Strategic Advantage

1 LIFE CYCLE STAGES – NdFeB SINTERED MAGNET SUPPLY CHAIN

UPSTREAM – RAW MATERIALS (SCOPE 3)

1 MINING & CONCENTRATION
- PrNd ore mining
- Beneficiation
- Concentrate production

2 SMELTING & SEPARATION
- Oxide roasting
- Smelting
- Metal extraction
- PrNd oxide separation

3 REFINING & METALLURGY
- Purification
- Solvent extraction
- Pr, Nd metal production
- Other REE production

4 MATERIAL CONSUMABLES
- Fe, B, Dy, Tb, Al
- Additives
- Fluxes & gases
- Packaging materials

CORE PRODUCTION (SCOPE 1 & 2)

5 ALLOYING & POWDER MAKING
- Alloy melting
- Strip casting
- Hydrogen decrepitation
- Jet milling

6 POWDER PROCESSING
- Orientation
- Magnetic field alignment
- Surface coating

7 FORMING & SINTERING
- Press molding
- Sintering (vacuum / inert atmosphere)
- Heat treatment

8 MACHINING & FINISHING
- Cutting / Grinding
- Surface finishing
- Dimensional inspection

9 MAGNETIZATION & TESTING
- Magnetization
- Magnetic testing
- Sorting & inspection

DOWNSTREAM – APPLICATION (SCOPE 3)

10 PRODUCT INTEGRATION
- Magnet assembly
- Component integration
- System assembly

11 USE PHASE
- Operation phase
- Energy use (negligible direct CO_2-eq from magnets)

12 END-OF-LIFE
- Collection
- Disassembly
- Recycling / Reuse
- Disposal

SCOPE 3 Indirect emissions (upstream) | SCOPE 1 Direct emissions (process, fuel) | SCOPE 2 Indirect emissions (purchased energy) | SCOPE 3 Indirect emissions (downstream)

2 LCA FRAMEWORK

Functional Unit
1 kg of NdFeB sintered magnet (at sintered block)

System Boundary
Cradle-to-Gate (Upstream + Core Production)
Cradle-to-Grave (Including Downstream)

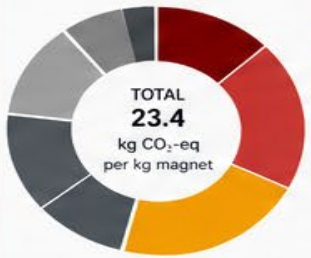
Impact Category
Global Warming Potential (GWP 100)
Unit: kg CO_2-eq

Methodology
ISO 14040/44, EN 15804+A2
ReCiPe 2016

Data Quality
Primary & Secondary Data (2024–2025)

3 CARBON FOOTPRINT BREAKDOWN (Cradle-to-Gate)

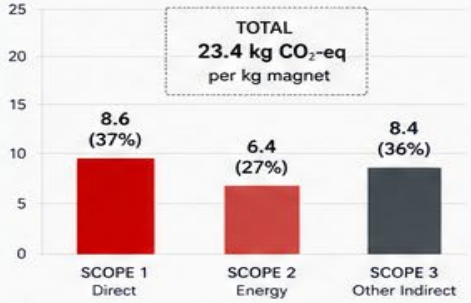
kg CO_2-eq per kg of NdFeB sintered magnet



Mining & Concentration	2.8 (12%)
Smelting & Separation	4.0 (17%)
Refining & Metallurgy	5.1 (22%)
Material Consumables	2.3 (10%)
Alloying & Powder Making	3.6 (15%)
Powder Processing	1.7 (7%)
Forming & Sintering	2.6 (11%)
Machining & Finishing	0.9 (4%)
Magnetization & Testing	0.4 (2%)

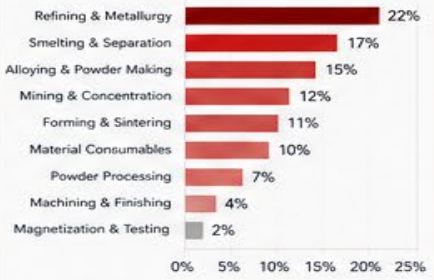
4 EMISSIONS BY SCOPE (Cradle-to-Gate)

kg CO_2-eq per kg of NdFeB sintered magnet



5 HOTSPOT ANALYSIS

Contribution to Total GWP



6 CRADLE-TO-GRAVE OUTLOOK

(End-of-Life Scenarios Impact)

End-of-Life Pathways % of magnets recycled	Total GWP kg CO_2-eq per kg magnet
0% (Landfill)	24.8
25%	23.0
50%	20.7
75%	18.3
100% (Closed-loop recycling)	15.4

Recycling NdFeB magnets can reduce total life cycle emissions by up to **38%**.

7 DOWNSTREAM APPLICATIONS OF NdFeB MAGNETS

- Electric Vehicles (traction motors, EPS, pumps)
- Wind Power (generators)
- Elevators & Escalators (gearless motors)
- Industrial Motors & Automation (servos, robots)
- HVAC & Pumps (high efficiency systems)
- Consumer Electronics (speakers, HDDs, earphones)
- Medical Devices (MRI, scanners, equipment)

8 KEY INSIGHTS

- ✓ Upstream (mining, smelting, refining) contributes ~**51%** of total GWP.
- ✓ Electricity mix and refining technologies are critical levers for decarbonization.
- ✓ Advanced recycling (hydrogen decrepitation, direct recycling) offers significant CO_2-eq reduction potential.
- ✓ Design for disassembly and circularity will be essential for future compliance and competitiveness.

9 PATHWAYS TO REDUCE CARBON FOOTPRINT

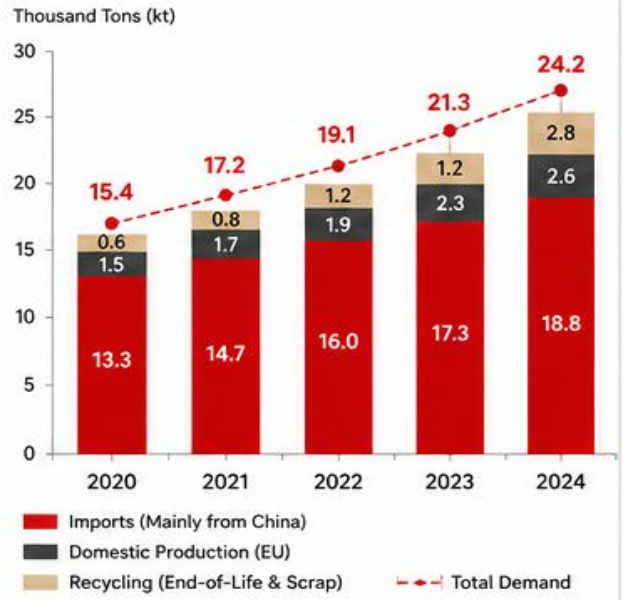
- Use of renewable energy
- Process efficiency & heat recovery
- Low-carbon refining technologies
- Recycling & material circularity
- Innovation in magnet design & substitution

For in-depth expert modeling and defensible results for regulatory reporting, SimaPro or **GaBi** are superior, while **OpenLCA** is ideal for research or when budget constraints exist

5 General Summarized Overview

Summary of the European Rare Earth Magnetics Market

1 STACKED BAR CHART
DEMAND vs SUPPLY BREAKDOWN (kt)

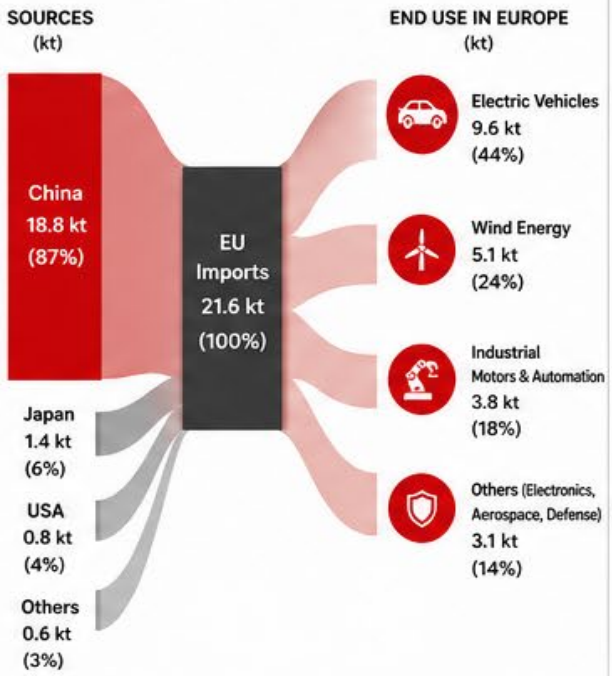


2024 SNAPSHOT

Total Demand	Imports	Domestic Production	Recycling
24.2 kt	~77%	~11%	~12%

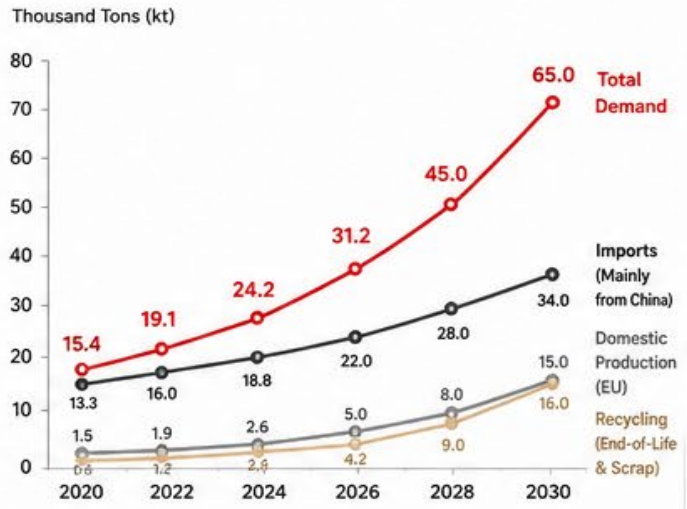
Europe remains highly dependent on imports, primarily from China (>85%).

2 SANKEY DIAGRAM
IMPORT DEPENDENCY (2024)



China dominates the European rare earth magnet supply chain with ~87% share in 2024.

3 FORECAST CURVES
OUTLOOK TO 2030 (kt)



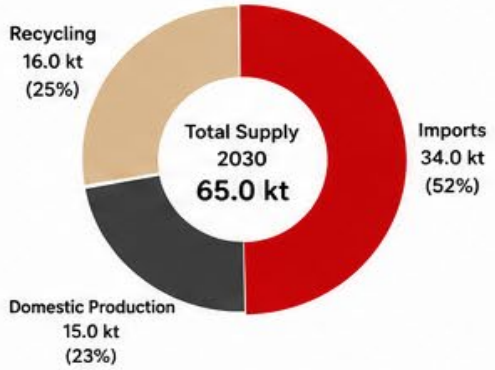
2030 OUTLOOK (kt)

Demand	Imports	Domestic Production	Recycling
65.0	34.0	15.0	16.0

By 2030, Recycling + New Projects can offset ~31 kt (~48% of total demand), reducing import dependency from ~87% (2024) to ~52%.

4 IMPACT OF RECYCLING & NEW GREENFIELD PROJECTS

SUPPLY CONTRIBUTION IN 2030 (kt)



KEY PROJECTS & PIPELINE IMPACT

New Greenfield Projects
Estonia, France, Germany, UK and others expected to add ~15 kt by 2030.

Recycling Potential
End-of-life EV motors, wind turbines & electronics to contribute ~16 kt by 2030.

TAKEAWAY
Europe can significantly reduce dependency, but imports will remain necessary in the medium term.

KEY MESSAGES

- ✓ Demand for rare earth magnets in Europe is expected to nearly triple by 2030.
- ✓ Imports (mainly from China) will remain dominant but decline in share.
- ✓ Recycling and new greenfield projects are critical to build a resilient value chain.
- ✓ Strong policy support (EU Critical Raw Materials Act) is accelerating investments.

EU TARGETS UNDER CRMA BY 2030

10%	40%	25%	65%
Domestic Extraction	Domestic Processing	Recycling	Sourcing from Non-single Countries

BUILDING EUROPE'S SELF-RELIANT VALUE CHAIN

Mining → Separation & Processing → Metal & Alloy Production → Magnet Manufacturing → Recycling & Circularity

From Dependency to Competitiveness

6 Q&A

Si&Mex
TRANSFORMING CHALLENGES IN OPPORTUNITIES

RARE EARTH ELEMENTS & NdFeB SINTERED MAGNETS

POWERING THE TECHNOLOGIES OF TOMORROW

NdFeB sintered magnets deliver the highest energy density among permanent magnets. Rare earth elements are essential for a sustainable future across e-mobility, wind energy, robotics and advanced industrial applications.

THE RARE EARTH FAMILY

57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	62 Sm Samarium
63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysposium	67 Ho Holmium
68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	21 Sc Scandium	39 Y Yttrium

NdFeB MAGNET ADVANTAGES

- Highest Energy Density
- High Coercivity & Remanence
- Excellent Temperature Stability
- Enabling Compact & Efficient Designs
- Critical for e-Mobility & Green Energy

RARE EARTHS – CRITICAL FOR HIGH PERFORMANCE NdFeB MAGNETS

- High Energy Density
- High Coercivity
- Thermal Stability up to 200–250 °C
- Enabling Compact & Lightweight Solutions
- Essential for e-Mobility, Wind Power, Robotics, Industrial & Consumer Electronics

GLOBAL SUPPLY LANDSCAPE (2024)

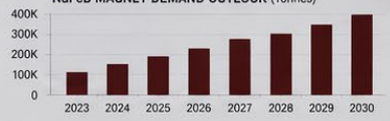
EUROPEAN PROJECT HIGHLIGHTS

- **Germany** – Bitterfeld (Heraeus Remloy) Largest EU magnet recycling plant 600 – 1,200 t/y NdFeB powder
- **Estonia** – Narva (Neo Performance Materials) First integrated rare earth magnet plant in EU ~5,000 t/y capacity (target)
- **United Kingdom** – HyProMag (Plymouth) Rare earth separation & magnet recycling commercial scale-up
- **Sweden** – LKAB & Norra Kärr Rare earth mining & processing pilot projects
- **Norway** – Fen Project Rare earth mining development

NdFeB MAGNET APPLICATIONS

e-Mobility · Wind Power · Robotics & Automation · Elevators & Escalators · Consumer Electronics

NdFeB MAGNET DEMAND OUTLOOK (Tonnes)



DRIVERS OF GROWTH

- EV & Hybrid Vehicle Expansion
- Wind Power Installations
- Industrial Automation & Robotics
- Energy Efficiency & Miniaturization

SUPPLY CHAIN CHALLENGES

- ✓ High Import Dependence on Critical REEs
- ✓ Limited Refining & Metal Production in Europe
- ✓ Price Volatility & Geopolitical Risk
- ✓ Need for Recycling & Circular Solutions

THE PATH FORWARD

- ✓ Develop Domestic Mining & Refining Capacity
- ✓ Scale Up Recycling & Urban Mining
- ✓ Strengthen EU Supply Chain Resilience
- ✓ Innovation in Magnet Performance & Substitutes

Thank you

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