

A detailed black and white microscopic image of wood grain, showing various patterns of cellulose fibers and growth rings. The image is used as a background for the report cover.

S&P Global Energy

DyTb Market Report

Dysprosium (Dy) and Terbium (Tb) oxides

October 2026

Preamble

This draft **DyTb Market Report** aims to increase transparency within the Dysprosium (Dy) and Terbium (Tb) oxides and permanent magnets supply chain, helping public and private stakeholders make more informed investment decisions across the commodity lifecycle. It briefly outlines current supply chain bottlenecks, resiliency issues, and the market signals needed to support a more robust and diverse supply base. This report is part of S&P Global's rare earths and permanent magnets market transparency series, which examines key rare earth elements across the supply chain, including previous work on neodymium and praseodymium (NdPr).

Dysprosium and terbium are heavy rare earth elements (HREEs), unlike NdPr, which are light rare earth elements (LREEs). HREEs are geologically less abundant, occur in fewer economically recoverable deposits, and require complex separation processes, resulting in a more constrained supply chain. S&P Global conducted a bottom-up, asset-level analysis of production costs for rare earth oxide production. These production cost curves provide an independent view of supply economics and identify the marginal supplier in a structurally tight market. The analysis focuses on a resilient supply base outside dominant market positions and restricted supply sources.

This analysis reflects a multi-year effort combining bottom-up asset modelling, proprietary market intelligence, extensive research, expert assumptions, and industry consultation to overcome significant data limitations across the opaque mineral value chain.

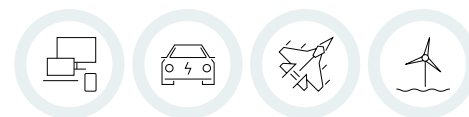
The market values in this report represent a fundamentals-based assessment of the cost and the break-even range required for rare earth and DyTb oxides production sources to remain economically viable and meet sufficient G7+Australia demand. This enhanced cost transparency can facilitate better-informed offtake agreements and investments throughout the supply chain. However, actual transactions also factor in inventory levels, broader market conditions, global trade dynamics, and other variables not included in this analysis.

These values are different to the spot market price assessments published by Platts, part of S&P Global Energy ([link](#)).

Given the limited availability of public data, this report is based on S&P Global's proprietary market and mineral intelligence and our analysis of company disclosures, and market information. We welcome input from market participants to support the ongoing refinement of future editions.

Contacts:

Critical Minerals Consulting
CERACriticalMinerals@spglobal.com



Key Takeaways

- S&P Global estimates structural cost ranges of \$327-366/kg Dy oxide and \$897-978/kg Tb oxide by 2028 to support ~802 metric tons (t) Dy and ~222 t Tb oxide production under a more geographically diversified supply base. Current prices remain above these levels due to tight availability in Western markets.
- Relative to pre-export restriction prices, these structural cost ranges imply an additional ~\$83-114 million (Dy) and ~\$86-104 million (Tb) in annual expenditure by 2028.
- Global demand is projected to grow ~43% and ~36% from 2025 to 2030 for Dy and Tb, respectively, driven by NdFeB magnet demand from mobility, plus by wind turbines, electronics, and robotics.
- China accounts for ~98% of refined Dy and Tb supply and ~91% of mined supply. By 2028, resilient capacity could reach ~2,394 t Dy and ~519 t Tb, requiring ~\$3.7 billion in capital expenditures (CapEx). By 2030, over 20 projects could increase capacity to ~3,565 t Dy and ~776 t Tb, requiring ~\$6.4 billion in CapEx.

Introduction

Dysprosium and terbium are HREEs¹ used mainly in neodymium-iron-boron (NdFeB) magnets, where they increase coercivity (resistance to demagnetization) and maintain magnetic performance at high temperatures. NdFeB magnets are available in different grades. Higher grades, such as super-high coercivity (SH), ultra-high coercivity (UH), and extra-high coercivity (EH), are designed for demanding operating conditions. Dy and Tb are added to these higher grades, used in Electric Vehicles (EV) motors, wind-turbine generators, and defense applications. Beyond magnets, Dy and Tb are used in lighting, optical technologies, and nuclear control systems.

The rare earth supply chain is highly concentrated, with China dominating mining, refining, metallization, and permanent magnet production. This concentration is particularly pronounced in HREE mining, as most deposits contain relatively low HREE concentrations. China also accounts for nearly all HREE separation and refining.

This concentration was exposed in April 2025, when China's export licensing on seven REE, including Dy and Tb, tightened supply and disrupted industries across America, Asia, and Europe. By July 2026, Dy and Tb oxide prices reached \$2,300/kg and \$4,900/kg in North America vs. \$215/kg and \$1,005/kg in China.²

These disruptions intensified efforts to build resilient HREE supply chains. A major milestone came in 2025, when Lynas Rare Earths Ltd began commercial production of separated Dy and Tb at scale, with initial exports to Japan.³ Others are following, with Caremag expected to start production in late 2026 and Energy Fuels working to scale up HREE production in the United States.

Dy and Tb's Properties (High Magnet Grades)

Magnetic pulling power:

~223 – 414 kJ/m³

Highest of any magnet, incl. ferrite, SmCo, AlNiCo

Magnetism kept under stress:

~1,592– 2,785 kA/m

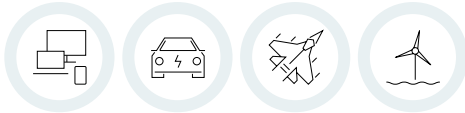
Above ferrite and AlNiCo, matches SmCo (under high heat conditions)

Density:

7.5 to 7.7 g/cm³

Above ferrite, similar to AlNiCo, below SmCo

1. Heavy Rare Earth Elements: A subset of rare earth elements which are generally less abundant and more supply-constrained than light rare earth elements (LREEs).² Platts Rare Earths Market Report, July 2026. Prices refer to dysprosium oxide and terbium oxide assessments for CIF North America and FOB China. 3. S&P Global Energy, "Japan's JOGMEC, Malaysia's ECERDC to Advance Rare Earths Exploration," 16 Dec. 2025.



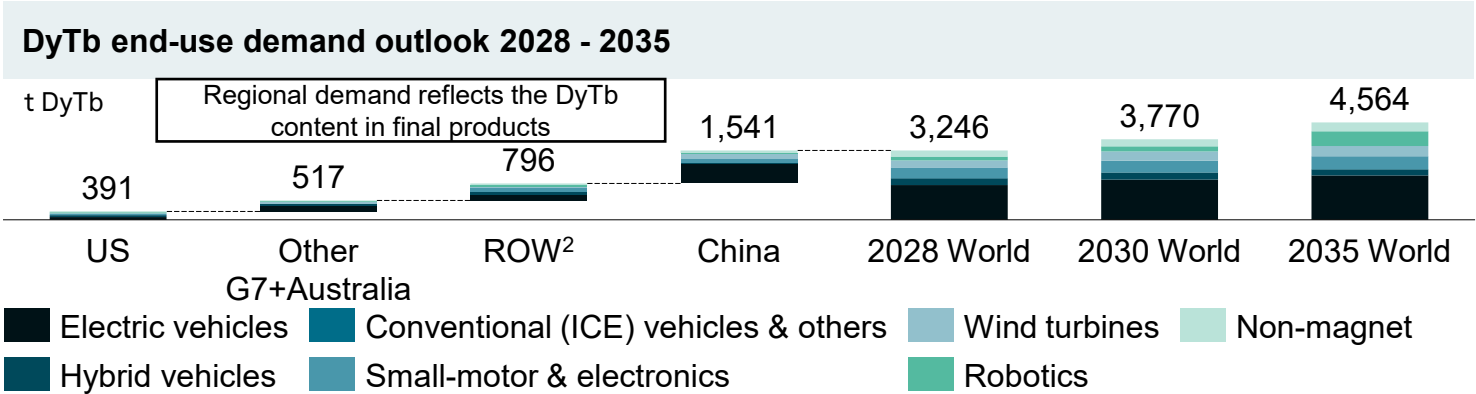
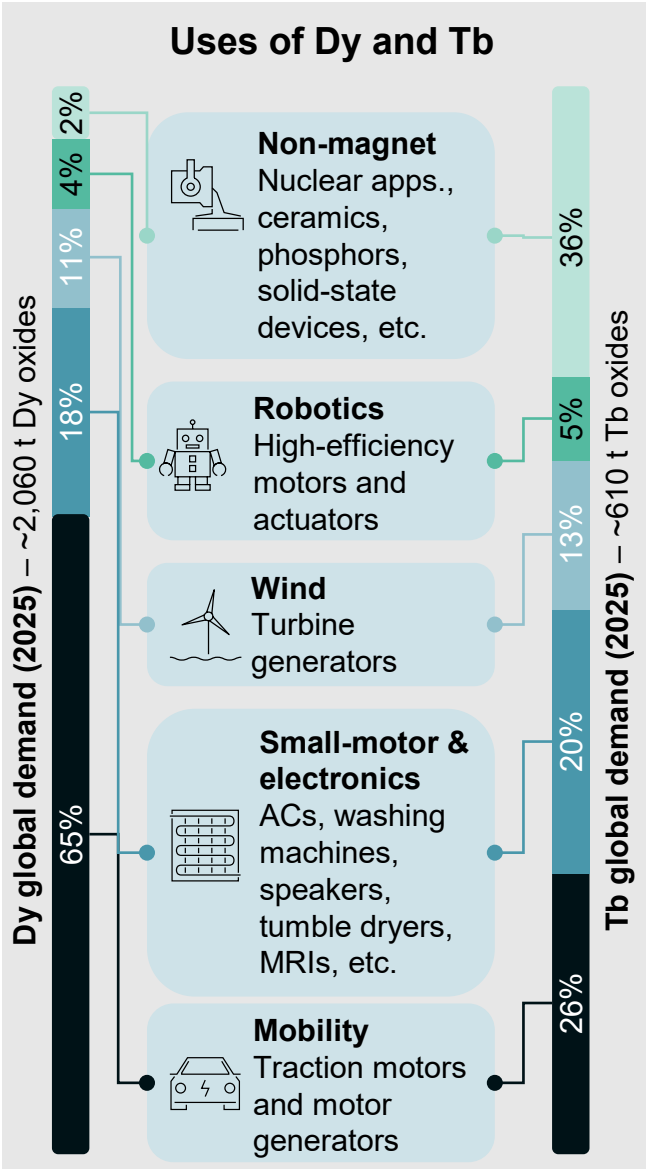
Dy and Tb demand

Permanent magnets account for ~98% of Dy demand. Tb demand is more diversified, with ~36% of consumption coming from non-magnet applications, such as phosphors and specialty electronics. Within magnets, both are used to enhance coercivity and thermal stability. These properties allow magnets to maintain performance under high temperatures and continuous operating stress, making Dy and Tb particularly important for EV, wind turbines, and defense applications. Tb is mainly used for the highest-performance grades as it delivers greater temperature resistance, despite significantly higher cost.

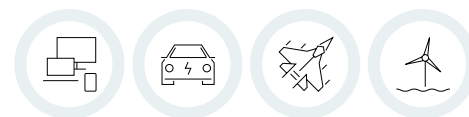
Global Dy and Tb demand reached ~2,060 t and ~610 t in 2025, respectively. Mobility accounted for ~65% and ~26% of consumption, while small motors and electronics represented ~18% and ~20%. DyTb demand is projected to grow ~7% annually, reaching ~3,770 t by 2030.

Due to its dominant position in rare earth separation and permanent magnet manufacturing, China accounts for ~90-94% of DyTb first-use consumption¹. However, many of these magnets are ultimately exported either directly or embedded within finished products, reducing China's share of global end-use demand to approximately ~61%.

Magnet innovations offer a pathway to limit future demand growth. One key example is the grain boundary diffusion (GBD) technique, which reduces HREEs requirements while maintaining magnet performance. Manufacturers such as Proterial Ltd. have also developed magnets that reduce or eliminate the need for HREEs. While these innovations are expected to improve material efficiency, DyTb remain essential for many high-temperature and high-performance magnet applications.



1. First-use consumption is approximated using China's share of global sintered NdFeB magnet production (~90-94% in 2024), according to International Energy Agency (IEA), *Global Critical Minerals Outlook 2025*; 2. Rest of World
Sources: S&P Global Analysis



Dy and Tb supply

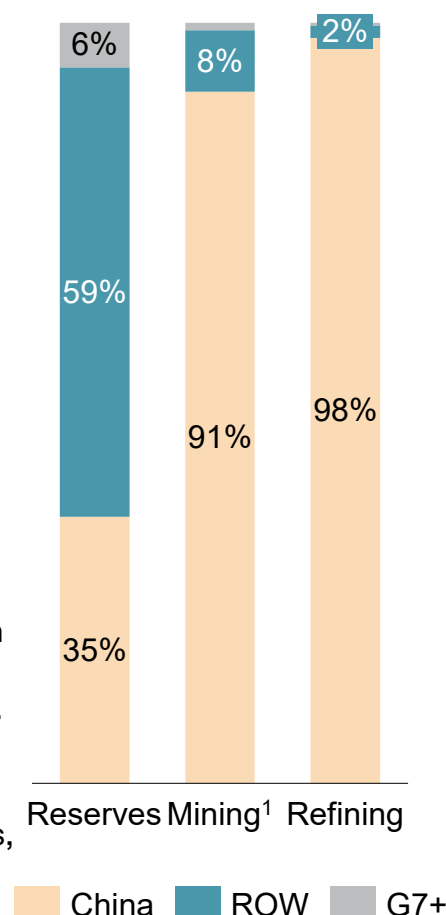
Unlike LREEs, HREE resources are scarcer and concentrated in fewer deposits. China, Myanmar, and Laos account for ~91% of global mined production of Dy and Tb, with most feedstock originating from ion-adsorption clay deposits and the remainder sourced from a limited number of xenotime-rich and other hard-rock deposits.

Serra Verde's operation in Brazil is currently the only commercial-scale producer of ionic clay-derived HREE feedstock outside China. Historically, production was sold to Chinese processors, but the company has since announced a long-term offtake agreement associated with its combination with USA Rare Earth and US-backed partners. Potential future sources include Carina, Caldeira, and Colossus projects in Brazil, as well as the xenotime-rich Browns Range project in Australia.

Supply chain concentration becomes even more pronounced downstream, where China represents approximately ~98% of global separation and refining capacity. Dy and Tb are recovered alongside other rare earths and separated through complex, multi-stage solvent extraction processes, with HREE requiring more extraction stages than LREE. As a result, HREEs are more difficult and costly to separate, limiting the number of facilities capable of producing Dy and Tb oxides.

By 2030, 22 expansion and greenfield separation projects could add approximately 3,084 t of Dy oxide and 642 t of Tb oxide separation capacity outside China, including developments by Lynas, MP Materials, and Caremag. However, the availability of DyTb-rich feedstock may become a key constraint. Recent feedstock agreements, strategic acquisitions, and vertically integrated developments underscore the increasing importance of linking mining and separation capacity to diversify the Dy and Tb supply chains.

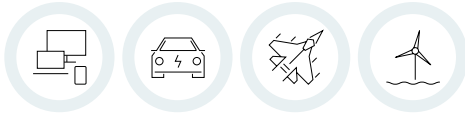
Market Structure (2025)¹



Recent market events

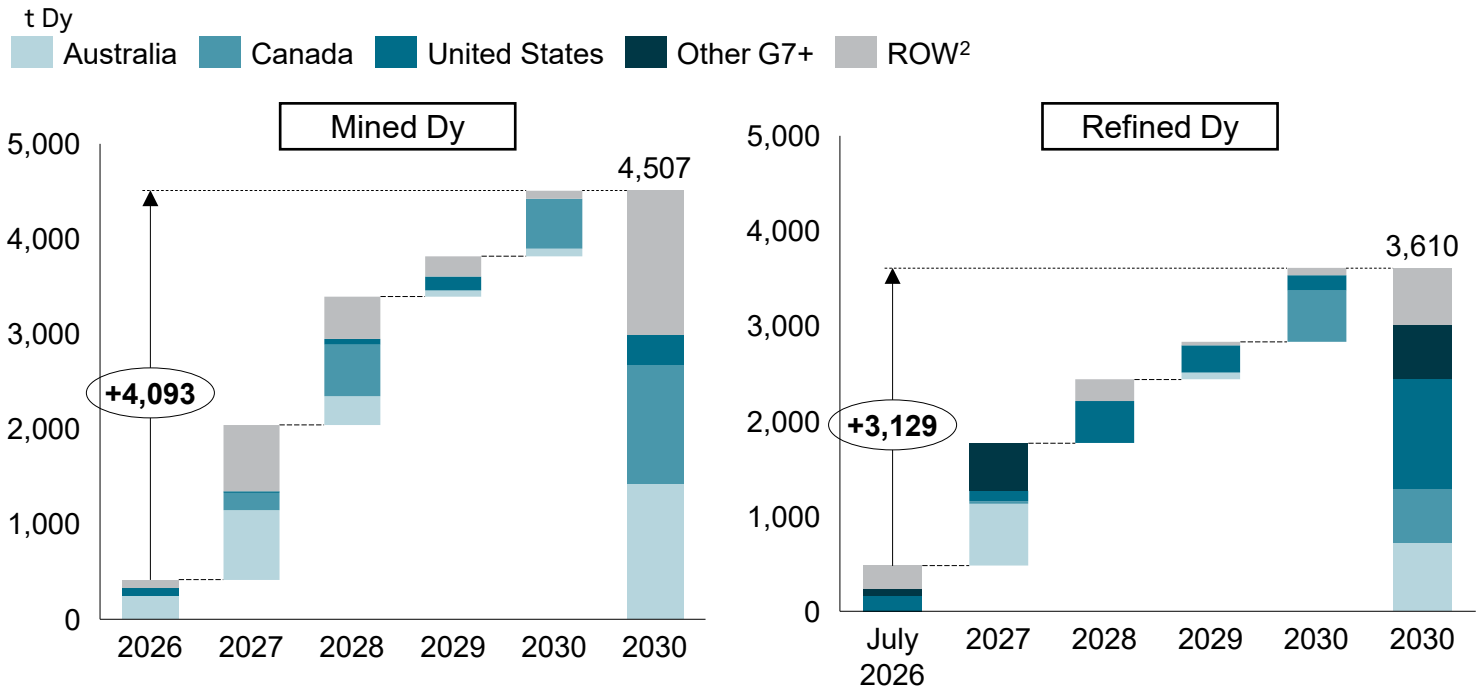
- POSCO Holdings targets 4.8 kt/year of rare earth output by 2028, rising to 8.7 kt/year by 2030, with feedstock from Laos and Malaysia. Its US JV with ReElement Technologies (6 kt/year) will separate Dy and Tb oxides, feeding magnet plants in Europe (2027) and the US (2028) [Platts, July 2026].
- Japan's JOGMEC will invest up to C\$47.7 million in a JV with Toyota Tsusho to develop the Lofdal HREE deposit in Namibia. Final commercialization decision expected in 2026 [Platts, July 2026].
- Harena Rare Earths secured up to \$4.84 million from the US Development Finance Corporation (DFC) to advance its ionic clay project in Madagascar. The feedstock-only developer plans to produce concentrate from mid-2028 at 4 kt/year TREO, including 1.7 kt of magnetic oxides such as Dy, Tb and others [Platts, August 2026].
- Meteoric Resources' feasibility study for its project in Minas Gerais, Brazil, targets 122 t/year of DyTb over 20 years, with a \$498.4 million investment. Construction is expected to start late-2026 and production in 2028 [Platts, August 2026].

1. Reserve figures are reported on an REO-equivalent basis, while mining and refining figures are reported as contained DyTb oxide equivalent. China share includes production from Myanmar and Laos, where mining operations and output are substantially linked to Chinese investment, ownership, or offtake arrangements. Further details on mining assumptions are provided in the Mining Appendix, while refining assumptions and methodology are discussed in the cost curves section.

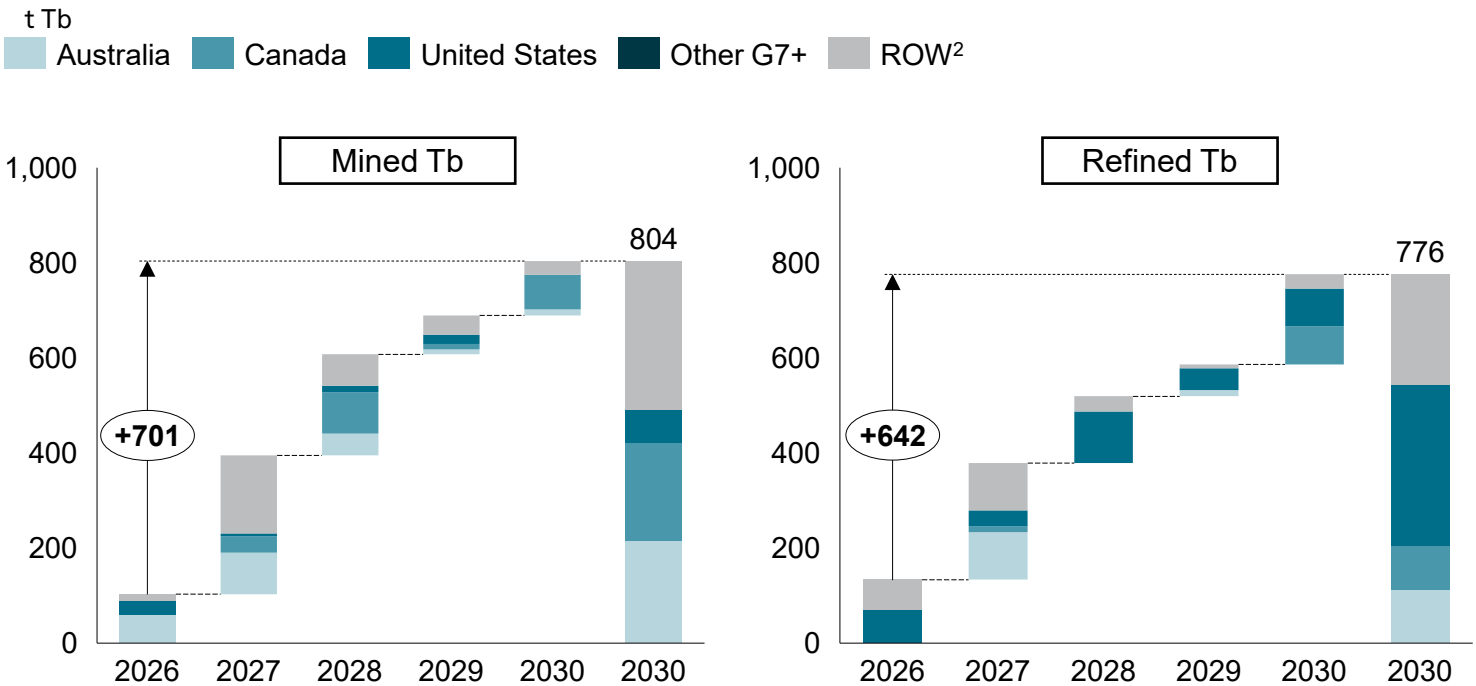


The supply chart represents potential risked supply pipeline based on company announcements

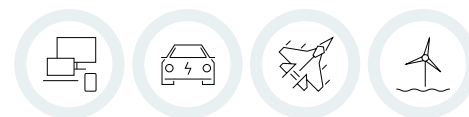
Resilient Dy oxide announced capacity¹



Resilient Tb oxide announced capacity²



1. The analysis excludes assets located in Russia, China, and North Korea, as well as any assets worldwide that are majority-owned by Chinese companies (Myanmar and Laos); 2. ROW includes HREE mining and refining capacity in countries not shown separately, including Brazil, Namibia, South Africa, Sweden, Norway, among others.
Sources: S&P Global Analysis



Supply-demand balance

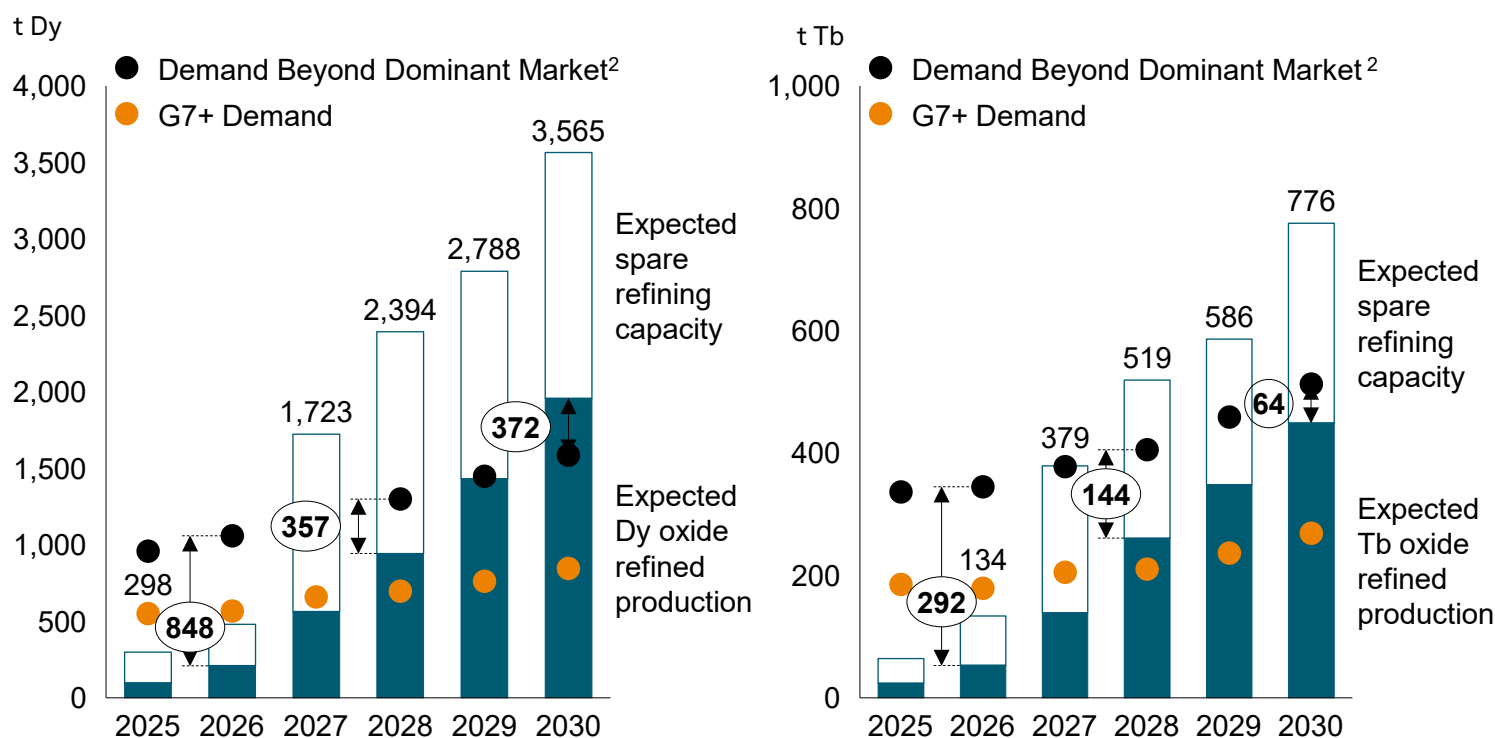
Dysprosium

- Announced capacity is expected to ramp up rapidly, but production is projected to reach only 55% utilization by 2030 due to commissioning and feedstock constraints.
- In 2026, announced resilient Dy oxide production¹ totals 210 t Dy, leaving an 848 t Dy gap between supply and demand beyond the dominant market².
- By 2028, production is projected to reach 943 t Dy, sufficient to meet G7+ demand but short of the total demand beyond the dominant market.
- By 2030, if all covered projects are developed on proposed timelines and expected utilization, production is expected to reach 1,958 t Dy, exceeding the total demand beyond the dominant market of 1,585 t Dy and resulting in a supply surplus.

Terbium

- While announced capacity expands quickly, output is expected to reach only 58% utilization by 2030 as projects ramp up and feedstock remains constrained
- In 2026, announced resilient Tb oxide output¹ amounts to 53 t, resulting in a 292 t shortfall against the combined demand benchmark²
- By 2028, announced resilient production rises to 519 t, above the G7+ demand but still short of the combined demand benchmark.
- By 2030, if all covered projects are developed following proposed timelines and expected utilization rates, resilient Tb oxide output reaches 449 t, still 64 t below the combined demand benchmark.

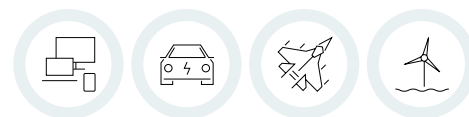
Supply-demand balance of resilient supply¹



1. Resilient supply excludes assets located in China, Russia, and North Korea, as well as any assets worldwide that are majority-owned by Chinese companies; 2. Demand beyond dominant market comprises global demand excluding China

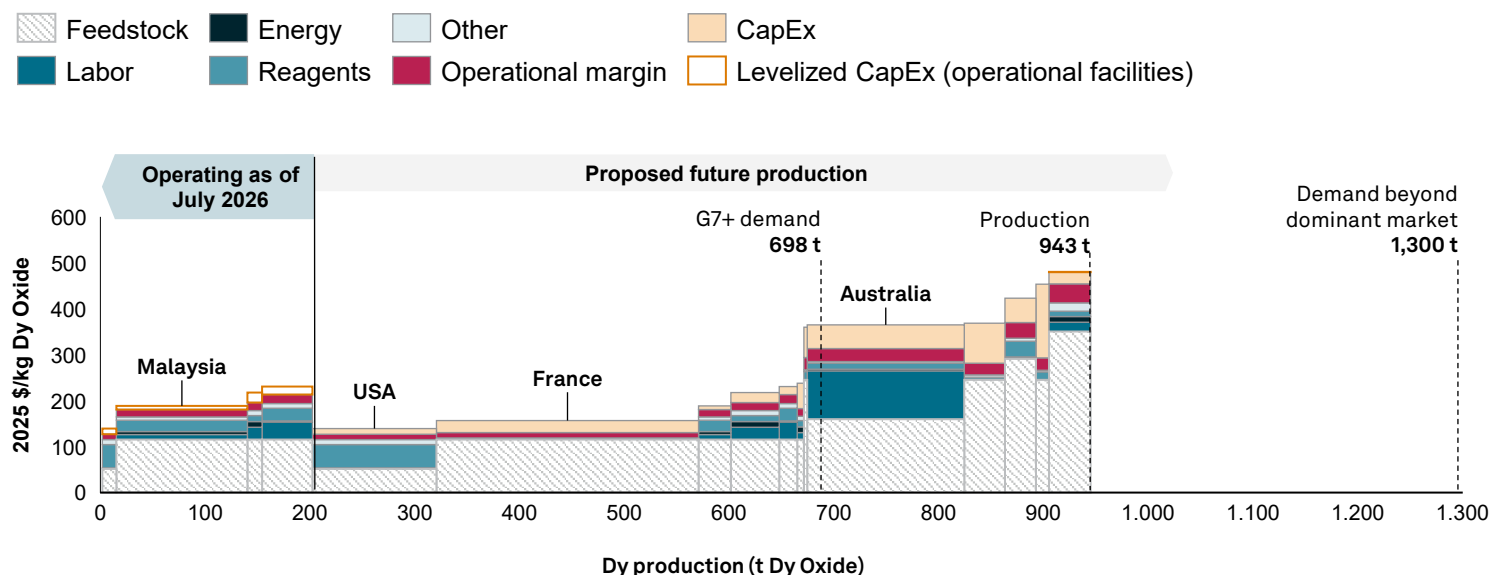
Note: Supply-demand balance excludes China, Russia, and North Korea

Sources: S&P Global Analysis; Platts prices

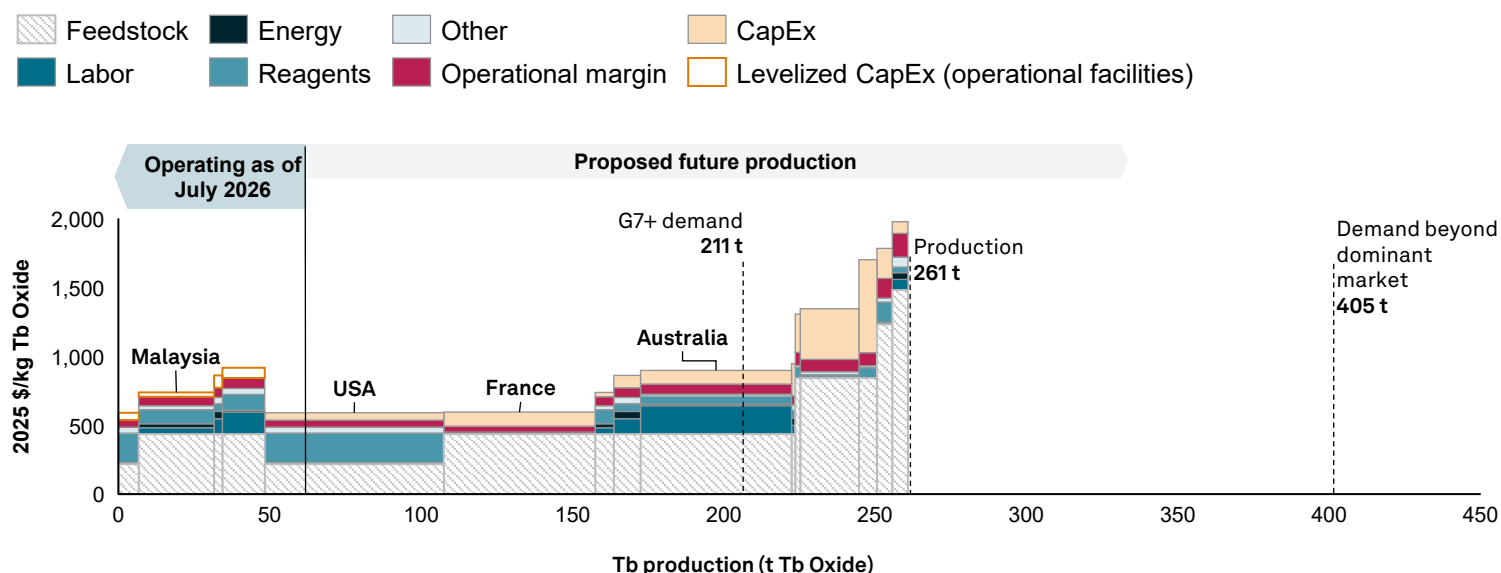


Structural Cost: Represents the full cost required for an asset to achieve its target return on investment, assuming projects are developed in line with announced timelines and operate at expected utilization rates². This cost considers an unrisks projection subject to normal industry attrition and delays.

2028 Dy oxide resilient production structural cost curve^{1,2}



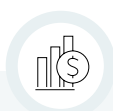
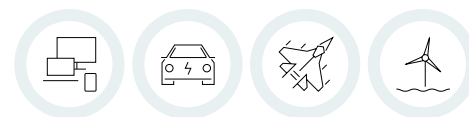
2028 Tb oxide resilient production structural cost curve^{1,2}



1. The analysis excludes assets located in Russia, China, and North Korea, as well as any assets worldwide that are majority-owned by Chinese companies;

2. Utilization rates were estimated using project-announced operating assumptions where available, derived from concentrate grade availability where applicable, and otherwise assumed at 85%

Sources: S&P Global Analysis for Dy and Tb supply, demand and costs; USGS (Rare Earths 2026 Commodity Summary)



Structural cost - Findings

- S&P Global CERA estimates a structural cost range of **\$327-366/kg Dy oxide** would support over 85% (802 t) of current and potential Dy supply, while **\$897-978/kg Tb oxide** would support over 85% (222 t) of current and potential Tb supply over the long term.
- Relative to pre-export restriction prices, these structural cost ranges would result in approximately \$83-114 million and \$86-104 million in additional spending in 2028 for Dy and Tb, respectively.
- By 2028, an aggregate capital investment of \$3.7 billion will be required to unlock all Dy and Tb announced supply potentially covering G7+ Australia demand.
- Excluding CapEx, a cost range between **\$290-316/kg Dy oxide** and **\$777-820/kg Tb oxide** would be sufficient to sustain operation of these projects once commissioned.
- Feedstock is expected to remain the largest cost component for both Dy and Tb. By 2028, feedstock costs are expected to range from \$50/kg to over \$370/kg Dy oxide and from \$220/kg to over \$1,500/kg Tb oxide.
- Separation costs are estimated at \$40-200/kg Dy oxide and \$300-800/kg Tb oxide¹. The higher cost of Tb reflects its lower abundance in most feedstocks, requiring more material to be processed to produce each kilogram of oxide. REE extraction involves a trade-off between higher-CapEx nitrate circuits and lower-CapEx chloride circuits with higher operating expenditures (OpEx).

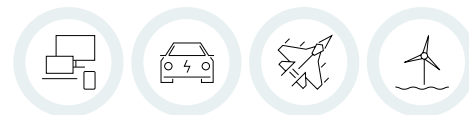


Structural cost - Approach

- Reflects Market Complexity: Built on extensive research and bottom-up modelling, incorporating asset-level data, industry consultation, benchmarking, and expert assumptions to navigate a highly opaque supply chain.
- Targets the Marginal Supplier: The 80th-90th percentile identifies the highest-cost producers. Long-term commodity prices naturally gravitate toward the cost of the last unit needed to meet demand. This percentile filters out extreme outliers while capturing the true marginal cost.
- Incentivizes Supply Resiliency: This analysis establishes a long-term structural benchmark capturing the full asset economics.
- Allocates Costs: Cost allocation is a key consideration in Dy and Tb production. Because multiple rare earths are recovered through the same separation process, costs are allocated across the rare earth basket based on the historical sales value of saleable products. Consequently, Dy and Tb prices play a major role in determining the costs attributed to each oxide.

1. Including CapEx and excluding feedstock costs.

Sources: S&P Global Analysis for Dy and Tb supply, demand and costs; USGS (Rare Earths 2026 Commodity Summary)



Challenge of cost components and methodological approach

Feedstock specification is an important determinant of downstream processing costs. Differences in total REE grade, individual REE concentration, mineralogy, and impurity content influence reagent consumption, power requirements, recovery rates, and process complexity. As a result, two feedstocks with similar DyTb output can have materially different separation costs and overall project economics.

Mining and Processing costs



Feedstocks: Feedstock costs are based on each facility's sourcing strategy, using associated mining costs for vertically integrated facilities and weighted average feedstock costs for non-vertically integrated facilities based on the feedstock type. Overall asset level mining and processing costs are estimated following a similar asset level approach to the separation of costs allocated across NdPr, Dy, Tb, Sm, Eu, Gd and Y according to expected revenue share.



Labor¹: Labor costs are estimated using labor cost factors per metric ton of feedstock processed, differentiated by feedstock type and separation process. Labor costs are scaled based on wage rates by country.



Separation OpEx

Energy¹: Includes fuel, power and utility costs, estimated using energy intensity factors differentiated by feedstock type and separation process. Energy demand is assumed to comprise 80% natural gas and 20% electricity, with costs based on facility throughput and adjusted for country-level natural gas prices and wholesale electricity tariffs.



Reagents¹: Reagent costs are estimated using chemical consumption rates per metric ton of production and corresponding regional prices. Estimates are based on a combination of reagent-specific consumption data and reported overall reagent costs.



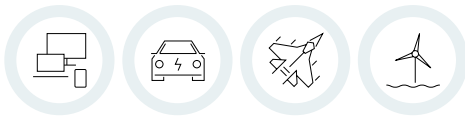
Operational margin: An operational margin is applied to represent the facility-level profit margin, ongoing sustaining capital requirements, and return on investment. The margin is assumed to be 10% of total facility costs, excluding initial and sustaining CapEx.



Separation CapEx

Capital expenditure: Includes levelized initial CapEx, allocated to each facility and recovered over a 20-year project life using a 7% discount rate. Sustaining CapEx represents ongoing investments required to maintain operations and productive capacity, estimated as a percentage of initial CapEx. Capital costs are allocated across NdPr, Dy, Tb, Sm, Eu, Gd, Y and Ho based on their estimated revenue share.

1. Operational costs (Labor, Energy, Reagents) are allocated across all rare earth products announced by each facility, assuming the facility is able to separate and commercialize its full rare earth product basket.

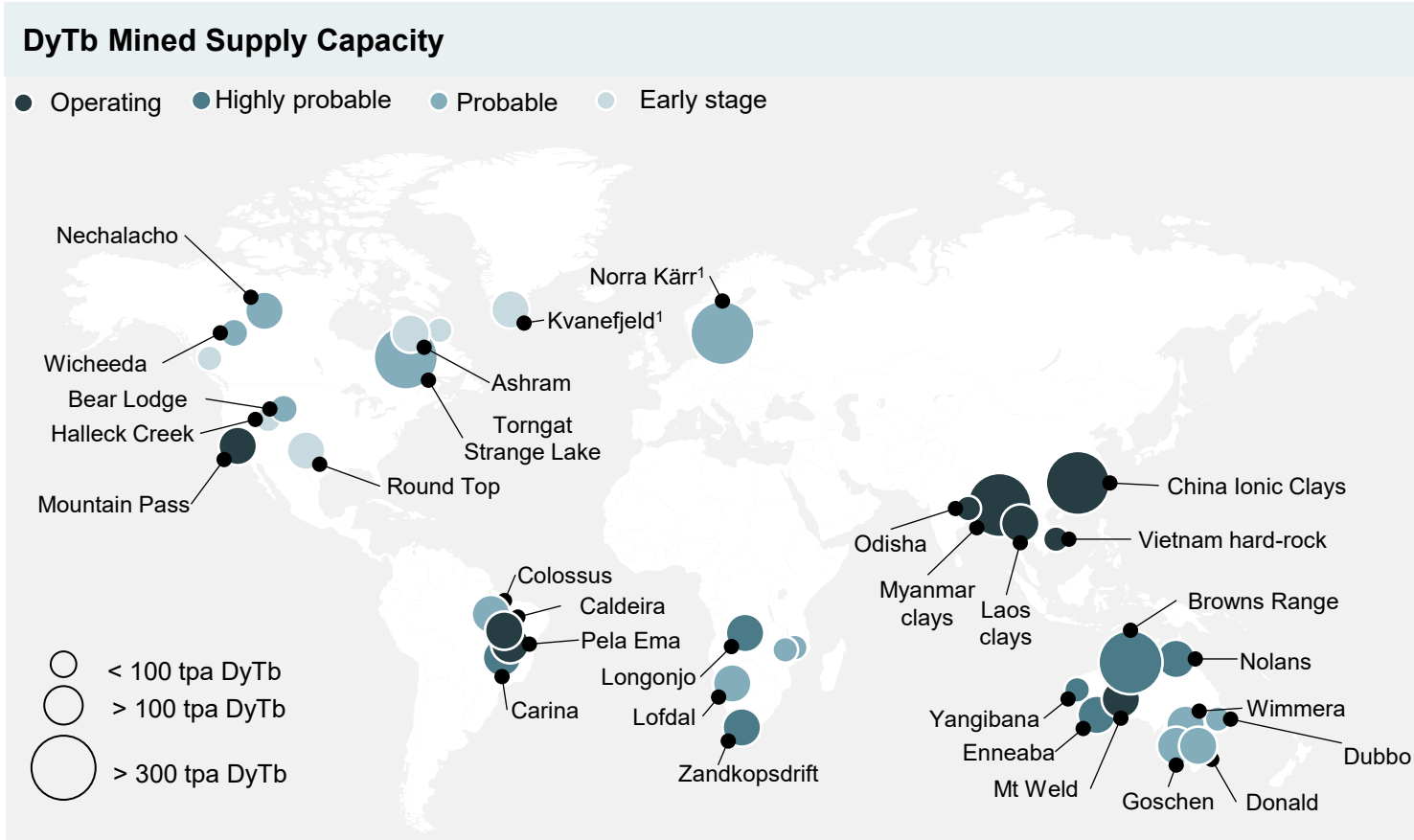
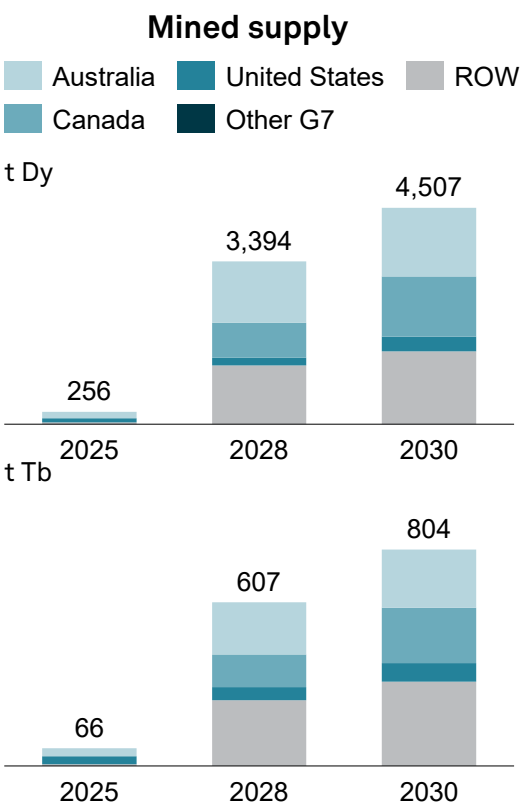


Appendix: DyTb Mining

Dy and Tb mined supply remains highly concentrated, with China, Myanmar, and Laos together accounting for approximately 91% of global mined DyTb production in 2025. The remaining 9% came from a small number of projects, primarily in Australia and Brazil, as HREE resources are scarcer and less geographically diversified than LREEs.

Australia, Canada, and Brazil are expected to become important sources of Dy and Tb supply. Growth will come from projects including Browns Range in Australia, and ion adsorption clay projects in Brazil, including Pela Ema, Caldeira, Colossus, and Carina. By 2030, Australia is projected to mine ~1,400 t of Dy and ~200 t of Tb, while Canada could contribute ~1,250 t of Dy and ~200 t of Tb. Additional supply is expected from Brazil as these projects advance.

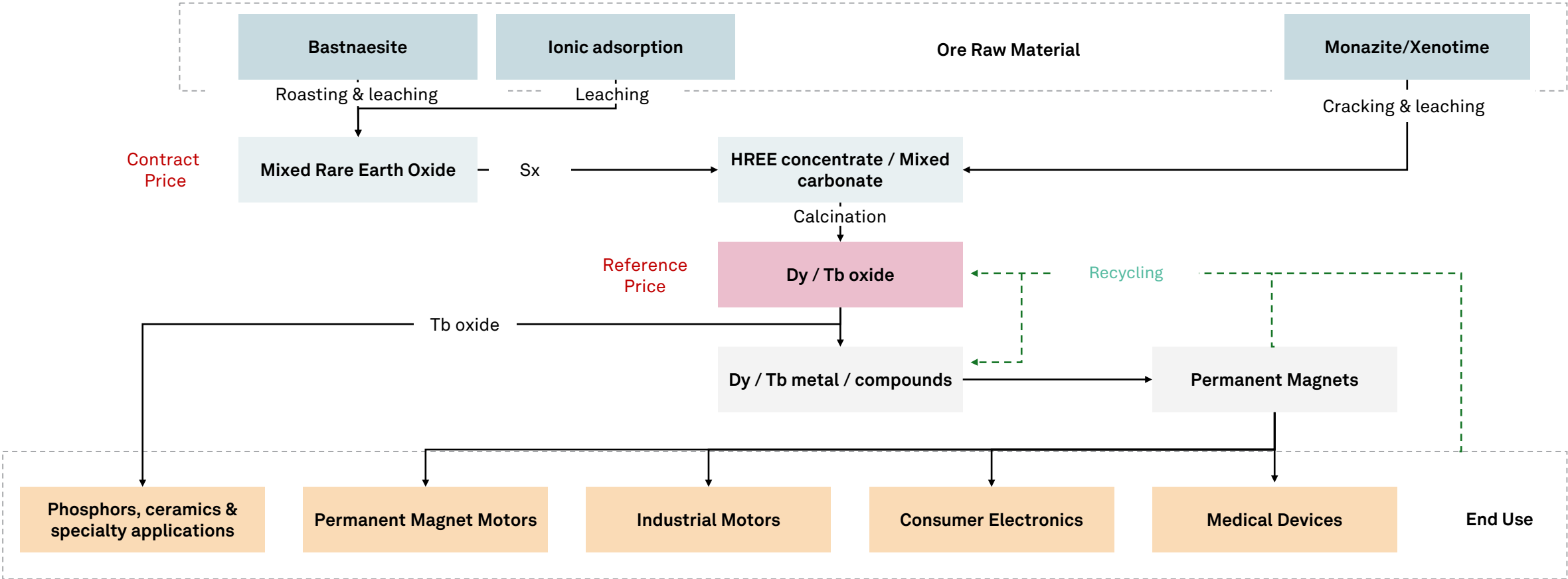
Recent developments highlight linkages between Dy and Tb mining and separation capacity, including vertically integrated projects, feedstock agreements, and strategic acquisitions. Examples include the Strange Lake project in Canada, the Browns Range-Eneabba supply agreement in Australia, and USA Rare Earth's acquisition of Serra Verde in Brazil.



1. Processing for Eudialyte- and Steenstrupine-hosted deposits has not been demonstrated at commercial scale

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DyTb value chain



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