

A large, clear glass hourglass is the central focus, with dark sand falling from the top bulb into the bottom bulb. A bright yellow diagonal line cuts across the hourglass from the top right to the bottom left. The background is a soft, out-of-focus light blue and white.

Technology minerals

The rare earths
race is on!

April 2011

Introduction

This paper builds on our analysis of the technology minerals¹ sector contained in our previous paper, “Material risk: Access to technology minerals.” In that paper we considered the critical minerals supply risk issue for the high-tech industry. We concluded that there is an urgency for projects to be brought into production if they are to participate in the period of elevated prices.

Over the last 12 months, there has been a surge in interest from the global press, along with serious concern from various worldwide government organizations regarding these technology minerals, particularly the rare earths.² This interest was sparked by the overall prediction of an emerging rare earths supply gap, with a constant deficit until 2013E, despite new production forecast to come online.

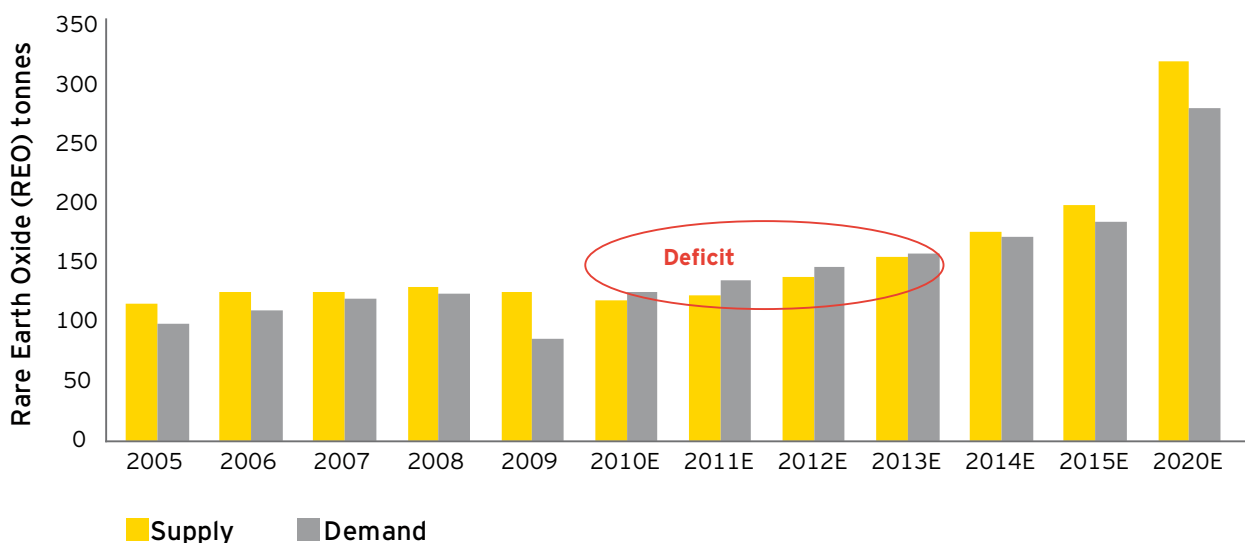
This impending supply/demand imbalance and the recent Chinese quota restrictions have heightened global awareness of the importance and criticality of this issue, in particular to the green energy sector (which accounts for 20% of minerals demand, according to the US Department of Energy study published in December 2010).

It is possible that China will become a net importer of some heavy rare earths in the foreseeable future, therefore contributing to the additional supply tightness in the rare earths market, and that the rare earths market will grow to US\$4b–US\$6b by the middle of the decade from its current value of about US\$2b–US\$3b.

Rare earths companies’ need for large investment in exploration and even larger in development of a downstream supply chain capability has led the two near-term production rare earths companies, Lynas Corporation and Molycorp Inc., to pursue a large number of equity partnerships and strategic partnerships, which are detailed further in this paper.

Lynas Corporation and Molycorp Inc., whose combined market capitalization is over three times the estimated annual size of the entire rare earths market today, are expected to start

Diagram 1: Global rare earths supply and demand, 2005–2015E and 2020E



Source: Dudley J Kingsnorth, Industrial Minerals Company of Australia Pty Ltd (IMCOA), March 2010, Forecast Global Demand and Supply for Individual Rare Earths in 2010E to 2015E(±20%) and in 2020E (±25%)



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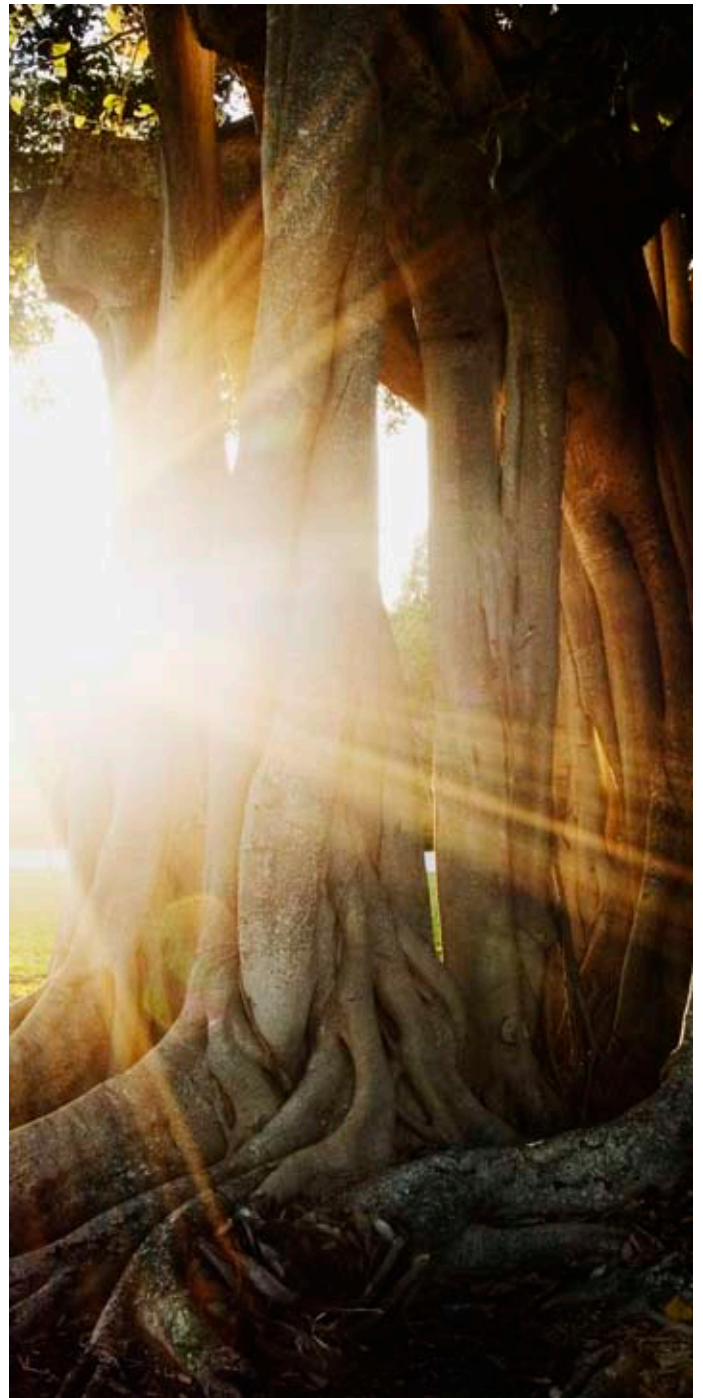
“The race is on for the next generation of advanced rare earths exploration companies. Finding the right partner can be critical in this process.”

production in 2011 and 2012, respectively. There will be a significant time lapse before other rare earths companies will be production-ready. It is this period where premium prices will provide most value to aspiring producers.

But how should advanced rare earths exploration companies finance project development? Should they adopt a partnership strategy similar to that of Lynas Corporation and Molycorp Inc., to produce Rare Earth oxides or should they accelerate cashflow by developing to the less capital intensive concentrate stage.

In this paper, we seek to highlight the various investment frameworks in development, the fundamentals driving the case for investment in rare earths exploration and production, the financing and the available exit options (full or partial) to rare earths developers and investors:

- ▶ What are the short- and medium-term expected demand trends for rare earths?
- ▶ What is the global stakeholder response to the rare earths supply issue: from the governments to the explorers and the end users?
- ▶ What factors are critical in analyzing a rare earths project?
- ▶ What sources of funding are available to develop a rare earths project?
- ▶ What challenges, risks and issues are inherent in exiting a rare earth project?



¹ Technology minerals include rare earths, PGM, antimony, beryllium, cobalt, tantalum, graphite, tungsten, niobium, fluorspar, indium, gallium, magnesium and germanium.

² Rare earths elements (REEs) include yttrium(Y), scandium(Sc), lanthanum(La), cerium(Ce), praseodymium(Pr), neodymium(Nd), promethium(Pm), samarium(Sm), europium(Eu), gadolinium(Gd), terbium(Tb), dysprosium(Dy), holmium(Ho), erbium(Er), thulium(Tm), ytterbium (Yb) and lutetium(Lu). In addition, REEs are classified between light rare earths and heavy rare earths. Light rare earths include La, Ce, Pr, Nd, Sm and Pm. Heavy rare earths include Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y. Sc is found in most rare earth element deposits and is sometimes classified as a rare earth element.

Executive summary

Successful development of rare earths exploration companies is, as with any mining project, a risky endeavor.

The successful development of rare earths exploration companies requires an understanding of the expected short- and medium-term demand trends. According to the latest research, the demand trend is skewed toward one light rare earth (neodymium) and the four heavy rare earths (dysprosium, europium, terbium and yttrium) that are commonly used in magnets in the renewables sector.

In addition, successful development relies on governments encouraging entrepreneurs and investors to take risks by creating a framework to support the development of inherently risky projects focused on mineral exploration and development. In this sector, the government response is currently under formulation and varies from resource-rich to resource-poor countries, as well as between developed and emerging countries, which are in effect going through their own industrial revolution.

In this report, we consider the critical factors when analyzing a rare earths project, reviewing 19 projects in 8 countries. Each project considered contains the 17 elements forming the rare earths group. However, their elemental distribution varies from project to project. This makes comparison problematic and, from a partnering point of view, complicates the investment decision.

In addition, the development stage and speed of a number of projects that still require significant funding, which we do not foresee coming entirely from the debt or equity capital markets, will create competition within the same potential pool of investors. Therefore, early commencement by the management team to assess a full or partial exit strategy to explain each investment's potential and timing becomes critical in order to safeguard market position.

Of course elemental distribution is probably only one of the key factors to consider when analyzing a rare earth project. Ore grades, rare earths pricing, metallurgy and existing infrastructure are also key. Further, although there are numerous identified new projects at various developmental stages, any attempt to estimate their impact on future supply is problematic as the projects' production and timing are still highly uncertain.

To date, the majority of recent experience (Molycorp Inc. and Lynas Corporation) has been equity and debt investment in exchange for supply contracts as well as technological transfer agreement. We foresee that the Molycorp Inc. and Lynas Corporation model of development through partnership may only be available for a very limited numbers of players in the light rare earths space: first mover advantage has been lost and the additional contribution of Molycorp Inc. and Lynas Corporation to global supply is already significant. In the heavy rare earth space, we foresee that there is still time for the creation of vertically integrated players, but these players also need to press on with their projects. For the majority of the other players, management teams should now consider alternative strategies, including the acceleration of development for production of concentrate or the possibility of full exit to another player while prices of rare earths oxides remain attractive.

In our view, the race is on for the next generation of advanced exploration rare earths companies.

Ernst & Young can offer guidance as you consider entering into partnership as an end user or an exploration company or want to explore a full exit strategy.

The question is, who will be successful in getting to production first?





What are the expected short- and medium-term demand trends for rare earths?

Within the 17 rare earths elements, the demand and supply criticality of each element will vary depending on the end application demand pattern.

In December 2010, the US Department of Energy, in its report *Critical Materials Strategy*, examined the role of rare earths metals and other materials in the clean energy economy. The findings in respect of rare earths were that for the short- (0 to 5 years) to medium- (5 to 15 years) term, one light rare earth (neodymium) and four heavy rare earths (dysprosium, europium, terbium and yttrium) were to be considered critical, in particularly for the green energy sector. Note that in 2010, lanthanum and cerium represented 66.8% of the global demand.

These rare earths are relevant in the following main applications summarized in Table 1 due to their specific properties and the lack of available substitutes.

From a demand perspective, Table 2 shows specific sectors that demand these critical rare earths and have the greatest expected rate of growth.

Not only are these minerals critical to the above sectors, they are also the minerals, with the exception of yttrium, expected to be in short supply in 2015 and 2020, as shown in Diagram 2.

Table 1: Critical rare earths – properties and applications

Rare earths	Properties	Applications (estimated specific rare earths usage by application)
Neodymium	Catalytic, magnetic, electrical and optical	Magnets (69.4%) Metal alloys (16.5%) Others (15%) Ceramics (12%)
Dysprosium	Magnetic and optical	Magnets (5%)
Europium	Optical	Phosphors (4.9%)
Terbium	Magnetic and optical	Phosphors (4.6%)
Yttrium	Optical	Phosphors (69.2%) Ceramics (53%) Others (19%)

Source: Lynas Corporation ASX Mid Caps conference presentation, March 2010, pages 6 and 13; Industrial Minerals Company of Australia Pty. Ltd. (IMCOA), January 2011.

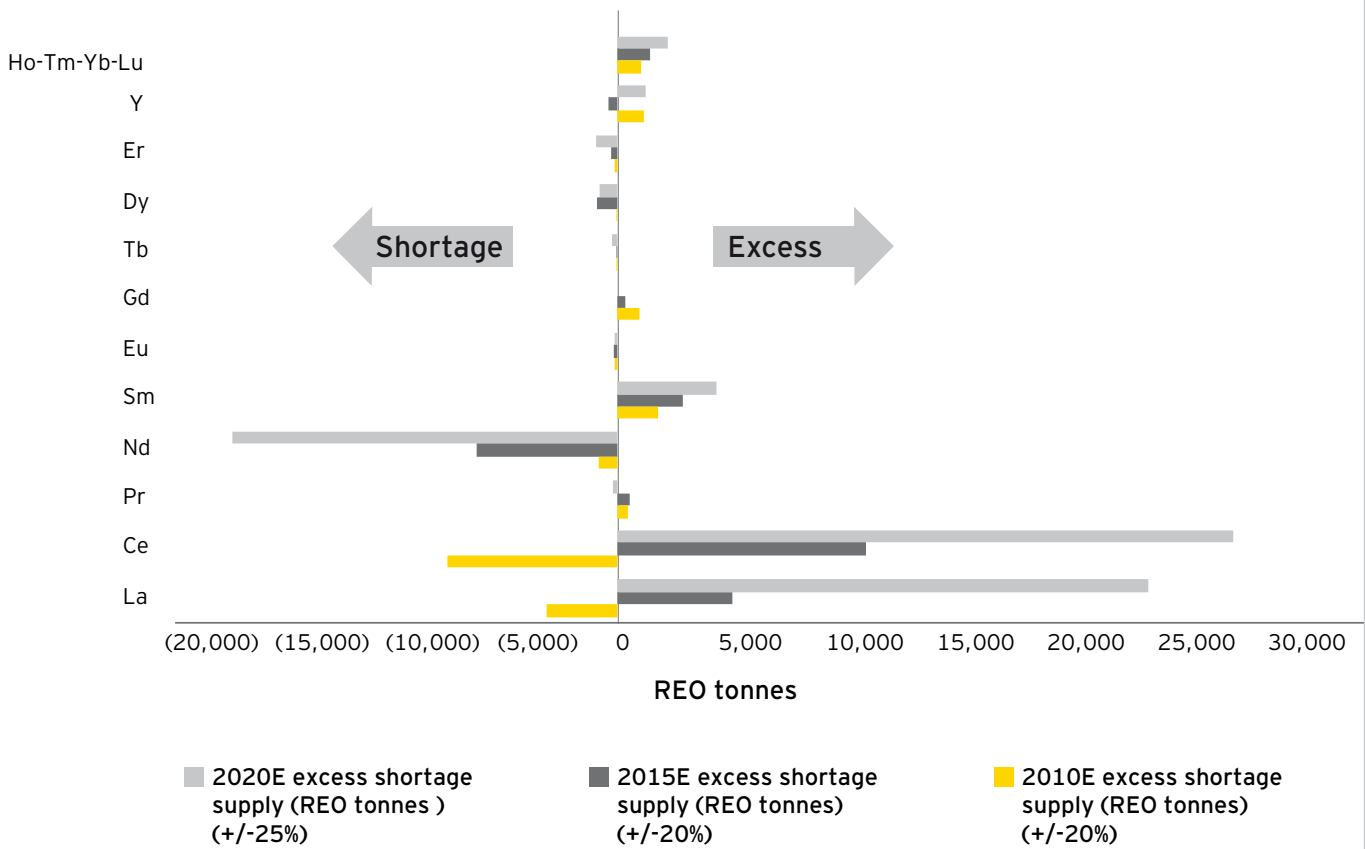
Table 2: Application demand growth rates

Applications	Annual growth 2010–2015	Annual growth 2015–2020
Magnets	10%–15%	10%–15%
Metal alloys	8%–12%	5%–10%
Phosphors	6%–10%	5%–7%
Ceramics	6%–8%	6%–8%
Others	6%–8%	8%–12%

Source: Dudley J Kingsnorth, Industrial Minerals Company of Australia Pty. Ltd. (IMCOA), January 2011, *Forecast Global Demand and for Rare Earths in 2010E to 2015E (±20%) and in 2020E (±25%)*. Above table exclude catalysts, glass and polishing demand rate of growth, also estimated by Dudley J Kingsnorth.



Diagram 2: Forecast global demand and supply for individual rare earths in 2010E, 2015E and 2020E



Source: Dudley J Kingsnorth, Industrial Minerals Company of Australia Pty. Ltd. (IMCOA), March 2010, Forecast Global Demand and Supply for Individual Rare Earths in 2010E and 2015E ($\pm 20\%$) and in 2020E ($\pm 25\%$).

In conclusion, the light rare earth (neodymium) and the four heavy rare earths (dysprosium, europium, terbium and yttrium) seem to represent the greatest opportunity over the short and medium term. This supply gap has led to increasing attention from governments, explorers and end users.

What is the global stakeholder response to the rare earths supply issue – from the governments to the explorers and the end users?

Each nation differs in terms of its existing natural resources, system of governance and industrial makeup. This affects the associated policy implemented by each nation to safeguard its own interests.

Government policy, in turn, shapes the institutional environment in which entrepreneurial decisions are made. We consider government policy vital to entrepreneurship and, in the case of rare earths exploration companies, fundamental to support the risks associated with such exploration.

Table 3 summarizes the goals and key business policies of a sample of nations, highlighting the differences between resource-rich and resource-poor nations.

The following points are key:

1. Other than China and India (which have developed, or have aspirations to develop, high-tech industry users of these minerals), the resource-rich nations' main focus is on the development of efficient mining and, in some cases, downstream processing facilities (e.g., Molycorp Inc. in the US).
2. China is the largest producer and has currently the largest reserves of rare earths. It is also developing downstream high-tech industry users of rare earths. As a result, its own future internal rare earths consumption will only increase, explaining the recent Chinese reduction in export quota.
3. India, which has a similar population and growth rate to China, is developing its policy goal regarding technology minerals and in particular rare earths. This policy is likely to feature increased exploration to map out India's existing resources in addition to welcoming external inward investment.
4. The US has been a major producer in the past and is currently rebuilding its rare earths supply chain, from mines to magnets.
5. Resource-poor areas such as Japan, the EU and South Korea have been focusing on and assessing the risk of supply shortage on their existing industrial footprint. Japan and South Korea have been the most proactive in sourcing minerals through direct involvement from government entities such as Japan Oil, Gas & Metals National Corporation (JOGMEC) and Korea Resources Corporation (KORES). The EU has been slow in its response and is yet to involve a government entity. However on January 26, 2011, the EU set out its views on a strategic framework to deliver a more sustainable use of natural resources and a shift toward resource-efficient, low-carbon growth in Europe in the Europe 2020 flagship initiative. In a subsequent communication, dated February 2, 2011, it was indicated that the European Commission will assess the feasibility of increasing lending (which may include grant-loan elements) to industry, including to mining and refining projects and particularly to post-extractive industries.

China is focusing on concentrating its rare earths industry by implementing the following policies:

- ▶ Controlling its production by bringing under state ownership 11 rare earth mines in the Jiangxi province under a 'state planned mining zone' (introduced in January 2011).³
- ▶ Reducing the associated environmental pollution through the implementation of tougher emission limits from October 1, 2011 to 15 pollutants. This will apply to all industry players including miners and smelters of rare earth alloys.⁴
- ▶ Curbing new illegal mining and smuggling.⁶
- ▶ Continuing to reduce the export⁶ quota volume and implementing increase in exports tariff⁷ for rare earth minerals announced in December 2010 to direct production to new domestic technology industries.
- ▶ Changing the taxation system by implementing a resource tax for mined light and heavy rare earth minerals from April 1, 2011.⁵
- ▶ Capping China's total output of rare earth oxides to 93,800 tonnes in 2011, up 5% from 2010.⁶
- ▶ Suspending the prospecting on production licenses for rare earth, tungsten or antimony until June 30, 2012.⁶

³ "China brings 11 rare earth mines under state control", Agence France-Presse, January 20, 2011, via Dow Jones Factiva, © Agence France-Presse.

⁴ "China caps emissions for rare earth miners", Agence France-Presse, March 1, 2011, via Dow Jones Factiva, © Agence France-Presse.

⁵ "China to impose tenfold resource tax increase on rare earth minerals from April", IHS Global Insight Daily Analysis, March 24, 2011, via Dow Jones Factiva, © IHS Global Insight Limited.

⁶ "China to cap 2011 rare earth output at 93,800 T", Reuters News, March 31, 2011, via Dow Jones Factiva, © Reuters Limited.

⁷ "China Raises Rare Earth Export Tariff", NewsTrak Daily, December 16, 2010, via Dow Jones Factiva, © NewsTrak International Co. Ltd.

Table 3: Material strategies from selected areas

Nation	% of global reserves ¹⁰	Goal	Key business policy
Rare earths reserve-rich areas:			
Australia	1.4%	▶ Maintain investment in the mining sector while fairly taxing depletion of natural resources	▶ Commitment to become a long-term supplier of rare earths to countries such as Japan ▶ Commitment for fast turnaround of land permit applications
Canada	Not quantified by USGS but in exploration	▶ Sustainable development and use of mineral and metal resources ▶ Environmental protection	▶ Promote recycling ▶ Use life-cycle-based approach to mineral management and use
China	50%	▶ Stable supply of raw material	▶ REE export quotas and taxes ⁸ ▶ Industry consolidation and limited mining permits until mid-2011, increasing environmental laws ⁹ ▶ Proposed unified pricing policy
India	2.8%	▶ In development stage but likely to include policy around supply shortage	▶ In development stage but likely to include policy framework around securing and augmenting domestic sources of supply, building technological capabilities, promoting international investment and cooperation and possibly stockpiling
US	11.8%	▶ Competitive domestic rare earths industry ▶ Long-term availability of strategic and critical materials by 2015	▶ Rare Earth Supply-Chain Technology and Resources Transformation (RESTART) and National Defense Authorization Acts ▶ Stockpiling ▶ Information gathering
Rare earths reserve-poor areas:			
EU	–	▶ Limit the impact of potential material supply shortages	▶ Mineral trade policy for open international markets ▶ Increased recycling ▶ Information gathering
Japan	–	▶ Secure stable supply of raw materials	▶ Funding for international mineral exploration ▶ Loan guarantees for high-risk mineral projects ▶ Stockpiling ▶ Information gathering
South Korea	–	▶ Reliable supply of materials	▶ Financial support ▶ Agreements with resource-rich nations ▶ Stockpiling

Source: US Department of Energy, "Critical Materials Strategy, December 2010"; The Hague Centre for Strategic Studies and TNO, "Rare Earths Elements and Strategic Mineral Policy, 2010."; Japan Oil, Gas and Metals National Corporation, (JOGMEC) "JOGMEC's role in sourcing the supply of critical minerals, January 22, 2011."

⁸ China has recently announced an increase in REE export tax to 25% for lanthanum and cerium, and China has reduced export quota by about 35% vs. H1 2010. In addition, on March 24, 2011, China has announced its plans to increase taxes on rare earth elements. The tax applicable from April 1, 2011 will rise from the current level of 0.5 to 3 yuan per tonne to 30 yuan per tonne for medium and heavy rare earths or 60 yuan per tonne for light rare earths.

⁹ China is preparing to tighten environmental standards for rare earth mining in a move that might raise prices. The rule would limit pollutants allowed in wastewater and emission of radioactive elements and phosphorus.

¹⁰ as per the US Geological Survey (USGS), Mineral Commodity Summaries, January 2011, available at http://minerals.usgs.gov/minerals/pubs/commodity/rare_earths/mcs-2011-rare.pdf

Responses from end users have included the development of technological solutions¹¹:

- ▶ General Electric is working with the US Department of Energy to consider how to make permanent magnets using nanotechnology to reduce the rare earths content by 80%.
- ▶ General Motors has developed products without rare earth magnets such as the eAssist hybrid engine available in the 2012 Buick LaCrosse.
- ▶ The development of recycling solutions, which are constrained today by the lack of an efficient collection system, the complex dismantling and treatment process, and their energy-intensive processing.
- ▶ Backward integration including partnering with explorers in exchange for off-take agreements.

Responses from the explorers have included:

- ▶ Re-examining known deposits and the discovery of new rare earths projects, as well as planning the development of new downstream processing capability.

In conclusion, the initial responses have depended on the objective of each stakeholder. However, the government responses need to vary to accommodate the existing presence and quality of the minerals in the country concerned and to-date most are currently only under formulation. In our view, prudent government policy to ensure the retention of mineral competitiveness and/or unfettered access to minerals should include the encouragement of investors to take risks by creating a framework to support exploration.



¹¹ Jeremy Lemer, "Companies look to cut use of rare earths," Financial Times Limited, February 23, 2011 via Dow Jones Factiva © 2011



What factors are critical in analyzing a rare earths project?

There are several critical factors specific to the rare earths projects to consider when analyzing such a project. These include the element distribution, the price of each rare earths element, the stages of project development, the estimated project costs, the metallurgy and downstream processing and other factors common in the mining industry including ore grade and closeness to infrastructure.

The element distribution

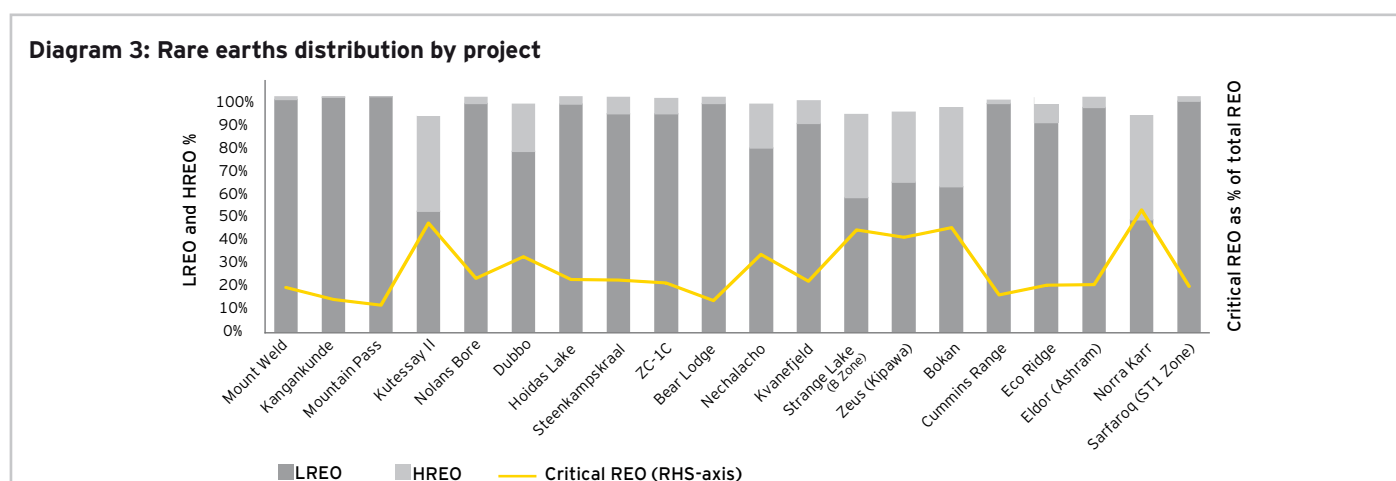
All rare earths deposits generally contain all 17 rare earth elements. However, the distribution and weighting of the different elements within each deposit varies from project to project, which is an important consideration for project developers and investors.

Technology Metals Research¹² estimates that there are currently more than 251 individual active rare earths projects being run by 165 companies in 24 different countries outside China. The projects are at varying stages of development.

From this sample, the research group identified 19 companies in 8 different countries that it categorized as advanced rare earths projects, which are summarized in Appendix 1. Those projects met one or both of the following criteria:

- ▶ Deposit has been formally defined as a mineral resource or reserve under the guidelines of a relevant scheme such as NI43-101 or the JORC code
- ▶ Deposit has been subject to past mining campaigns for rare earths, for which reliable historical data is available, even if the data is not currently compliant with a relevant scheme in terms of resource of reserves definition

As Diagram 3 below illustrates, from an element distribution perspective and based on volume distribution, the advanced rare earths projects' element distribution is skewed toward light rare earths oxides (LREO).¹³ Exceptions are Kutessay II, Dubbo, Strange Lake, Zeus, Bokan and Norra Karr, which nevertheless have more than 20% heavy rare earths oxides (HREO) as a percentage of the total REO.¹⁴ The proportion of critical REO¹⁵ over the total REO for each of the project is more than 20%, except for Mount Weld, Kangankunde, Mountain Pass, Bear Lodge, Cummins Range and Sarfaroq (ST1 Zone).



Source: see page 26

¹² Gareth Hatch, "Comparative value metrics for 13 advanced rare earths projects", Technology Metals Research, www.techmetalsresearch.com, November 10, 2010

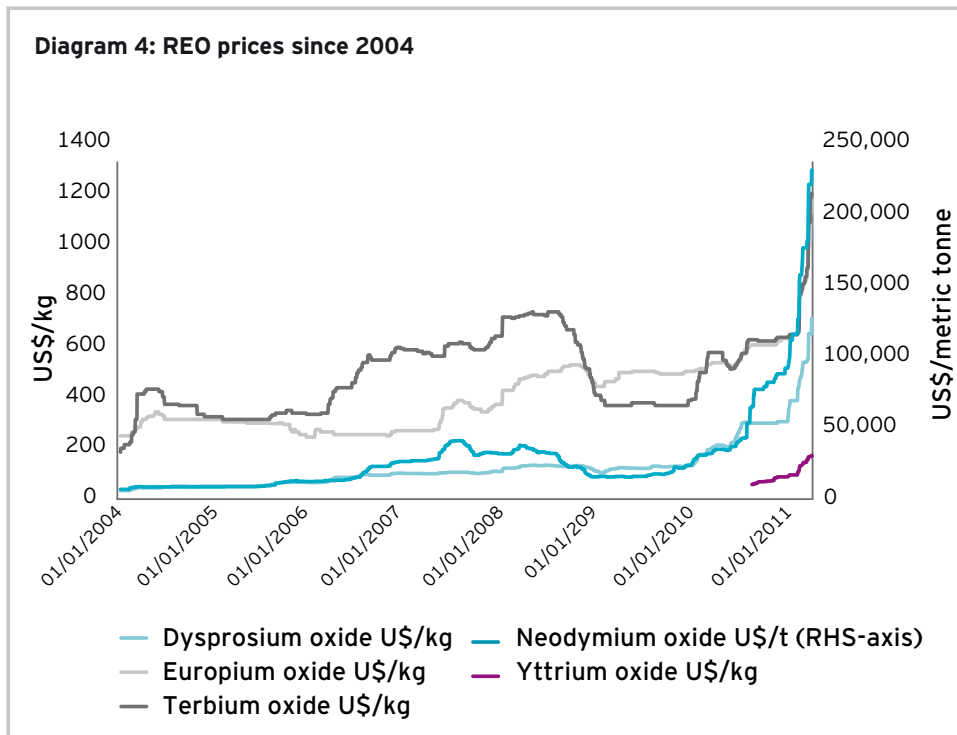
¹³ LREO are defined as cerium (ce), lanthanum (la), neodymium (nd), praseodymium (pr) and samarium (sm); HREO are defined as dysprosium (dy), europium (eu), gadolinium (gd), terbium (tb) and yttrium (y).

¹⁴ No volume or value attributed to holmium, erbium, thulium, ytterbium and lutetium, as these elements are typically produced to special order and do not have a regularly published price.

¹⁵ Critical REO include LREO neodymium and HREO dysprosium, europium, terbium and yttrium.

The price of each rare earths element

The price of each rare element varies, as shown in Diagram 4 for dysprosium, terbium, yttrium, europium and neodymium. Therefore each project will have a slightly different weighted average price per REO.



Source: Thomson Datastream, to April 13, 2011.

The main catalyst for the increase in rare earths oxide prices was China's announcement of a cut in the export quota on July 8, 2010.

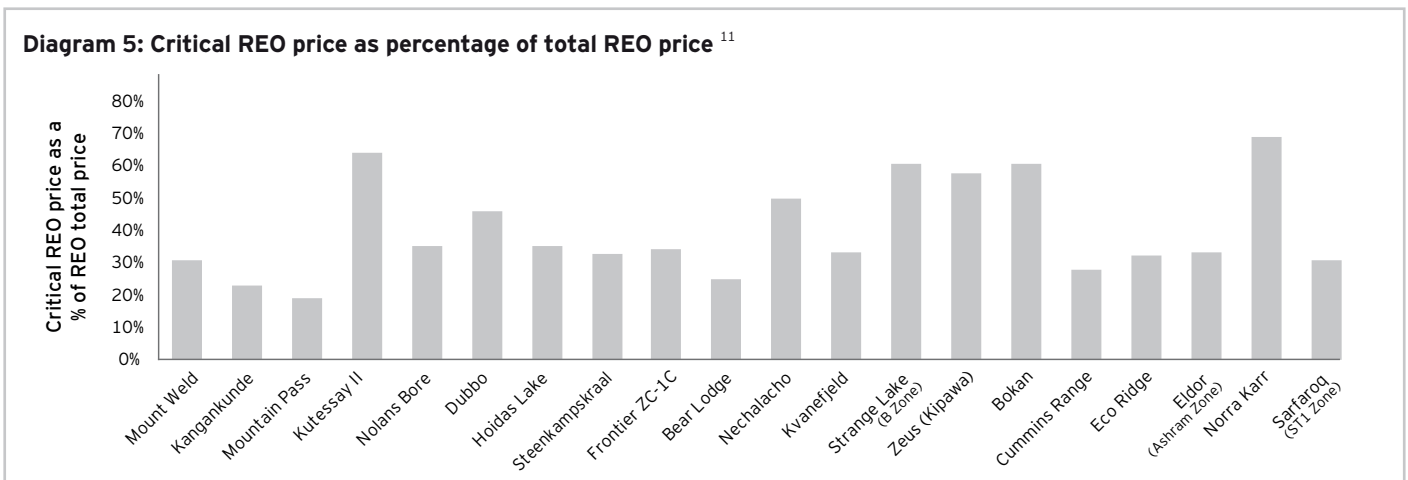
Going forward, there are various factors that will impact the expectations concerning rare earths oxides prices. These include:

- ▶ In the short term, the impact of the recent earthquake and tsunami on the Japanese economy. It is likely that deliveries of rare earth metals and alloys to Japan will slow in the short term, which could lead to a reduction of the rare earths oxide prices.
- ▶ In the medium term, the speed at which new volume of rare earths oxides will come onto the market. Molycorp Inc. and

Lynas Corporation are both in start up phase and despite the fact that it will take some time for these two companies to get to full production, these will eventually represent about 25% and 15% respectively of the 2013E global expected supply. It is therefore likely that this new supply will have a softening effect on the light rare earth oxide prices.

- ▶ The impact of recent Chinese policies on concentrating their local rare earths industry and the next expected export quota revision for 2011, which could also trigger another price increase.
- ▶ In the long term, the risk of technological advancement leading to a reduction in the quantity of minerals needed per application. This should be equally counterbalanced by possible new demand for emerging applications.

Diagram 5 illustrates that the price of the critical REO as percentage of total REO price is estimated to be above 50% in the case of Kutessay II, Nechalacho, Strange Lake, Zeus, Bokan and Norra Karr.

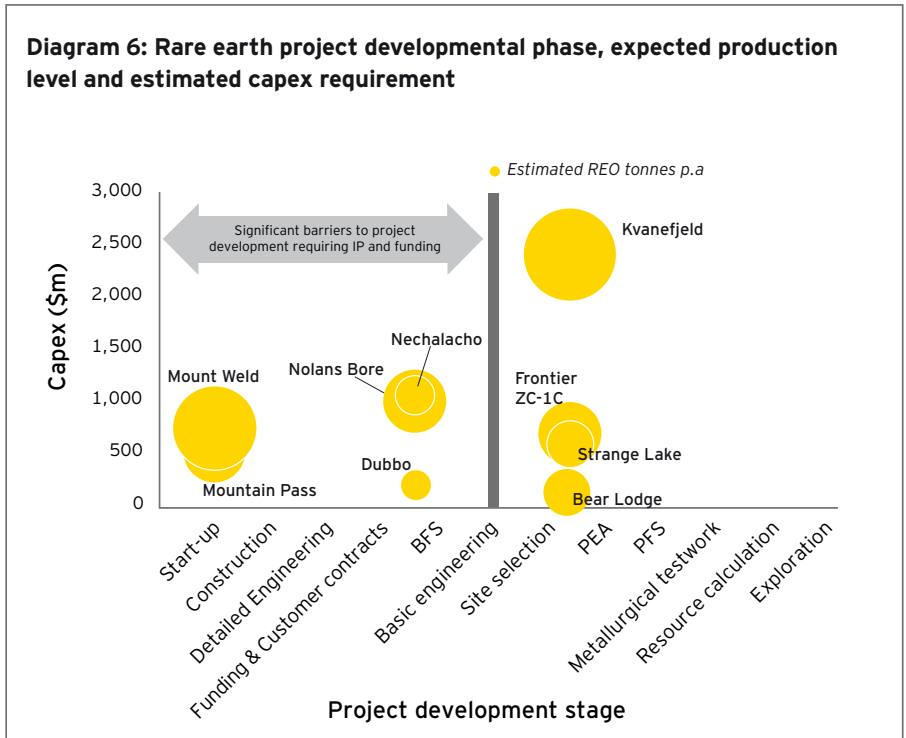


Source: Ernst & Young estimates using distribution sourced details on page 26 and metals prices as at April 8, 2011 based on FOB Surveys from Stans Energy Corporation, corporate news, <http://www.stansenergy.com/press-releases/stans-energy-corp-announces-kutessay-ii-rare-earth-distribution/>, 12 April 2011

The stages of project development

There are a dozen key steps in each project development: exploration, resource calculation, metallurgical testwork, prefeasibility study (PFS), preliminary economic assessment (PEA), site selection, basic engineering, bankable or definitive feasibility study (BFS), funding & customer contracts, detailed engineering, construction and start-up production.

The most advanced rare earths projects are all at different stages of development as shown in Diagram 6. Stans Energy, Navigator Resources Limited and Commerce Resources Corp. are still at the resource calculation stage.



Source: see page 26

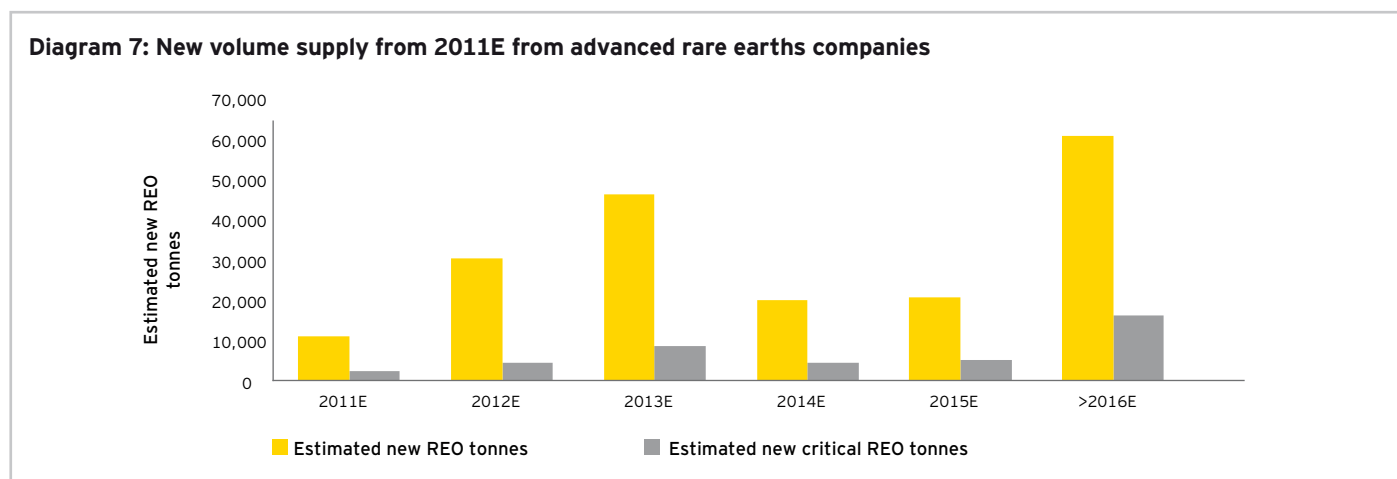
Matamec Exploration Inc, Stans Energy Corporation, Ucore Rare Metals inc, Navigator Resources Limited, Pele Mountain Resources inc, Commerce Resources Corp, Tasman Metals Ltd, Hudson Resources inc and Great Western Minerals Group, capex and or production estimates are not available

The various stage of development of the projects will result in different production starts as it can take from 7 to 15 years from exploration to production. The prolonged period of depressed prices caused under investment in the sector. The recent price rally has provided the much needed stimulus to reactivate suspended production and promote exploration. Prices will need to be sustained for much longer for financiers to provide significant levels of developmental capital.

might never make it to production stage once the new start-ups Molycorp Inc. and Lynas Corporation reach full production.

The estimated project costs

As shown in Diagram 6, the above 9 projects have an estimated combined capex requirement of more than US\$7b. Five projects which are currently pre basic engineering are by themselves already estimated to require more than US\$4.6b.



Source: Ernst & Young estimates based on companies' announcements

As Diagram 7 demonstrates, the majority of new volume supply from the sample described in Appendix 1 is expected to come online after 2015 for both REO and critical REO,¹⁶ assuming that the miners meet their own timetable and can produce at maximum capacity, which is highly uncertain.

In addition to the sample of 19 companies, there are other companies and projects outside of China, which are summarized in Appendix 2. The potential additional supply capacity from these could be another 50,000 tonnes of REO from 2015, assuming that the projects are on schedule, which is equally uncertain. Finally, China is also estimated to produce about 27,500 additional REO tonnes in 2015 compared with 2010.¹⁷

The new volume supply summarized above in Diagram 7 will be impacted by the factors described previously in the pricing subsection, as projects' economics and viability are dependent on the future price of rare earths oxides. It is possible that some of these projects, particularly those with a light rare earths focus,

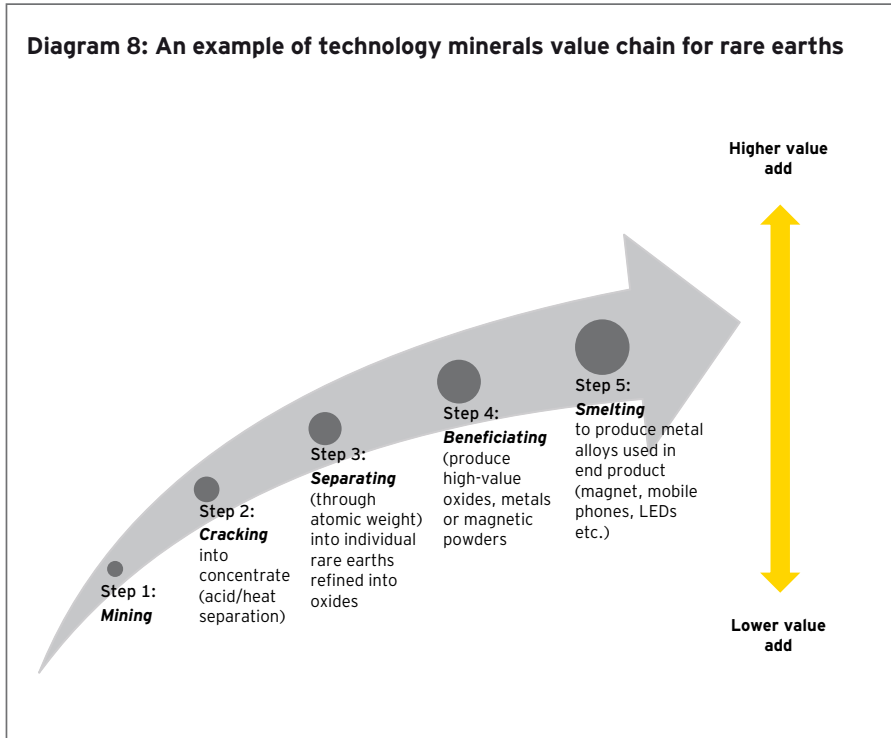
The projects of Frontier Rare Earths, Rare Element Resources, Avalon Rare Metals, Greenland Minerals & Energy and Quest Rare Minerals have yet to reach the stages where intellectual property (IP) needs to be developed to crack the rare earth from the host ore, large funding needs to be raised or customer contracts identified.

The metallurgy and downstream processing

Metallurgy and processing refers to the five steps detailed in Diagram 8. In the case of rare earths, the metallurgy is particularly complex due to the existence of the radioactive element of thorium.

¹⁶ Critical REO include LREO neodymium and HREO dysprosium, europium, terbium and yttrium.

¹⁷ Dudley J Kingsnorth, Industrial Minerals Company of Australia Pty Ltd (IMCOA), March 2010, Forecast Global Demand and Supply for Individual Rare Earths in 2010E to 2015E(±20%) and in 2020E (±25%)



Source: Ernst & Young analysis

Other factors common to mining projects:

There are other relevant factors not detailed here that are not rare earths specific but merit mention. These include ore grade and proximity to infrastructure, which are also paramount to the success or failure of a mining project. Ore grade determines the cost and timing of deposit access, and analysts consider projects with ore grade over 10% to be "very good." Appendix 1 contains some estimates of ore grade. Infrastructure such as roads, railways, power and water are also essential to any mining project to keep capex costs down.

In conclusion, there are several critical factors that need to be considered when analyzing a rare earth project. Save for Kutessay II, Strange Lake, Dubbo, Bokan, Norra Karr and Zeus, the majority of rare earths projects before 2016 have limited focus on critical REO (neodymium, dysprosium, europium, terbium and yttrium) and are currently in different stages or developing at different speeds. A planned and well-thought-out approach to how the project can be funded for subsequent stages or a full exit strategy will become critical to avoid being left behind.



What sources of funding are available to develop a rare earths project?

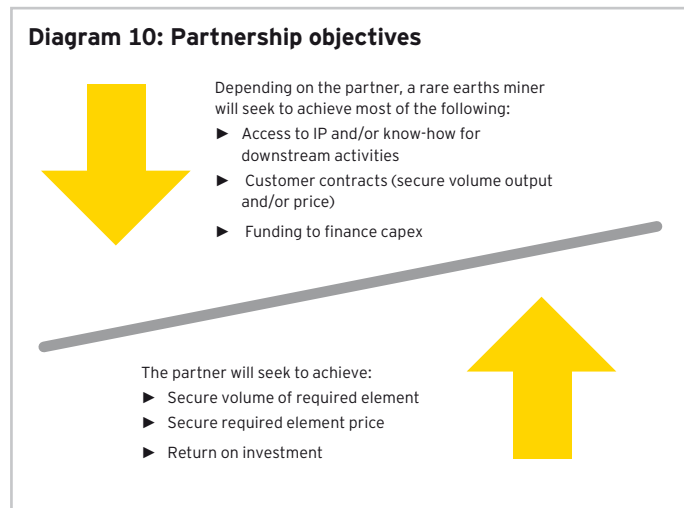
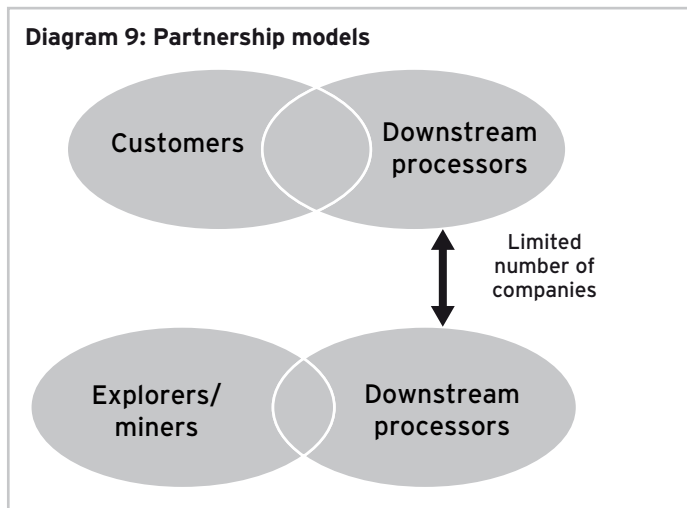
We anticipate that competition from rare earths explorers for debt and equity to fund the development of rare earths projects (and possibly the associated downstream production facilities), will lead to some availability constraint on capital markets. It is likely that there will be limited capacity in the equity and debt markets due to the global financial crisis that started in September 2008 and despite the \$407.8m IPO in July 2010 of Molycorp Inc.

This limited capacity is also due to the size of capital investment required, the risks associated with downstream application, uncertainty around the elemental demand and the existing stages of development of projects. Ongoing uncertainty surrounding the future price of rare earths oxides once the additional light rare earths production of Molycorp Inc. and Lynas Corporation are made available in the market, may also constrain investment.

Light rare earths projects

Developers of light rare earths projects will need to adjust their strategy to survive and adapt their value chain accordingly as new volume is made available. We believe:

- ▶ A limited number of explorers/miners will successfully reach start up phase, including the construction of concentration facilities. The concentrate is most likely to be sold to or toll treated by sector participants with separation facilities into additional partnership agreements with downstream processors and/or end users.
- ▶ The majority of explorers/miners are likely to stop at the pilot plant stage or earlier, and will need to sell their project to an existing, more advanced player with an existing separation plant.



In addition, we consider that the market will draw a distinction between advanced rare earths projects with light and heavy rare earths focus, as there is still an expected supply shortage in the heavy rare earths over the next 10 years.

This likely separation in the rare earths model between light rare earths producers and heavy rare earths producers will result in different strategies and associated funding models, and will also impact the overall viability of the stand alone project.

In practice, Appendix 3 summarizes the experience of Molycorp Inc. and Lynas Corporation to-date. Their experience has been equity and debt investment in exchange for supply contracts and technological transfer agreements. However, it is likely that the Molycorp Inc. and Lynas Corporation experience will not be available to the majority of the other players and that light rare earths projects will not become fully vertically integrated producers. It is now critical for these projects to consider their perceived strategic advantage compared with their peers and

to formulate the appropriate strategy to realize the value of their project in order to benefit from the current strong rare earths oxides price. Early decision in this market may prove to be beneficial, as opposed to waiting to fund the project to extract additional value from the entire rare earths value chain.

Heavy rare earths projects

As far as heavy rare earths projects are concerned, there is potentially still time to develop a number of vertically integrated players. Time will also be of the essence to achieve first mover advantage. Otherwise, similarly to the light rare earths projects, these projects may also become consolidated into one of the early developers.

For those still considering partnership models, there are several models that may be suitable:

Unincorporated JVs – a contractual relationship is established between the participants.

Incorporated or Equity JVs – set up by the incorporation of a separate legal entity by the partners.

Farm-in/Farm-out – structured through investing in projects to earn a specified percentage stake in the joint venture. The existing owner farms out in exchange for capital and/or a market for its output. Alternatively, a major miner completes a BFS by a specified time to earn a percentage in the joint venture. They may also arrange financing in return for a stake in the venture.

Buy-out and royalty agreements – a junior miner enters into an agreement with a major miner. Instead of an equity stake, the junior is either bought out or earns a royalty on production from the major.

Cross-border leases – an arrangement between two partners that aims to reduce the overall cost of project financing. Commonly used in transport and infrastructure, a lessor uses depreciation tax allowances to reduce taxable income and passes this tax saving on to a lessee entity.

The choice of partnership structure influences the risks and complexities that the partners will face throughout the life of the agreement.

Diagram 10 depicts some of the key objectives when considering a partnership.

In conclusion, timing for explorers is now critical to secure the future of their projects. We anticipate that there is still early mover advantage to be had in the heavy rare earths focused projects to create vertically integrated players but that the window of opportunity for the light rare earths projects explorers is closing down rapidly as new volume outside of China is already being added by early movers such as Molycorp Inc. and Lynas Corporation. This opportunity to develop a light rare earths vertically integrated player will be more difficult to achieve and may not offer the best value creation. Instead, it is more likely that light rare earths late developers will find an M&A option, assuming that their project has the right characteristics. No doubt, this will create a dramatic change in the competitive landscape for end users.



What challenges, risks and issues are inherent in exiting a rare earth project?

Disposing of rare earths projects can include part disposal through partnership or full exit through M&A approaches. Below we summarize some of the challenges, risks and issues from an explorer's point of view, based on the development stage of the asset.

	Post-discovery and pre-feasibility	Post-feasibility and pre-production	Operational assets
Financing	High	High	Low
Reliability of supply/demand	Low	Medium	High
Downstream activities	Low	Medium	High
Value	▶ Low valuation in early stage	▶ Steeper value curve	▶ Improved value
Traditional funding model	▶ Equity (TSX, AIM or ASX) primary or secondary	▶ Sell equity to a partner in exchange for know-how and/or customer offtake ▶ Bank finance ▶ Project finance ▶ Equity issuance	▶ Balance sheet funding ▶ Rights issue ▶ Debt issuance
Risks	▶ Project feasibility risk	▶ Project execution risk	▶ Rising costs ▶ Failing commodity prices ▶ Environmental risk
Prevalent partnership models	▶ Typically letters of intent from potential customers	▶ Offtake agreement with/ without equity ▶ Joint marketing and distribution agreement ▶ Technology/know-how/ IP and technical assistance agreements	▶ Partnerships already typically agreed

In respect of disposal, the explorer will be seeking to improve value. The valuation will typically tend to rise sharply between the discovery stage and the completion of the bankable feasibility study and thereafter when the project starts producing. The valuation will of course also be dependent on the capital costs, grade, expected productivity, metallurgy, management and external factors such as the strength of the global economy. In respect of rare earths, the management team that considers selling its asset will need to successfully articulate the strengths of the project in light of likely significant competition for only a limited pool of capital.

In respect of a partnership, we have summarized below the key risks and challenges from an end-use point of view :

- ▶ Understanding the ore grade to determine whether the project economics can work
- ▶ Understanding the element distribution and costs associated from extraction to production, including whether the metallurgy and processing have been proven
- ▶ Understanding the required infrastructure around the mining project, including closeness to existing roads, railway or river transport with nearby water and power sources, as this can have significant impact on capex requirements

- ▶ Political risk and country risk
- ▶ Management's experience developing metallurgy and bringing mines to production
- ▶ Existing shareholder base and financial structure of the rare earths company; often exploration companies will have complex shares structures

Whether a company decides to exit from a rare earth project fully, or partially through a partnership, timing of the investment will be critical due to the number of projects in the pipeline. It will require significant planning and understanding of all reported assets and the future management plan.

In conclusion, all current advanced exploration rare earths companies are yet to be in the operational assets category. They will therefore have to follow either a full or partial exit strategy to fund their growth. Some will succeed while relying on public equity raising and/or equity stake disposal in exchange for future offtake agreements, but it is likely that these will be a minority and that for most, the obvious approach will be a full exit.

Summary

Successful development of rare earths exploration companies is, as with any mining project, a risky endeavor. It requires a good management team with a significant amount of planning to deliver a project on time and cost.

Rare earths projects have interesting characteristics that make them complex projects to analyze, which complicates the investment decisions but can also lead to significant reward for the right project.

There are a large number of projects aiming to satisfy the estimated supply gap, and we foresee that this will become a race to develop the next producing asset.

Few management teams will be successful in developing rare earths assets to production and as a vertically integrated player. For those that are, there is likely to be a bright future. Other less successful companies may want to start thinking about adapting their strategy to an environment where first mover advantage is key in such a small market.

The question is, who will be successful in getting to production first?



How Ernst & Young can help

Ernst & Young can offer you guidance in making these difficult decisions as you consider entering into partnership or exiting fully.

We can accompany you throughout the life cycle of a rare earths project, whether you are an end user or an explorer.

At Ernst & Young we have a depth and breadth of capabilities and experience that can help you address the key considerations and issues that we have summarised below.

Issues	Considerations	Ernst & Young capabilities
Project selection	<ul style="list-style-type: none"> ▶ Element distribution that meets your requirements ▶ Project with the right ore grade ▶ Project at the right stage of development to satisfy your future expected demand ▶ Project costs and associated contingencies ▶ Project with known and/or understood metallurgy and downstream processing ▶ Extent of infrastructure and its proximity 	<ul style="list-style-type: none"> ▶ Financial, operational, commercial, IT, human capital and tax due diligence ▶ Valuation and business modelling ▶ Project benchmarking
Partner selection	<ul style="list-style-type: none"> ▶ Financial capability of the partner 	<ul style="list-style-type: none"> ▶ Coordination of partner selection process ▶ Valuation and business modeling ▶ Governance advisory ▶ Financial due diligence
Project structuring	<ul style="list-style-type: none"> ▶ Planning the partnership (scope, legal and financial structure, strategy and business plan) ▶ Forming the partnership (financing, legacy risk issues, dispute mechanism, governance, dissolution) ▶ Operations (post-deal integration, meeting partners' financial and tax reporting requirements, decision-making process, capital management) ▶ Dissolution (sale to third party, sale to one partner, separation) 	<ul style="list-style-type: none"> ▶ Financial, operational, commercial, IT, human capital and tax due diligence ▶ Valuation and business modeling ▶ Transaction integration ▶ Dispute advisory knowledge regarding the clarity of business plan ▶ Financial and tax structuring ▶ Statutory audits, tax compliance and advisory ▶ Risk advisory ▶ Finance transformation and consolidation ▶ IT effectiveness ▶ Potential cost reduction ▶ Governance advisory ▶ Investigations and disputes monitoring ▶ Equity and debt capital market advisory
Full exit	<ul style="list-style-type: none"> ▶ Planning the exit (financial, legal, marketing) ▶ Assessing the valuation ▶ Timing of the exit and length of process ▶ Finding interested parties 	<ul style="list-style-type: none"> ▶ M&A advisory ▶ Sell side advisory ▶ Financial, operational, commercial, IT, human capital and tax due diligence ▶ Valuation and business modelling ▶ Financial and tax structuring ▶ Statutory audits, tax compliance and advisory

Appendix 1 – Advanced rare earths projects

Company	Market cap (US\$)	Cash (US\$) as at date	Project/country	Stage	Ore grade (%) cut-off (c/o) (%) ¹⁸	Estimated production start	Estimated production (tonnes p.a.) ¹⁹
Lynas Corporation Ltd.	\$3,189.4m	\$275.9m December 31, 2010	Mount Weld/ Australia	Close to start-up	8.1%	Q3 2011/ 2012	11,000
			Kangankunde/ Malawi	Funding and customer contracts	c/o:2.5%	Not available	11,000 phase 2
Molycorp Inc.	\$3,853.3m	\$316.4m December 31, 2010	Mountain Pass/ USA	Start-up	4.24% c/o:3.5%	Q4 2012 Q4 2013	5,000
Stans Energy Corporation	\$293.6m	c. \$2.7m not disclosed	Kutessay II/ Kyrgyzstan	Resource calculation	8.24% c/o:5%	Q4 2012 or 2013	19,050 to 40,000
Arafura Resources Ltd.	\$293.6m	c. \$2.7m not disclosed	Kutessay II/ Kyrgyzstan	Resource calculation	0.3% c/o:n/a%	Q4 2012 or 2013	Not available
Alkane Resources Ltd.	\$354.5m	\$63.8m November 5, 2010	Nolans Bore/ Australia	Bankable feasibility study	2.8% c/o:1%	2013	20,000
Great Western Minerals group Ltd.	\$371.1m	\$22.6m February 28, 2011	Dubbo/Australia	Bankable feasibility study	0.745% c/o:n/a	2013	2,580
Frontier Rare Earths Ltd.	\$312.5m	\$8.9m January 22, 2011	Hoidas Lake/ Australia	Metallurgical test	2.4% c/o:1.5%	>2016	5,000
			Steenkampskraal/ South Africa	Feasibility study	16.7% c/o:n/a	H2 2013	2,700
Rare Element Resources Ltd.	\$276.2m	\$55.5m not disclosed	Zandkopsdrift/ South Africa	Preliminary economic assessment	2.32% c/o:1%	Q4 2014/Q1 2015	20,000
Avalon Rare Metals Inc.	\$488.2m	\$70m not disclosed	Bear Lodge/USA	Preliminary economic assessment	3.46% c/o:1.5%	2015	10,400
Greenland Minerals & Energy Ltd.	\$662.2m	c. \$38m not disclosed	Nechalacho (Thor Lake)/Canada	Bank feasibility study	1.56% c/o:C\$260 per tonne of Net Metal Return	Q4 2015	10,000
Hudson Resources Inc.	\$331.9m	c. \$8m July 8, 2010	Kvanefjeld/ Greenland	Preliminary economic assessment	1.07% c/o:0.015% U3O8	2015-16	43,729
Quest Rare Minerals Ltd.	\$76.5m	\$4.0m September 30, 2010	Sarfartoq/ Greenland	Preliminary economic assessment	1.51% c/o:0.8%	2015	Not available
Matamec Exploration Inc.	\$311.9m	\$49.4m November 31, 2010	Strange Lake (B Zone)/Canada	Preliminary economic assessment	0.933% c/o:0.58%	2016	12,000
Ucore Rare Metals Inc.	\$56.2m	c. \$7m not disclosed	Zeus (Kipawa)/ Canada	Preliminary economic assessment	0.23 c/o:0.5% ZrO2	>2015	Not available
Navigator Resources Limited	\$142.5m	\$3.1m September 2010	Bokan (Dotson – I&L zone)/USA	Metallurgical testwork	0.75% c/o:0.5%	2014-16	Not available
Pele Mountain Resources Inc	\$80.2m	\$20.5m December 31, 2010	Cummins Range/ Australia	Resource calculation	1.72% c/o:1.0%	Not available	2,000 to 4,000
Commerce Resources Corp.	\$48.3m	\$4.6m not disclosed	Eco Ridge/Canada	Pre-feasibility study	0.132% c/o:0.043%U3O8	Not available	Not available
Tasman Metals Ltd.	\$120.8m	\$13.3m not disclosed	Eldor (Ashra)/ Canada	Resource calculation	1.74% c/o:1.25%	Not available	Not available

Source: see page 26

¹⁸ Each company publishes its resources/reserves differently to comply with local rules; accordingly, these figures need to be reviewed with care as they do not necessarily make allowances for the varying recovering associated with each reserve/resource.

¹⁹ Although some companies have given indication to the timing of production as well as estimates of annual production, it is very difficult to assess the production timeframe or the quantities to be produced.

Appendix 2 – Other rare earths projects

Current producers outside China

Company	Location	Country	Current capacity (REO tonnes p.a.)	Target capacity > 2015 (REO tonnes p.a.)
Lovozerky Mining Company	Kamasurt Mine, Kola Peninsula	Russia	3,000-4,400	15,000
Solikamsk Magnesium Works	Solikamsk Processing Plant, Urals	Russia	Up to 3,600	n/a
Indian Rare Earths Ltd.	Orissa, Tamil Nadu and Kerala	India	25-100	10,000
Toyota/Sojitz/Government of Vietnam	n/a	Vietnam	1,800-2,000	>2,000
Neo Material Technologies Inc.	n/a	Thailand	n/a	n/a
Industrias Nucleares do Brasil S/A	Buena Norte	Brazil	1,500	>1,500
TOTAL			9,925-11,600	>28,500

Source: Chen Zhanheng, "Global rare earths resources and scenarios of future rare earth industry," *Journal of Rare Earths*, Vol.29, No. January 1, 2011, Ernst & Young estimates.

Under preparation producers outside China

Company	Location	Country	2011–2013 capacity (REO tonnes p.a.)	Target capacity > 2015 (REO tonnes p.a.)
Sumitomo/Kazatomprom/SARECO JV	Ulba	Kazakhstan	3,000 by 2011	15,000
Toyota/Sojitz/Government of Vietnam	Dong Pao	Vietnam	300	5,000
Toyota/Indian rare earths JV	Orissa	India	5,000	10,000
Mitsubishi/Neo Material Technologies Inc/Mineração Taboca S.A.	Pitinga	Brazil	500	1,000
TOTAL			8,800	31,000

Source: Chen Zhanheng, "Global rare earths resources and scenarios of future rare earth industry," *Journal of Rare Earths*, Vol.29, No. January 1, 2011, Ernst & Young estimates.

Other exploration early projects outside China

Company	Location	Country	2011–2013 capacity (REO tonnes p.a.)	Target capacity > 2015 (REO tonnes p.a.)
Japan – Mongolia JV	n/a	Mongolia	0	0

Source: Chen Zhanheng, "Global rare earths resources and scenarios of future rare earth industry," *Journal of Rare Earths*, Vol.29, No. January 1, 2011, Ernst & Young estimates.

Appendix 3 – What models have been used in practice to develop a rare earth project

Molycorp Inc. and Lynas Corporation, given the more advanced stage of development of their projects, have been the most active in seeking partners and have followed the approaches below:

Table 4: Equity partnership

Target	Acquiror/country	Announced date	Comment	Completion expected by
Santoku America Inc.	Molycorp Inc./US	April 18, 2011	Acquisition of Santoku America Inc. provides Molycorp Inc. with the capability to begin manufacturing and selling rare earth alloys for the production of neodymium iron boron (NdFeB) magnets and samarium cobalt (SmCo) magnets	April 2011
AS SILMET	Molycorp Inc./US	April 4, 2011	Acquisition of AS Silmet provides Molycorp Inc. with its first European rare earths processing facilities, doubling its rare earth oxides capacity to 6,000 p.a.	April 2011
Molycorp Inc.	Hitachi Metals Ltd./Japan	December 21, 2010	JV to manufacture rare earths alloys and magnets	April 2011
Molycorp Inc.	Sumitomo Corporation/Japan	December 10, 2010	Sumitomo to purchase \$100m shares and provide \$30m debt financing in exchange for seven-year supply contract.	February 2011
Lynas Corporation Ltd.	China Nonferrous Metal Mining (Group) Co. Ltd. (CNMC) China	May 1, 2009	CNMC to acquire 51.66% stake in Lynas for \$184.04m.	Deal terminated on September 24, 2009 following decision from Foreign Investment Review Board

Source: Mergermarket, Lynas Corporation and Molycorp Inc. 2011 investor presentations and company websites

Table 5: Strategic partnership

	Partner/country	Announced date	Comments	Completion expected by
Lynas Corporation	Rhodia S.A./France	January 19, 2009	Technical cooperation agreement and rare earth supply contract (10 years)	Not disclosed
Molycorp Inc.	Neo Materials Technologies Inc/USA	August 6, 2010	Letter of intent for cooperation in the "mines to magnet" supply chain including technology transfer agreement and technical assistance as well as potential supply agreement, cooperative marketing and distribution arrangements	Not disclosed

Source: Mergermarket, Lynas Corporation and Molycorp Inc. 2011 investor presentations and company websites

Table 6: Other supply contracts:

	Customer/country	Announced date	Comments
Lynas Corporation	Sojitz Corp (JOGMEC)/Japan	March 30, 2011	10-year rare earth joint-distribution and marketing contract for 8,500 tonnes and \$250m fundraising
Lynas Corporation	Seven undisclosed parties	Not disclosed but estimated that discussions started back in 2007 for some of these customers	Long-term multiple-year contracts or letter of intents
Molycorp Inc.	W.R. Grace & Co./US	November 5, 2010	Five-year supply contract of lanthanum ending in 2015 plus option for Grace to extend to 2018
Molycorp Inc.	Various including US chemical and energy companies and Japanese and European industrial, electronics and chemical companies	various	19 non-binding letter of intent representing 138% of 2013 anticipated production volume

Source: Mergermarket, Lynas Corporation and Molycorp Inc. 2011 investor presentations and company websites

Within this sample, Great Western Minerals announced on January 31, 2011 a letter of intent to supply rare earths alloys to US-based Electron Energy Corporation. In 2009 it announced a letter of intent with Toyota Tsusho Corporation, which expired on April 1, 2010.

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Diagram 3: Rare earths distribution by project

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Diagram 6: Rare earth project developmental phase, expected production level and estimated capex requirement

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EYG no. ER0023



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