Sprott | Equity Research

RAINBOW RARE EARTHS (RBW LN)

Initiating Coverage: Low capex, high margin developer for critical NdPr

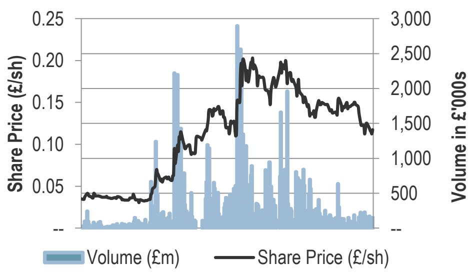
RECOMMENDATION: **BUY** *PRICE TARGET*: **35p/sh** *RISK RATING*: **HIGH**

SHARE DATA	£0.12/sh
Shares (basic, FD)	479 / 488
52-week high/low	£0.20 / £0.03
Market cap (US$m)	US$77m
Net cash (debt) (US$m)	2
1.0xNAV8% @ US$80/oz (US$m)	496
1.0xNAV5% FD (A$/sh)	US$1.02
P/NAV (x)	0.16x
Average daily value (£m, 3M)	0.17

FINANCIALS (June yr end)	FY2024E	FY2025E	FY2026E
Total REO produced (kt)	1.0	5.3	7.1
Incl NdPr (kt)	0.3	1.5	2.1
Revenue (US$m)	28	154	206
AISC (US$/t)	19,156	9,995	9,502
Income (US$m)	0.3	70.9	68.0
EPS (US$/sh)	0.00	0.09	0.09
PER (x)	343.4x	1.3x	1.3x
CFPS (US$/sh)	(0.01)	0.08	0.11
P/CF (x)	59.8x	1.2x	1.2x
EBITDA (US$m)	12.0	106.0	142.6
EV/EBITDA (x)	12.4x	0.9x	0.0x

SPOT VALUATION	FY2024E	FY2025E	FY2026E
1xNAV8% FD (£/sh)	1.43	1.53	1.60
ROI to 1xNAV (% pa)	87%	67%	27%

SOTP 1xNAV8% US$80/oz	US$m	£/sh
Phalaborwa NPV 3Q21E	524	1.07
Gakara	75	0.15
Central SG&A & fin costs 3Q21E	(107)	(0.22)
Net cash 1Q20	2	0.00
Tonnes outside mine plan	3	0.01
TOTAL	496	1.02



Source: S&P Capital IQ

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Multi-asset REE developer starting with Phalaborwa tailings

Rainbow Rare Earths is a multi-asset rare earths developer. RBW's flagship asset is the Phalaborwa tailings project in South Africa and it also owns the Gakara project in Burundi. Listed in 2017, the key events for the company were the recruitment of George Bennett, the former CEO of mining contractor MDM, in 2019 and the earn-in agreement for Phalaborwa entered in 2020. Rainbow now possess a low capex, high margin NdPr + Dy, Tb project and a credible management team that has built >20 projects in Africa including tailings reprocessing operations in South Africa and Mexico.

$5bn in-situ value in gypsum stacks (3.0Moz at 2.3g/t AuEq)

Phalaborwa's has an JORC inferred resource of 38.3Mt at 0.43% TREO including 29.1% NdPr. The stacks are processed tailings of phosphoric acid production from apatite. At spot REE prices (US$83/kg NdPr), contained in-situ value is US$5.0bn at US$139/t, equivalent to 3.0Moz at 2.3g/t $AuEq_{1800/oz}$. This represents a large and high grade inventory, particularly for surface tailings reprocessing. This is 10x the grade of Chinese ionic clay operations with similar low cost sulphuric acid availability, thus we forecast a robust operation through the commodity cycle.

Beneficial metallurgy and enriched in key rare earths

Beyond size and grade, Phalaborwa has two other advantages. First, the stacks have already been treated with sulphuric acid, thus the rare earths are already "cracked", or in soluble form, with 50-80% lower acid consumption required to produce rare earth oxides. Test work indicates leach recovery of 70% at ambient temperatures (anticipated to improve to ~75% in a heated process) with the potential to produce separated rare earth oxides to capture 100% payability.

Industrial facility with power, roads, rail and reagents

Our visit to site confirmed the advantages of the project. The site is an established industrial complex with acid manufacturing facilities present, established grid and rail connects and cleared space to establish a processing plant. The complex is permitted as a chemical facility, thus avoiding mining BEE requirements. The adjacent town of Phalaborwa has an establishing mining and industrial base, population of 20k, paved motorway access, and an airport. The above results in a SCPe capital intensity of 30% of the peer average developer.

Initiate with Buy rating and 35p/sh price target based on $0.5xNAV_{80/kg}$

We model Phalaborwa as a 2.2Mtpa operation producing 6.5ktpa of rare earth oxides including 2.1ktpa of NdPr. At US$80/kg NdPr, this generates average annual FCF of US$73m per year over the 17-year production life, which generates an NPV8% of US$524m. We add US$3m for cash, US$2m for tonnes outside the mine plan, and US$75m for Gakara, while we subtract US$107m for G&A and central costs. We generate a NAVPS of £0.74 and initiate coverage with a BUY rating and £0.35/sh price target based on 0.5x NAVPS.

Investment case

Rainbow Rare Earths, is an LSE-listed rare earths company with rare earths development assets in South Africa and Burundi. The flagship project is the Phalaborwa Project in South Africa, which has an inferred resource of 38.3Mt at 0.43% TREO in two gypsum stacks, which are tailings from historic phosphoric acid production which ceased in 2014. What makes Phalaborwa unique among REE projects is the rare earths have already been cracked by the phosphoric acid production process and require a magnitude lower acid consumption to produce carbonate or rare earth oxides. In addition, the project is part of an established industrial site with existing power and rail access with nearby sulphuric acid production. Beyond Phalaborwa, Rainbow owns the Gakara asset in Burundi, which is very high grade and can be upgraded to a high grade concentrate using physical separation.

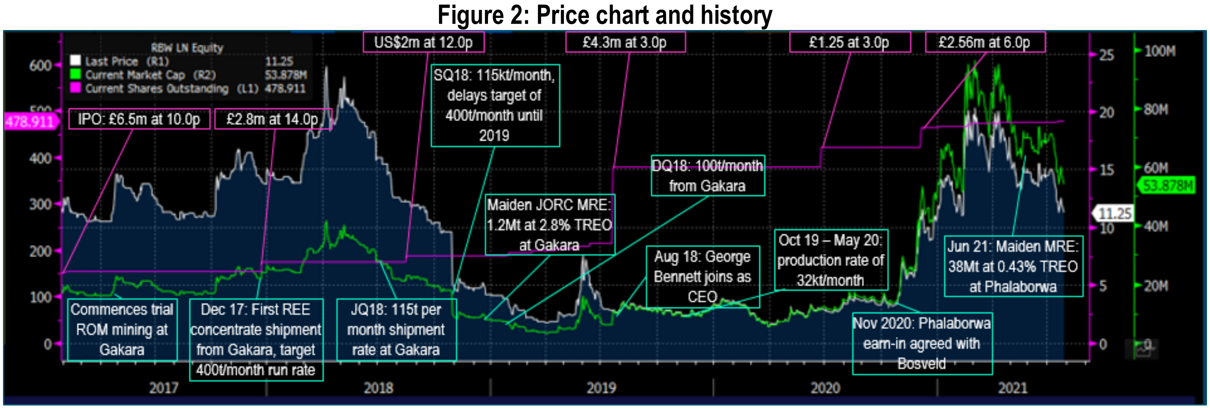
Figure 1: (A) Location map, (B) Gypsum Stacks, (C) Satellite overview of Phalaborwa, (D) Bosveld phosphate plant

Source: Google Maps, Rainbow Rare Earths, SCPe

Corporate history

Rainbow Rare Earths listed in 2017 and initially focused on developing the Gakara project. Trial mining commenced in 2017 but could not reach the initial production target of 400 tonnes per month due to complex mineralization and insufficient resource definition. The turning point was the appointment of proven CEO George Bennett in August 2019, and the strategic pivot to earn into the Phalaborwa retreatment project (80% earn-in for US$750k) in November 2020. Since the pivot to Phalaborwa, Rainbow declared a maiden resource in June 2020 and is targeting a PEA in fall 2021.

Figure 2: Price chart and history



Source: Rainbow Rare Earths, SCPe, Bloomberg market data

Proven management

CEO George Bennett brings project development experience from his time as CEO of LSE-listed and South Africa-headquartered MDM Engineering from 2006 until its sale in 2014 for US$120m. Over this period, MDM built 22 processing facilities including Acacia's Bulyanhulu tailings retreatment plant, and GoGold's Parral Tailings plant. In 2008-2009, MDM, including George Bennett as CEO and current RBW Technical Director Dave Dodd, built the then largest tailings treatment plant globally at Stilfontein, SA; a ~28Mtpa plant to recover Au and U_3O_8, utilizing a complex flowsheet with relatable reagent, acid, and materials parallels to Phalaborwa.

Large and high grade: US$5bn in-situ value at US$139/t (3.0Moz at 2.3g/t AuEq at US$1800/oz)

At 0.43% TREO (4,300ppm) Phalaborwa is higher grade than the South Chinese ionic clay deposits (400-2000ppm) that are the major source of global heavy REE production. Phalaborwa is also higher grade than other phosphogypsum tailings, as the majority of phosphate production is from marine sediment origin deposits, whereas Phalaborwa's source was a carbonatite intrusion with higher genetic REE grades. At 38.3Mt at 0.43% (4,300ppm) TREO, and high 29.1% Nd-Pr assemblage within REOs, the existing gypsum stacks provide nearly 20 years of production life and at in-situ grades equivalent to >2g/t AuEq. This gives Phalaborwa both the scale and margins to establish a new operation and generate long-term returns for shareholders.

Table 1: Phalaborwa 2021 Resource Estimate

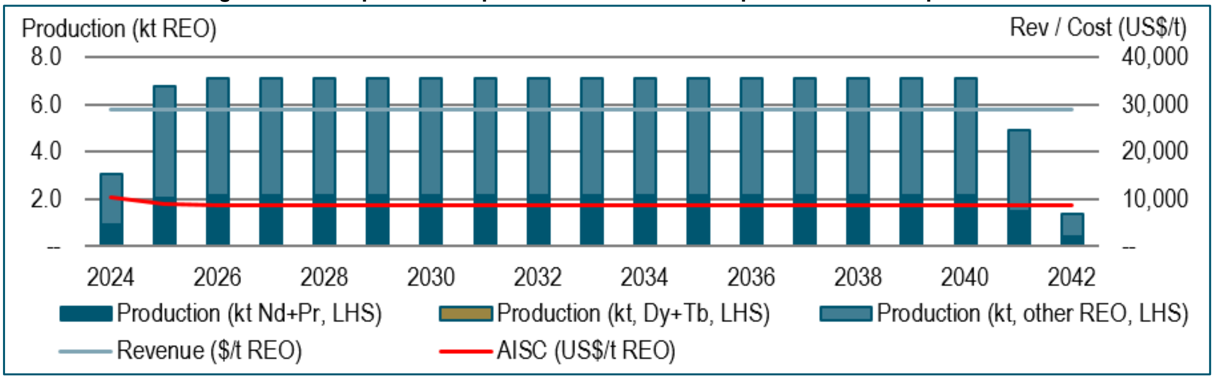
					Assemblage			
	Category	Tonnes	TREO	TREO	Nd	Pr	Dy	Tb
		(kt)	(%)	(kt)	(%)	(%)	(%)	(%)
Phalaborwa								
Stack A	Inferred	27,400	0.42%	115	23.3%	5.7%	1.0%	0.4%
Stack B	Inferred	10,900	0.46%	50	23.6%	5.7%	1.0%	0.3%
Total	**Inferred**	**38,300**	**0.43%**	**165**	**23.4%**	**5.7%**	**1.0%**	**0.4%**

Source: Rainbow Rare Earths

Low capex and high margins = high risk adjusted returns

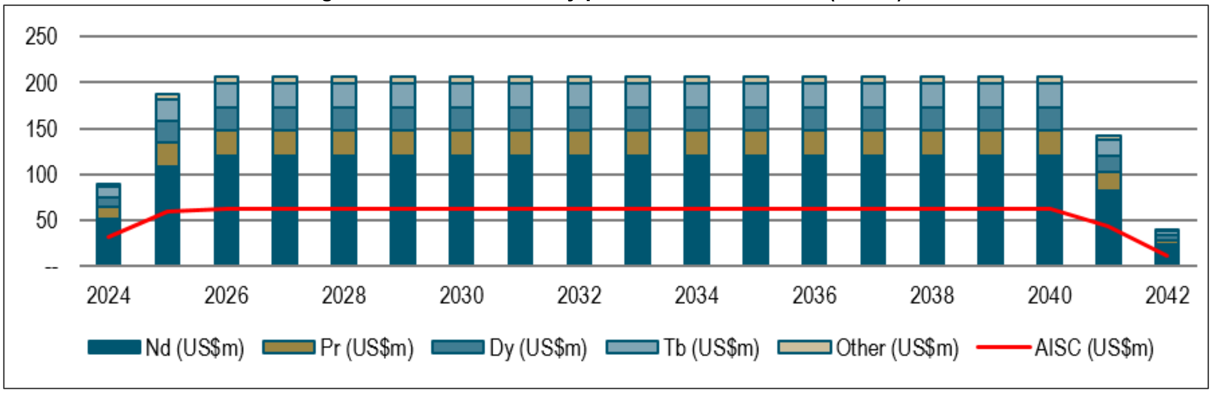
We base our estimates on a 2.2Mtpa base case operation, producing 7.1ktpa of separated rare earth oxides, including 2.1ktpa of neodymium (Nd) and praseodymium (Pr). At long term prices of US$80/kg NdPr, we estimate a LOM average EBITDA margin of 69%, generating US$73m of free cash flow per year at steady state. We estimate evaluation costs of US$10m, including PEA, DFS and pilot plant and initial capex of US$100m, with build start in 2023, first production and ramp up in 2024, and steady state commercial production in 2025. This generates an IRR of 56% and returns on capital employed of 27% over an SCPe 17-year production life, including 47% in the first five years. The financial metrics are complementary to our qualitative assessment that Phalaborwa is a low risk project with potential to generate outsized returns.

Figure 3: SCPe production profile and revenue/cost per tonne of REO product



Source: SCPe

Figure 4: SCPe revenue by product and total AISC (US$m)



Source: SCPe

High value assemblage: 29.1% NdPr with significant Dy and Tb credits

Phalaborwa's mineral assemblage (the composition of rare earth elements) includes 29.1% NdPr and with US$34/t (0.3kg/t NdPr Eq) of Dy and Tb credits. Neodymium (Nd) and praseodymium (Pr) are crucial components for high powered magnets used in strategic industries including wind turbines and EVs. They are currently the largest component of economic value for the majority of rare earth deposits. Each EV uses 1-3kg of NdPr and total demand reached 6,600t in 2020.

Dysprosium and terbium are 1.0% and 0.4% of TREO content and total US$34/t of in-situ value, respectively. Dy and Tb are higher frequency at Phalaborwa than at Lynas's Mt Weld or MP Minerals Mountain Pass mines; this gives Phalaborwa greater by-product value. As >95% of supply for heavy rare earths, including Dy and Tb, are produced from ionic clay deposits in Southern China, Phalaborwa represents a key diversification opportunity for western end users.

Table 2: Phalaborwa grade and mineral assemblage and notable comparable

							Assemblage				Low value		Deleterious	
Deposit	**Owner**	**Location**	**Ore Mineral(s)**	**Source**	**Resource**	**Grade**	**NdPr**	**Dy**	**Tb**	**SEG**	**Ce**	**La**	**U**	**Th**
					(Mt)	(% TREO)	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)	(ppm)
Phalaborwa	**Rainbow Rare Earths**	**South Africa**	**Phosphogypsum**	**2021 JORC estimate**	**38.3**	**0.43%**	**29.1%**	**1.0%**	**0.4%**	**ND**	**ND**	**ND**	**1.8**	**47.6**
Nolans	Arafura	W. Australia	Monazite. Allanite	2021 Updated DFS	56.0	2.6%	26.4%	ND	ND	ND	ND	ND	ND	ND
Mt Weld	Lynas	W. Australia	Monazite	2018 JORC Resource	55.4	5.4%	23.1% (1)	0.5% (1)	0.1% (1)	4.4% (1)	45.7% (1)	24.1% (1)	ND	ND
Longonjo	Pensana	Angola	Monazite	2019 PFS	226.0	1.5%	22.1%	0.6%	0.1%	4.3%	45.9%	23.9%	ND	ND
Makuutu	Ionic Rare Earths	Uganda	Ionic Clay	2021 JORC Resource	315.0	650 ppm	21.5%	1.5%	0.5%	6.8%	32.3%	20.0%	10	30
Ngualla	Peak Resources	Tanzania	Bastnaesite	2017 JORC Reserve	21.3	4.8%	21.2%	0.1%	0.1%	2.5%	48.3%	27.6%	14	55
Songwe Hill	Mkango	Malawi	Bastnaesite	2020 Ni-43 101 Resource	48.6	1.4%	20.2%	0.8%	0.2%	3.8%	45.7%	24.2%	12	318
Gakara	**Rainbow Rare Earths**	**Burundi**	**Bastnaesite, monazite**	**2020 Tech Report**	**0.6**	**5.8%**	**19.1%**	**ND**	**ND**	**ND**	**ND**	**ND**	**84**	**287**
Mountain Pass	MP Materials	California	Bastnaesite	2014 NI-43-101 Tech Report (3)	19.2	8.2%	15.8%	ND	ND	1.7%	33.4%	49.1%	ND	ND
Browns Range	Northern Minerals	W. Australia	ND	2020 JORC Resource	9.2	0.7%	ND	8.5%	1.2%	ND	ND	ND	ND	ND

Sources: Company disclosures. (1) Mt Weld REO assemblage from 2012 Resource update and may not accurately reflect the current assemblage. (2) 2020 published exploration target. Gakara has achieved an average ~30% TREO head grade in trial mining 2018-date but the exploration target assumes more dilutive bulk mining methods.(3) Mountain Pass based on July 2020 Reserve from 2020 MP Materials Annual Report, current resource estimate not publicly available

Table 3: Key REE applications

APPLICATION	RARE EARTHS	DEMAND DRIVERS
Magnets	Nd, Pr, Sm, Tb, Dy	Automotive, Wind turbines, Drives for computers, mobile phones, mp3 players, cameras, Voice coil motors. Hybrid and Electric vehicles, Cordless power tools, Sensors, Medical imaging (MRIs)
Nickel Metal Hydride Batteries	La, Ce, Pr, Nd	Hydrogen absorption alloys for re-chargeable batteries
Phosphors	Ce, Pr, Gd	LCDs, PDPs, LEDs. Energy efficient fluorescent lights/lamps
Fluid Cracking Catalysts	La, Ce, Pr, Nd	Petroleum production – greater consumption by 'heavy' oils and tar sands
Polishing Powders	Ce, La, Nd	Mechano-chemical polishing powders for TVs, monitors, tablets, mirrors and (in nano-particulate form) silicon chips
Auto Catalysts	Ce, La, Nd	Tighter NO_x and SO_2 standards – platinum is re-cycled, but for rare earths it is not economic
Glass Additive	Ce, La, Nd, Er	Cerium cuts down transmission of UV light. La increases glass refractive index for digital camera lens
Fibre Optics	Er, Y, Tb, Eu	Signal amplification

Source: Rainbow Rare Earths, USGS

Met advantages with low acid consumption, low U + Th, >70% recovery

Met test work indicates 15-20kg of sulphuric acid consumption per tonne of throughput This is significantly lower than for a hard rock deposit as the REE content at Phalaborwa is already "cracked", i.e. it is in soluble form due to the sulphuric acid treatment already subjected during the phosphoric production process. Equivalent consumption for a hard rock concentrate processing facility is ~3 tonnes of acid per tonne of bastnaesite or monazite concentrate, roughly 2x the acid consumption intensity per tonne of REO product. Below we estimate acid consumption and costs per tonne of NdPr. At like-for-like acid unit costs, we estimate ~50% lower acid cost for Phalaborwa due to lower acid consumption. Next we compare Phalaborwa acid costs to a conceptual hard rock operation utilizing downstream processing at a new facility. We estimate 66% lower acid consumption for Phalaborwa, and acid costs are 85% lower total acid, assuming US$110/t for Phalaborwa (localized acid availability) and US$200/t (current US gulf prices) for a typical vertically integrated standalone producer.

Table 4: SCPe Phalaborwa acid costs vs example concentrate and hard rock producers

	Acid (kg/t)	Price	Grade	Nd+Pr	Process Recovery	Acid per tonne Nd+Pr	
		($/t)	(%)	(%)	(%)	(t)	$/t
Phalaborwa	20	110	0.43%	29%	70%	23	2,512
Example concentrate	3,000	110	50.00%	20%	70%	43	4,714
Example hard rock	300	200	3.00%	20%	70%	71	14,286

Source: SCPe

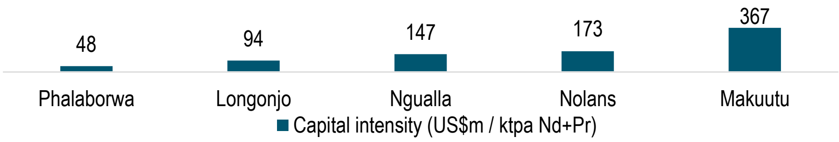
Logistics already in place: Active industrial site with power and reagents + rail, road and air access

Phalaborwa benefits from extensive infrastructure advantages over a greenfield project. Phalaborwa is an existing industrial site with grid power access (US$0.07/kWh from Eskom), rail access (Transnet) and workshops, office facilities and a high voltage switchyard in place. The adjacent town of Phalaborwa has an industrial economic base with machinery suppliers including Caterpillar, Wier/Warman pumps, and numerous fuel stations within 5km of the project. In non-Covid times, there are daily flights from Johannesburg to Phalaborwa Airport, servicing tourist traffic to nearby Kruger national park. There are also several high end hotels and guest houses servicing Kruger visitors, and Johannesburg is within a 6hr drive on well-maintained motorways. In direct infrastructure alone, this results in a US$40-140m savings vs other prominent development projects with publicly available capex estimates.

Figure 5: Peer PEA/PFS/DFS infrastructure capital requirement estimates

Project	Phalaborwa	Longonjo	Ngualla	Nolans	Makuutu
Company	Rainbow	Pensana	Tanzania	Arafura	Ionic Rare Earths
Mine Location	S. Africa	Angola	Tanzania	W. Australia	Uganda
Downstream Location	At Mine	Humber, UK	Teeside, UK	At Mine	none
Study	SCPe	2021 Business Plan	2017 DFS	2021 DFS Update	2021 Scoping Study
Production rate (t Nd+Pr per year)	2,064	4,500	2,420	4,440	821
Initial infrastructure capital (US$m)	--	40	134	91	7

Capital Intensity



Source: SCPe, Company disclosure

Gakara is a unique high grade project, opportunity to process Gakara concentrate at Phalaborwa

Gakara has high in-situ grades, (up to 30% head grade achieved in trial mining) with low U+Th, and has produced >54% TREO concentrate from a gravity separation pilot plant. We calculate a cash breakeven rate of ~80-85kt/month at ~$2750/t revenue per tonne. Production consistency improved under current management, with operations at roughly cash breakeven production rates in Q2. Stepping back, we believe that Phalaborwa, complements Gakara well by providing consistent cash flow and financial stability. This should better enable Rainbow to drill, define and ramp up a bulk operation at Gakara with less short-term production pressure. Operationally, we perceive synergy potential through the possibility to produce a high grade concentrate at Gakara for downstream processing at Phalaborwa, given the latter's low power costs and proximity to key reagents. The total distance between the two is ~3,300km. Even with conservative assumptions, our calculations suggest the vertical integration of the two assets would result in greater margin capture by Rainbow.

Figure 6: Gakara (A) mining, (B) processing, (C) Gakara to Phalaborwa map and potential transport routes, (D) SCPe conceptual downstream breakeven calculations

Costs		
Distance	km	3,300
Cost per tonne	US$/tonne*km	0.18
Transport costs	US$/tonne	594
Export duty assumption	5% of in situ	457
Total costs		**1,051**
Value		
Concentrate grade	% TREO	55%
NdPr %	% of TREO	20%
NdPr price	$/kg	83
NdPr value contained	**$/t**	**9,130**
Payability		
Concentrate payability	%	30%
Separated oxides payability	%	90%
Differential	**%**	**60%**
Breakeven processing cost	**US$/t**	**5,478**

Source: Rainbow Rare Earths, Google Maps, SCPe

Valuation

We value Rainbow using a discounted cash flow methodology for Phalaborwa. Our nominal $NPV_{8\%\text{-}80/kgNdPr}$ is US$524m. We add US$3m for cash at 31 December 2020, and exercised options and subtract US$1.4m for debt currently outstanding. We add US$2m (5% of in-situ value, ~$90/oz AuEq) for tonnes outside the mine plan, and we attribute US$75m of nominal value for Gakara. At this time, we do not include Gakara in our base case financial estimates, though it is included in our NAV. This results in a fully diluted but pre-funded NAV of US$496m or £0.36/sh. We assume US$65m of equity including US$50m for the build raise for a total of 294.1m shares. This results in our fully funded, fully diluted NAV of US$561m or £0.72/sh.

Peers

Comparing Rainbow's valuation to the peer universe, we believe the company offers excellent risk adjusted upside. With significantly lower associated capex, Rainbow is attractively valued relative to developer peers per tonne on an EV (including capex) to production (steady state annual NdPr) and to in-situ value. The re-rate to production is also notable. The two producers, MP Minerals (Mountain Pass Mine, California) and Lynas Resources, trade at multiples in excess of 1.5x NAV and 15x 2022e EBITDA, while Rainbow trades at 0.2x NAV and 1.5x steady state EBITDA, suggesting that a 5-10x re-rate into production based on implied peer metrics. Even if Rainbow suffers from a South Africa discount, we believe the upside is multiples of the current share price.

Figure 7: Comp table of selected listed rare earths producers and developers

						EV/EBITDA		EVRevenue		FCF yield		EV (incl capex)	
	Ticker	Market Cap	EV	NAVPS	P/NAV	2021e	2022e	2021e	2022e	2021e	2022e	per t prodn	per insitu $
		US$m	US$m	US$/sh	(X)	(X)	(X)	(X)	(X)	%	%	$/t NdPr	%
MP Materials	NYSE:MP	6,702	6,253	16.54	2.3x	45.0x	32.0x	26.6x	17.1x	(1%)	2%	0.99	26.7%
Lynas	ASX:LYC	4,907	4,652	3.59	1.5x	25.5x	17.2x	12.5x	9.8x	2%	(1%)	1.00	6.5%
Pensana	LSE:PRE	287	280	--	--	--	--	--	--	--	--	0.16	0.9%
Northern Minerals	ASX:NTU	146	139	--	--	--	--	--	--	--	--	na	4.9%
Peak Resources	ASX:PEK	132	129	--	--	--	--	--	--	--	--	0.20	2.8%
Arafura	ASX:ARA	76	80	--	--	--	--	--	--	--	--	0.19	2.8%
Ionic Rare Earths	ASX:IXR	73	71	--	--	--	--	--	--	--	--	0.45	5.9%
Mkango	TSXV:MKA	41	32	--	--	--	--	--	--	--	--	na	na
Rainbow Rare Earths	**LSE:RBW**	**78**	**74**	**1.02**	**0.2x**	**--**	**--**	**--**	**--**	**--**	**--**	**0.09**	**3.5%**
Mean					**1.9x**	**35.3x**	**24.6x**	**19.6x**	**13.4x**	**0%**	**0%**	**50%**	**7.2%**
Weigted Average					**1.8x**	**36.2x**	**25.0x**	**19.2x**	**13.8x**	**0%**	**0%**	**1%**	**8.5%**
Median					**1.9x**	**35.3x**	**24.6x**	**19.6x**	**13.4x**	**0%**	**0%**	**33%**	**4.9%**

Sources: Market data from S&P Capital IQ, company disclosure, SCPe

Initiate with BUY rating and 35p/sh price target based on 0.5x $NAVPS_{8\%\text{-}80/kg\ NdPr}$

We initiation with a BUY rating and £0.35/sh price target based on 0.5x NAV8%-$80/kg. Rainbow is our top pick of the rare earth developer universe. Where many of its developer peers are seeking to develop both a remote mine and a downstream processing facility, Rainbow has the benefit of significantly lower geological, mining, and logistical risk, while the scope and difficulty of the mine build is significantly lower than peers. Compared to producer peers, Rainbow is both significantly cheaper, and due to its low capex nature, well placed to enter production quickly and re-rate, in our view.

Catalysts

- Q3/Q4 2021: PEA on Phalaborwa
- 2022: Pilot Plant
- 2022: DFS
- End 2022: Financial Investment Decision on Phalaborwa
- 2023: SCPe construction
- 2024: SCPe first production and ramp up
- 2025: SCPe steady state production

Why we like Rainbow Rare Earths

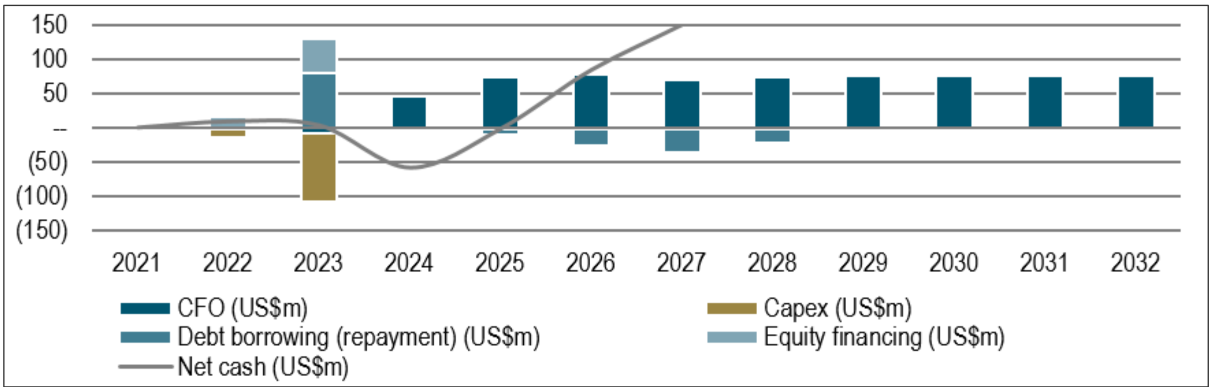
- Low capex project that benefits from significant infrastructure in place
- Low operating costs due to tailings reprocessing, low reagent consumption, grid power, local acid providers
- High per tonne value due to NdPr, Dy, Tb assemblage and ability to produce beneficiated product
- Proven management team that has built numerous mines and tailings projects

Corporate and Financial Summary

Share structure: Rainbow has 478.9m shares outstanding with 11.2m options and warrants at a weighted average exercise price of 8.6p/sh. We assume a further US$15m of equity at £0.115/sh for 94.0m shares to fund evaluation work, and US$50m of equity at 0.3x NAVPS (£0.21/sh) to fund the equity portion of project construction. We assume the final US$250k payment to Bosveld is made in shares (1.55m shares at £0.116/sh). We base our per share valuation on a fully-diluted, fully-funded assumed share count of 783.3m fully diluted, fully funded shares outstanding.

Balance sheet: As the end of December 2020, Rainbow had US$2.5m of cash with US$1.7m of borrowings. We estimate US$110m of capex, US$12m of G&A and US$10m of working capital to first production, creating a total external funding requirement of US$132m. We assume this is financed through US$80m of debt at a 10% cost of capital, and US$65m of equity, creating a safety margin of US$17m through ramp up.

Figure 8: SCPe cash flow and balance sheet estimates



Source: SCPe

Cash flow and profitability: We estimate a LOM EBITDA margin of 69% at US$80/kg NdPr which demonstrates a high margin operation. We estimate a 75% FCF yield at steady state with year 2024-2030 average return on capital employed (ROCE) of 34%. We estimate FCF payback in 2.2 years of the production life, highlight rapid payback of initial capital and healthy returns on capital invested.

Government and stakeholders:

Phalaborwa:

Ownership: Rainbow has an earn in option for 70% of Phalaborwa for 3 staged US$250k payments. The first two payments have been made and the third is due in December 2021 for cash or shares at Bosveld's election. Bosveld has a 30% free carried ownership stake in the Phalaborwa rare earths project. As the facility is classified as a chemical plant, it is not subject to Black Economic Empowerment (BEE) ownership, and we have not assumed a BEE ownership stake in our estimates. Government: The profit tax rate in South Africa is 27%. We have assumed a royalty rate of 2%, in line with the South African national tax rate for beneficiated metals. Withholding tax on dividends in South Africa is 10%. The primary permit required is for a new tailings stack on the existing site; the majority of other permits are in place including water, land use and material handling.

Gakara:

Ownership: Rainbow has a 90% interest in Gakara with a 10% state-owned free carry. Government: The profit tax rate in Burundi is 30% subject to a 1% minimum tax on revenue. Withholding tax on dividends is 5%. The applicable Government revenue royalty rate is 4% and there are US$30k in annual statutory payments to the two local communes. In June 2021, Rainbow noted that trial mining operations were suspended by the Burundi Government during mining convention negotiations, after concentrate exports were halted by the Government in April. Rainbow intends to recommence trial mining once agreed by the Government.

Ticker:	RBW LN	**Price / mkt cap:**	£0.12/sh, £56m	**Market P/NAV:**	0.16x	**Assets:**	Phalaborwa
Analyst: J Chan / B Gaspar		**Rec / PT:**	BUY / £0.35	**1xNAV$_{2Q20}$ FD:**	US$1.02/sh	**Country:**	South Africa

Group-level SOTP valuation	2Q21	3Q21E			
		US$m	O/ship	NAVx	£/sh
Phalaborwa NPV 3Q21E		524	80%	0.50x	0.39
Central SG&A & fin costs 3Q21E		(107)	-	0.50x	(0.11)
Tonnes outside mine plan (5% insitu value)		2	100%	0.50x	0.00
Cash and restr. cash 2Q21		3	-	0.50x	0.00
Cash from options		1	-	0.50x	0.00
Debt 2Q21		(1)	-	0.50x	(0.00)
Gakara		75		0.50x	0.08
1xNAV8% spot fully diluted, pre-funded		**496**			**0.36**
Assumed equity raised to first production		65		0.50x	0.08
1xNAV8% spot fully funded		**561**			**0.36**

1x fully funded NAVPS sensitivity to gold price and discount / NAV multiple					
Valuation (£/sh)	$60/kg	$70/kg	$80/kg	$90/kg	$100/kg
0.25xNAV	0.13	0.16	0.19	0.22	0.25
0.50xNAV	0.23	0.29	**0.36**	0.42	0.49
0.75xNAV	0.33	0.43	0.53	0.63	0.72
1.00xNAV	0.43	0.56	0.69	0.83	0.96
Phalaborwa NPV8% (US$m)	$60/kg	$70/kg	$80/kg	$90/kg	$100/kg
12% discount	249	306	362	419	475
10% discount	303	368	434	500	565
8% discount	370	447	**524**	601	678
6% discount	455	546	638	729	821
5% discount	506	606	706	806	907

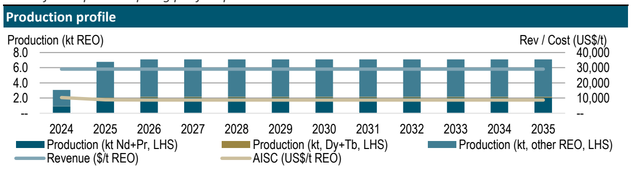
Phalaborwa 1xNAV sensitivity to recovery and payability					
Phalaborwa NPV8% (US$m)	Recov: 65.0%	70.0%	75.0%	80.0%	85.0%
Payability: 60%	163	201	239	277	315
Payability: 70%	245	290	334	378	423
Payability: 80%	328	378	429	480	530
Payability: 90%	410	467	524	581	638
Payability: 100%	492	556	619	682	745

Valuation over time	Jun '21	Jun '22	Jun '23	Jun '24	Jun '25
Mines NPV (US$m)	519.7	565.6	671.7	766.9	738.4
Cntrl G&A & fin costs (US$m)	(107.9)	(98.2)	(104.9)	(86.5)	(69.4)
Gakara & other	77.1	77.1	77.1	77.1	77.1
Net cash at 1Q (A$m)	(0.6)	8.3	2.7	(59.1)	(2.3)
1xNAV (US$m)	488	553	647	698	744
P/NAV (x):	0.12x	0.10x	0.09x	0.08x	0.08x
1xNAV share px FD (US$/sh)	1.00	1.13	1.33	1.43	1.53
ROI to equity holder (% pa)	*761%*	*212%*	*125%*	*87%*	*67%*

Sources and uses of cash			
SCPe evaluation costs	US$10m	SCPe current cash + options	US$3m
SCPe capex	US$100m	Debt package	US$80m
SCPe contingency	US$16m	Equity Raised	US$65m
SCPe G&A + fin. cost to first Au	US$13m		
SCPe working capital	US$9m		
Total uses	US$148m	Total proceeds	US$148m

**Cash from options expiring pre first pour*

Production profile



Production (100%)	Jun '24	Jun '25	Jun '26	Jun '27	Jun '28
Phalaborwa (kt TREO)	968	5,321	7,095	7,095	7,095
Phalaborwa (kt Nd+Pr)	281	1,548	2,064	2,064	2,064
Phalaborwa cash cost (US$/t)	11,886	7,752	7,752	7,752	7,752
Phalaborwa AISC (US$/t)	15,317	10,852	10,619	10,619	10,619
Group cash cost (US$/t)	12,466	8,332	8,332	8,332	8,332
Group AISC (US$/t)	19,156	9,995	9,502	9,502	9,502

Resource / Reserve	Mt	% TREO	000t REO	000t NdPr	EV/t NdPr
Measured, ind. & inf.	38	0.43%	165	48	1,550
SCPe Mine Inventory	38	0.43%	163	48	1,567
Commodity price	**Jun '22**	**Jun '23**	**Jun '24**	**Jun '25**	**Jun '26**
NdPr price (US$/t)	83	83	80	80	80
Share data					
Basic shares (m): 478.9	FD + options (m):		487.6	FD/FF	783.3
Ratio analysis	**Jun '22**	**Jun '23**	**Jun '24**	**Jun '25**	**Jun '26**
FD shares out (m)	583	783	783	783	783
EPS (US$/sh)	(0.00)	(0.00)	0.00	0.09	0.09
CFPS before w/c (US$/sh)	(0.00)	0.00	(0.01)	0.08	0.11
FCFPS pre growth (US$/sh)	(0.00)	(0.02)	(0.03)	0.07	0.11
FCF/sh (US$/sh)	(0.01)	(0.07)	(0.08)	0.07	0.11
FCF yield pre growth (US$/sh)	(4%)	(19%)	(28%)	62%	94%
FCF yield (%)	(10%)	(61%)	(68%)	62%	94%
EBITDA margin (%)	-	-	43%	69%	69%
FCF margin (%)	--	--	(220%)	37%	42%
ROA (%)	(8%)	(3%)	0%	31%	24%
ROE (%)	(8%)	(5%)	0%	50%	32%
ROCE (%)	(8%)	(2%)	7%	48%	54%
PER (x)	(27x)	(22x)	343x	1x	1x
P/CF (x)	(34x)	(25x)	60x	1x	1x
EV/EBITDA (x)	(29x)	(44x)	12x	1x	0x
Income statement	**Jun '22**	**Jun '23**	**Jun '24**	**Jun '25**	**Jun '26**
Revenue (US$m)	--	--	28	154	206
COGS (US$m)	--	--	(12)	(44)	(59)
Gross profit (US$m)	**--**	**--**	**16**	**110**	**147**
Expenses (US$m)	(3)	(4)	(2)	(2)	(2)
Impairment & other (US$m)	--	--	--	--	--
Net finance costs (US$m)	--	(2)	(8)	(8)	(8)
Tax (US$m)	--	--	(3)	(20)	(37)
Minority interest (US$m)	--	--	--	--	(20)
Net income attr. (US$m)	**(3)**	**(6)**	**3**	**80**	**79**
EBITDA (US$m)	*(2)*	*(2)*	*12*	*106*	*143*
Cash flow	**Jun '22**	**Jun '23**	**Jun '24**	**Jun '25**	**Jun '26**
Profit/(loss) after tax (US$m)	(2)	(4)	0	71	68
Add non-cash items (US$m)	--	--	1	7	9
Less wkg cap / other (US$m)	--	4	(12)	(18)	11
Cash flow ops (US$m)	**(2)**	**0**	**(11)**	**60**	**89**
PP&E (US$m)	(3)	(56)	(51)	(3)	(3)
Other (US$m)	--	--	--	--	--
Cash flow inv. (US$m)	**(5)**	**(56)**	**(51)**	**(3)**	**(3)**
Debt draw (repayment) (US$m)	--	40	40	--	(15)
Equity issuance (US$m)	16	50	--	--	--
Other (US$m)	--	--	--	--	--
Cash flow fin. (US$m)	**16**	**90**	**40**	**--**	**(15)**
Net change post forex (US$m)	9	34	(22)	57	71
FCF (US$m)	*(7)*	*(56)*	*(62)*	*57*	*86*
Balance sheet	**Jun '22**	**Jun '23**	**Jun '24**	**Jun '25**	**Jun '26**
Cash (US$m)	10	44	23	79	150
Accounts receivable (US$m)	1	2	5	13	14
Inventories (US$m)	0	3	6	18	6
PPE & exploration (US$m)	15	71	121	117	111
Other (US$m)	0	0	0	0	0
Total assets (US$m)	**26**	**121**	**155**	**228**	**281**
Debt (US$m)	2	42	82	82	67
Other liabilities (US$m)	1	9	2	5	5
Shareholders equity (US$m)	49	99	99	99	99
Retained earnings (US$m)	(24)	(28)	(28)	43	111
Minority int. & other (US$m)	(1)	(1)	(1)	(1)	(1)
Liabilities+equity (US$m)	**26**	**121**	**155**	**228**	**281**
Net cash (US$m)	*8*	*3*	*(59)*	*(2)*	*84*
Net debt to NTM EBITDA (x)	*4.2x*	*(0.2x)*	*0.6x*	*0.0x*	*(0.6x)*

Source: SCP estimates

Phalaborwa, Limpopo Province, South Africa

The town of Phalaborwa (previously spelled Palabora) is built adjacent to a large carbonatite intrusive body that has been mined for copper, magnetite (iron ore) and apatite (phosphorous). The copper mine commenced open pit production in 1956 and was a Rio Tinto operation for many years, and is currently operating under a majority Chinese JV ownership structure and is a block cave underground mine. The adjacent apatite orebody was developed by Foskor, a vertically integrated South African phosphate producer, and mined for phosphate feed stock processed at the adjacent but separately owned downstream facility operated by Sasol. The tailings from phosphoric acid production, in the form of gypsum stacks, host the rare earths mineralisation.

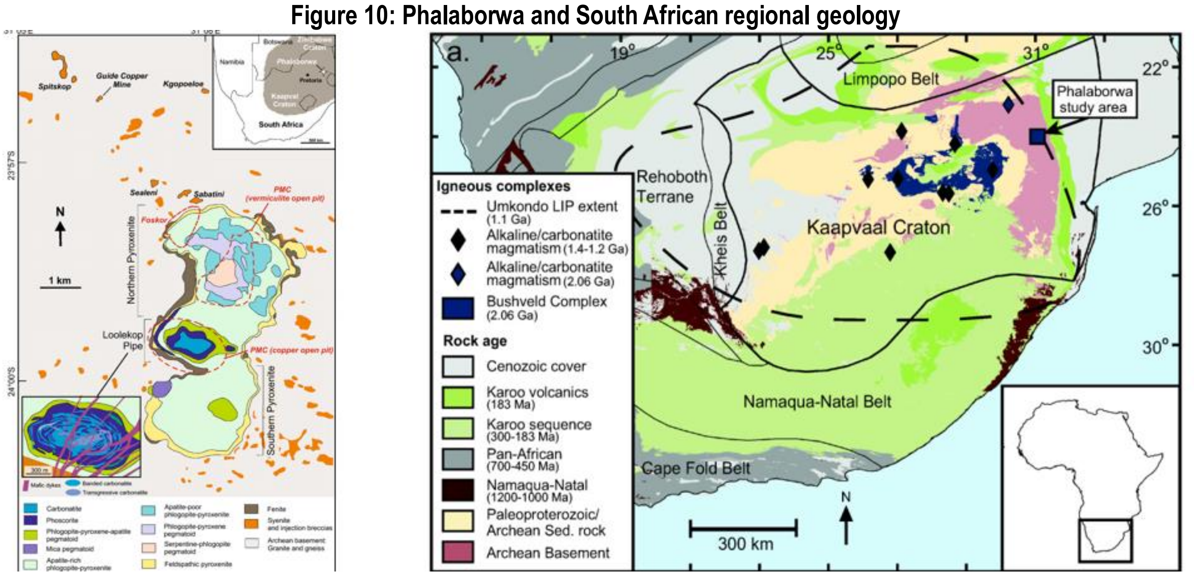
Figure 9: Location map

Source: Google Maps, SCPe

Geology

The Phalaborwa complex is a large (~8x3km) alkaline igneous ring complex with a ~2x1km carbonatite core with the outer ring composed of a feldspathic pyroxenite zone. The complex contains dunite, pyroxenite and apatite-rich pegmatoidal pyroxene. The country rock is Archean granite gneiss. The complex contained significant copper mineralisation (original resource 1,200Mt at 0.59% Cu), significant volumes of magnetite (iron ore) and foskorite and apatite-rich pegmatoid (>6% P_2O_5). The REE resource is hosted in 38.3Mt of phosphogypsum stacks which are the tailings of phosphoric acid production at the complex. The estimate is based on 1,056.3m of augur drilling completed in December 2020. The estimate used a 1.5t/m^3 density estimate but there may be potential to add tonnes, as the average density of samples collected from augur drilling was 1.66t/m^3.

Figure 10: Phalaborwa and South African regional geology



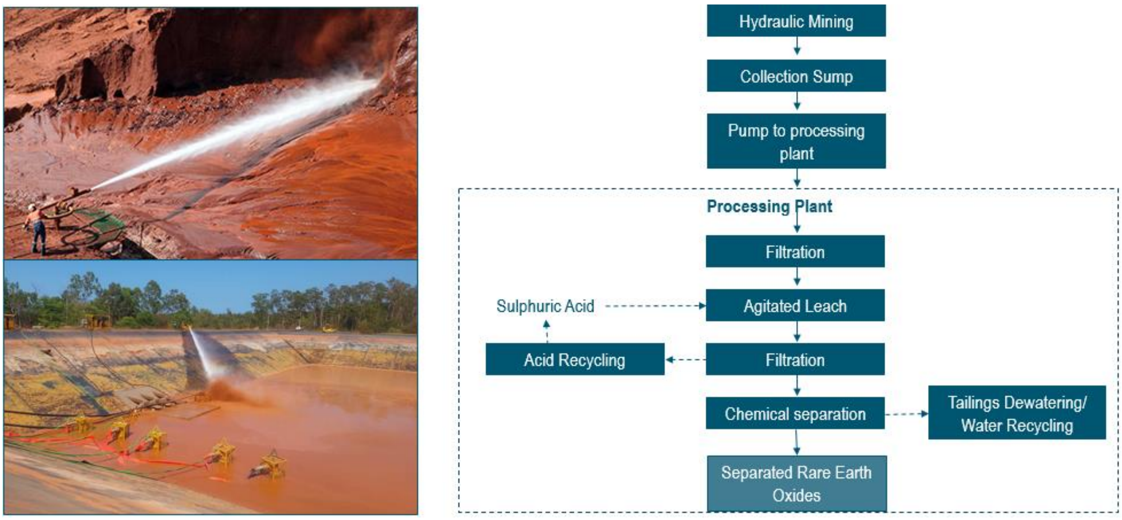
Source: Researchgate

As it relates to the Phalaborwa REE project, we see the following as the key geological takeaways. First, the source of the phosphogypsum is an alkaline intrusion, not a marine sedimentary source; thus the source and in-gypsum REO grades are significantly higher. Second, the apatite, copper and magnetite orebodies remain in production with significant remaining reserves. This suggests the synergistic operations, such as the copper mine and smelter that generate sulphuric acid, are likely to continue operating for the duration of Phalaborwa's 15-20-year production life. Third, the continued mining of the apatite resource means that there is potential for Bosveld to restart phosphoric acid production on site, which could replenish REE-bearing tailings depleted by rare earth processing. In a phosphoric acid restart scenario, there is also potential to process solution directly from solution, saving opex.

Mining and processing

Mining: The gypsum stacks are at surface and do not require blasting. The likely mining method is hydraulic mining with ore slurried and pumped to the processing plant. Usually, a screen is used to prevent oversize from entering, blocking, or clogging the pumps. We did not observe vegetation on the stacks; this should reduce the risk of blockages. We estimate low mining costs at SCPe US$0.50/t for hydromining. We further estimate US$0.50/t of tailings deposition costs.

Figure 11: (A) Hydromining at Base's Kwale and Rio Tinto's Weipa operations, (B) Example flowsheet



Source: Base Resources, Maxitool Group, Flowsheet from SCPe

Processing: The flowsheet at the processing plant is likely to include initial filtration, followed by agitated leach using sulphuric acid (consumption 25-30kg/t). We do not anticipate the need for crushing or comminution of the tailings material. Test work to date suggests recoveries of 70% of the REEs present within a 24-hour leach period at ambient temperature. The solution is then filtered through a membrane to recover 60-80% of the acid, while the filtrate is chemically separated to precipitate the rare earths. Chemical separation could be achieved using solvent extraction, resin in leach, or ion exchange, and this is subject to further test work.

Figure 12: Existing infrastructure at site includes pilot plant, spares, high voltage switchyard, workshop

Source: Rainbow Rare Earths

Product selection: Once the rare earths are leached and in solution, they can be precipitated into a mixed rare earth carbonate for further refining offsite, or precipitated individually by solvent extraction or continuous ion exchange into single rare earth oxide products. Although subject to confirmation in metallurgical testing and economic study, we expect unit costs to be similar between the two products. Rare earth oxides should achieve payability of 85-100% of Chinese benchmark products, depending on final product purity and shipping cost to end users. At a payability of 90% of spot over the life of mine, we estimate a 69% LOM EBITDA margin and LOM IRR of 49%. Conversely, producing a mixed rare earth carbonate final product reduces expected payability to 60-70% but simplifies the refining process on product specifications. At 65% payability, we estimate a SCPe LOM EBITDA margin of 58% at spot prices and an IRR of 32%. As Phalaborwa benefits from low uranium and thorium levels and local access to reagents, we expect a rare earth oxide product to maximize project economics, though this remains subject to trade-off study and lab and pilot plant testing.

Tailings: There is sufficient surface space within the existing complex to redeposit tailings in a new tailings stack. We believe there is potential to dry stack tailings, which would be more compact than the current gypsum stacks. There is a significant environmental clean-up aspect to the operation, which removes metal and radioactive content from the in-situ tailings currently deposited.

Economics

We model a 2.2Mtpa operation with recoveries of 75% to produce ~6.5ktpa of REEs in rare earth oxides, including 2.1ktpa of NdPr. We assume US$10m of pre-production evaluation and pilot testing capital, with project construction in 2023 for initial capex of US$100m to build a 2.2Mtpa agitated leach and ion exchange plant. We model project ramp up in 2024 with the first full year of production in 2025, with an overall 17-year production life.

Figure 13 Economic summary

	Base Case	2.5Mpta Tailings	Mixed REO Carbonate
Mine inventory (Mt)	38,000	>>	>>
Mine grade (% TREO)	0.43%	>>	>>
Tonnes produced (kt REO)	163	>>	>>
Recovery (%)	75%	>>	>>
Payability (%)	90%	>>	65%
Production rate (ktpa)	2,200	2,500	2,200
Production Life Life (years)	17.3	15.2	17.3
Average annual production (kt REO)	7.1	8.1	7
of which, Nd+Pr (kt Nd+Pr)	2.1	2.3	2

	Base Case	2.5Mpta Tailings	Mixed REO Carbonate
Mining Cost (US$/t)	1.00	>>	>>
Processing Cost (US$/t)	20.00	>>	>>
G&A Cost (US$/t)	4.00	>>	>>
Initial capex (US$m)	110	110	110
Sustaining capital (US$/oz)	524	559	287
Royalty (%)	2.0%	>>	2.0%
AISC (US$/oz)	10,702	10,702	10,013
NPV8%-80/kg	524.1	558.6	287
IRR (%)	56%	60%	37%

Source: SCPe

Sensitivities

Below we analyse project NPV sensitivity to various inputs including NdPr price, unit costs, inventory/grade, recovery and payability. The most sensitive inputs are price, recovery and payability. The NPV is less sensitive to unit costs due to very high per tonne margins and the nature of a tailings project (no overburden, low mining costs, low power consumption). Within the range of conceivable outputs, the project generates robust economics relative to Rainbow's ~US$75m mcap and SCPe US$100m initial capex.

Figure 14 Economic summary

Phalaborwa NPV5% (US$m)	NdPr: US$60/kg	US$70/kg	US$80/kg	US$90/kg	US$100/kg
DR: 5.0%	506	606	706	806	907
DR: 6.0%	455	546	638	729	821
DR: 8.0%	370	447	**524**	601	678
DR: 10.0%	303	368	434	500	565
DR: 12.0%	249	306	362	419	475

Phalaborwa NPV5% (US$m)	Mining: US$0.50/t	US$1.00/t	US$1.50/t	US$2.00/t	US$2.50/t
Processing: US$10.00/t	623	618	613	608	603
Processing: US$15.00/t	576	571	566	561	557
Processing: US$20.00/t	529	**524**	519	514	509
Processing: US$25.00/t	481	476	471	466	461
Processing: US$30.00/t	432	428	423	418	413

Phalaborwa NPV5% (US$m)	Inventory: 30.0Mt	34.0Mt	38.0Mt	42.0Mt	46.0Mt
Grade: 0.30%	228	248	266	281	294
Grade: 0.35%	316	342	365	385	401
Grade: 0.43%	457	493	**524**	551	574
Grade: 0.50%	581	625	663	696	724
Grade: 0.55%	670	719	762	800	832

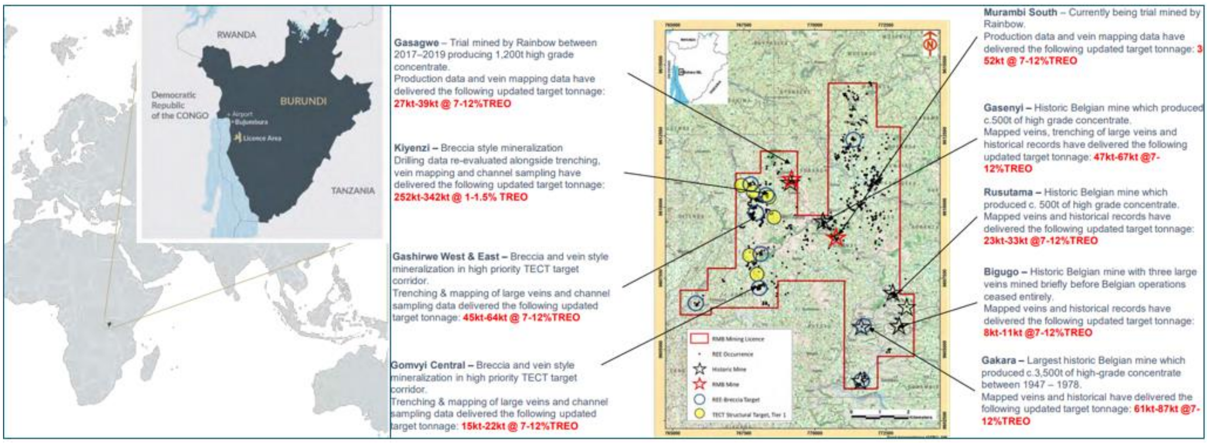
Phalaborwa NPV5% (US$m)	Recov: 65.0%	70.0%	75.0%	80.0%	85.0%
Payability: 60%	163	201	239	277	315
Payability: 70%	245	290	334	378	423
Payability: 80%	328	378	429	480	530
Payability: 90%	410	467	**524**	581	638
Payability: 100%	492	556	619	682	745

Source: SCP; all NPVs shown at 8% discount rate and US$80/kg NdPr unless otherwise noted

Gakara

Gakara, located in western Burundi, was the initial focus of the company from IPO until the Phalaborwa earn-in was agreed in November 2020. The project is located 20km S-SE of the capital city of Bujumbura and consists of a 96km^2 licence which has an exploitation permit. The operation is accessible by tarred road and then all-weather dirt road, approximately 90 minutes by 4x4 vehicle. Historical mining has taken place intermittently since the 1930s. Rainbow commenced trial mining in 2017 and quickly reached 100kt per month, however struggled to reach previous management's target of 400kt per month (5ktpa).

Figure 15: Gakara asset location and exploration target



Source: Rainbow Rare Earths

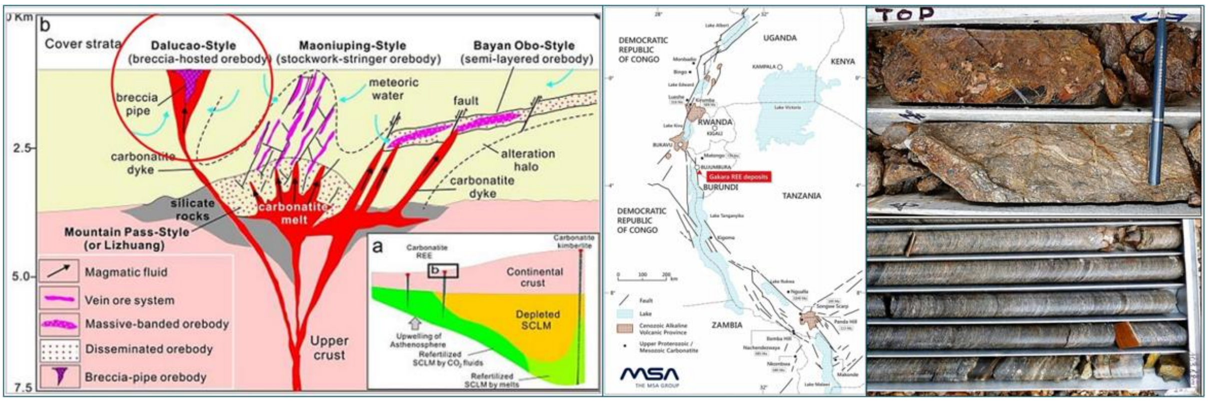
Operations

The operation consists of mechanised waste mining using excavators, with increasingly selective mining for ore mining and near ore waste removal. The strip ratio can be as high as 100:1 but waste mining costs are very low, circa US$0.60/t/. Processing consists of gravity concentration to produce a ~55% TREO bastnaesite/monazite concentrate. Production has reached and at times exceeded 100t/month, which is the production rate needed to achieve financial break even. The in-situ mineralization is very high grade, with ~30% head grade achieved in trial mining, and free digging, but complex. Tight drill density is needed to define a resource estimate, and to achieve a consistent operation that maximizes the trade-off between head grade and tonnage rates.

Geology

REE mineralization is related to carbonic and/or peralkaline magmatic emplacement, approximately 600-700Ma. Mineralization is hosted in metasediments and orthogneisses intersected by pegmatites. REE-hosting pegamatite veins cross cut the host rocks in an irregular and intermittent manner. Mineralization occurs as a stockwork of centimetre to decimetre wide veins of coarsely grained, locally brecciated, metasomatised bastnaesite and monazite. Other targets, such as Kiyenzi, are composed of massive REE injections including breccias, more homogenous bastnaesite/monazite veins, and phenocrysts within aplite and gneiss.

Figure 16: Deposition model for carbonatites, map of East African carbonatite orebodies, (C) mineralized gneiss breccia from Kiyenzi target



Source: Rainbow Rare Earths

Development plan

Rainbow has published an exploration target of 262-375kt at 7-12% TREO from vein hosted mineralization and 252-342kt at 1.0-1.5% TREO from breccias. A JORC-compliant MRE is targeted for 2022 to support a larger scale mechanised operation targeting 10-20ktpa of concentrate production (5-10ktpa of contained REO, 2,000-4,000t of NdPr). Rainbow has guided an estimate of US$20-25m capex and ~US$1650/t opex for a processing facility capable of producing 10ktpa of concentrate, per an SGS study. Under current management operations were brought more in line with standard large scale mining practice with lower head grades (~13-15% TREO) but greater productivity. When trial mining operations were suspended in June, production rates reached the ~80-85kt per month rate required for cash breakeven.

Figure 17: Mining operations at Gakara (A) Pre-2020 and (B) under current management; note the improvement in bench consistency

Source: Rainbow Rare Earths

SCP outlook

We attribute Gakara a nominal value of US$75m (£0.16/sh) in our NAV estimate and apply a 0.5x NAV multiple, for a contribution of £0.08/sh towards fully diluted (pre-funded) NAV per share but do not include capex or revenue forecasts from Gakara in our base case estimates at this time. In our view the project retains significant value, despite the work streams required to de-risk investment in a commercial scale operation, and could see its value unlocked by the potential to process concentrate from Gakara at Phalaborwa. This could enable Rainbow to capture an additional 30-60% payability depending on whether material is beneficiated to a cerium-depleted mixed rare earth carbonate, or to separated rare earth oxides.

Figure 18: (A) Gakara exploration target, (B) Conceptual economics based on 10-20ktpa of concentrate production

	Lower estimate			Upper estimate		
	Tonnes	TREO %	Contained (t)	Tonnes	TREO %	
		Vein Hosted Mineralisation				
Murambi South	36,000	7.0%	2,520	52,000	12.0%	6,240
Gasagwe	27,000	7.0%	1,890	39,000	12.0%	4,680
Rusutama	23,000	7.0%	1,610	33,000	12.0%	3,960
Gakara	61,000	7.0%	4,270	87,000	12.0%	10,440
Gomvyi Central	15,000	7.0%	1,050	22,000	12.0%	2,640
Gashirwe West and East	45,000	7.0%	3,150	64,000	12.0%	7,680
Bigugo	8,000	7.0%	560	11,000	12.0%	1,320
Gasenyi	47,000	7.0%	3,290	67,000	12.0%	8,040
Total Vein Hosted Exploration Target	**262,000**	**7.0%**	**18,340**	**375,000**	**12.0%**	**45,000**
		Breccia Hosted Mineralisation				
Kiyenzi grade tonnage model	98,000	1.0%	980	132,000	1.5%	1,980
Kiyenzi depth extension	60,000	1.0%	600	82,000	1.5%	1,230
Kiyenzi lateral extension	94,000	1.0%	940	128,000	1.5%	1,920
Total Breccia Hosted Exploration Target	**252,000**	**1.0%**	**2,520**	**342,000**	**1.5%**	**5,130**
		Breccia Hosted Mineralisation				
Total Exploration Target	**514,000**	**4.1%**	**20,860**	**717,000**	**7.0%**	**50,130**

Source: Rainbow Rare Earths, totalled by SCPe

Gakara conceptual economics		
Production (ktpa REO conc)	10	20
NdPr content (% of REO)	19.5%	19.5%
NdPr price ($/kt)	80	80
NdPr value contained (US$m)	156	312
Payable (%)	30.0%	30.0%
Payable NdPr value (US$m/yr)	**47**	**94**
Op Costs (US$/t REO)	1,650	1,650
Total op costs (US$m/yr)	**17**	**33**
Operating profit	**30**	**61**

Source: SCPe

Risks

Geological: We view this risk as low relative to peers. The gypsum stacks are at surface and are accessible grade and density sampling and we believe this is lower risk than grade and tonnage estimation of traditional hard rock vein deposits.

Mining: We view this risk as low. Hydraulic mining is an established mining method that is commonly applied in South Africa for tailings reprocessing, with numerous gold tailings projects currently operating in country.

Development: We view this risk as low. Phalaborwa is an existing industrial site with infrastructure in place. This should reduce the scope of required development. We believe ease of site access and proximity to equipment and skilled labour increase robustness of development timelines. Management have significant project development experience at MDM engineering and the key principals have collaborated together on previous projects.

Processing/Metallurgy: We view this risk as moderate. The resource itself has low uranium and thorium which is beneficial. Initial met testing results are encouraging with 70% recoveries in a 24h leach period. Additional lab and pilot scale testing is required to refine the recovery process to maximize product specifications, particularly for rare earth oxide products.

Infrastructure: We view this risk as low. The mine and processing plant have a long operating history and the associated infrastructure is already in place.

Environmental: We view this risk as low. Phalaborwa is already an industrial site. The contemplated operation should clean up already deposited tailings, resulting in a reduction of site environmental risk. Uranium and thorium levels are low and the process will not concentrate these materials in the tailings. In the context of much larger adjacent copper, magnetite and apatite mines and processing facilities, Phalaborwa Rare Earths will have a negligible impact on surface disturbance.

Social: We view this risk as low. The town of Phalaborwa has a large industrial base and we don’t expect the proposed operation to create land use or indigenous tensions given the character of the surrounding area.

Political: We view this risk as moderate to high. South Africa has extensive industrial infrastructure. Labour relations and social tensions have been high in country and this has impacted the profitability of some mining operations. Tailings operations in South Africa have been profitable and reliable in recent years. The project is classified as a chemical project, not a mining project, and therefore is not subject to BEE ownership requirements.

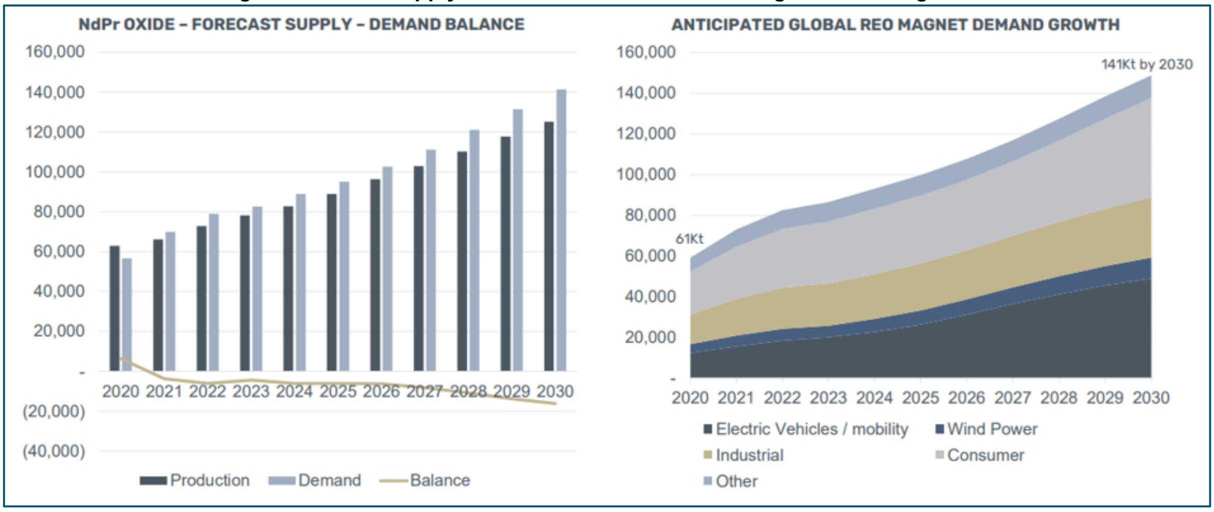
Appendix: Rare Earths Overview

Rare earths elements (REEs) consist of the lanthanide group (atomic numbers 57 to 71 in the periodic table). **Neodymium (Nd) and praseodymium (Pr)** are the key rare earths for the majority of prospective development assets, comprising 15-25% of the REO assemblage but >60% of the economic value of most development. The key end uses for Nd and Pr are high powered magnets which are essential components of electric vehicles, mobile electronics, and wind turbines. The most important deposits are bastnaesite and monazite deposits which are associated with carbonatites and/or alkali igneous processes. These deposits are most commonly found in rift settings and are associated with alkaline intrusions.

Outlook

While REEs are used for an array of end uses, the strategic focus has been on REEs used for permanent magnets. The most important of these are neodymium and praseodymium (~US$83/kg currently). An average EV uses 1-3kg of NdPr oxide and 200kg of NdPr oxides are currently installed per 1MW of new wind turbine generating capacity.

Figure 19: NdPr supply/demand balance and REO magnet demand growth



Source: Adamus Intelligence, Rainbow Rare Earths

The heavy rare earths have smaller markets due to their scarcity in economic concentrations. Due to their high prices, **terbium** (~US$1200/kg) and **dysprosium** (~US$540/kg) can be important by-product sources of economic value. **Dysprosium** and **holmium** (~$120/kg) have the highest magnetic strength of any elements but are more temperature sensitive than NdPr. The light rare earths, **lanthanum** and **cerium** are more abundant in economic deposits (commonly ~65-70% of total REO content by weight) are used in fluorescent applications. They are only a secondary component of the economic value of a typical deposit due to their lower prices (~US$1.5/kg). **Samarium** (~US$2/kg), **europium** (~US$30/kg) and **gadolinium** (~US$37/kg) are typically sold as a mixed concentrate product, typically up to 5% of deposit value.

Geology

While rare earths occur in hundreds of naturally occurring minerals, economically mineable concentrated REE deposits are associated with carbonatites, which tend to occur in rift zones of crustal extensions, and alkaline enriched igneous magmas. Many of the most important mines and development projects are carbonatites. These include the Bayan Obo, Weishan, Maoniuping and Daluxiang mines in China, the Mt Weld mine in Australia and the Mountain Pass mine in California. According to USGS, roughly 40% of known carbonatites globally are in Africa in the east African and southern African rift zones. Other important ore sources include ionic clay deposits in Southern China and Vietnam, which are an important source of medium and heavy REEs. Peralkaline igneous are an emerging potential new source of production and are enriched in heavy REEs.

Mineralogy

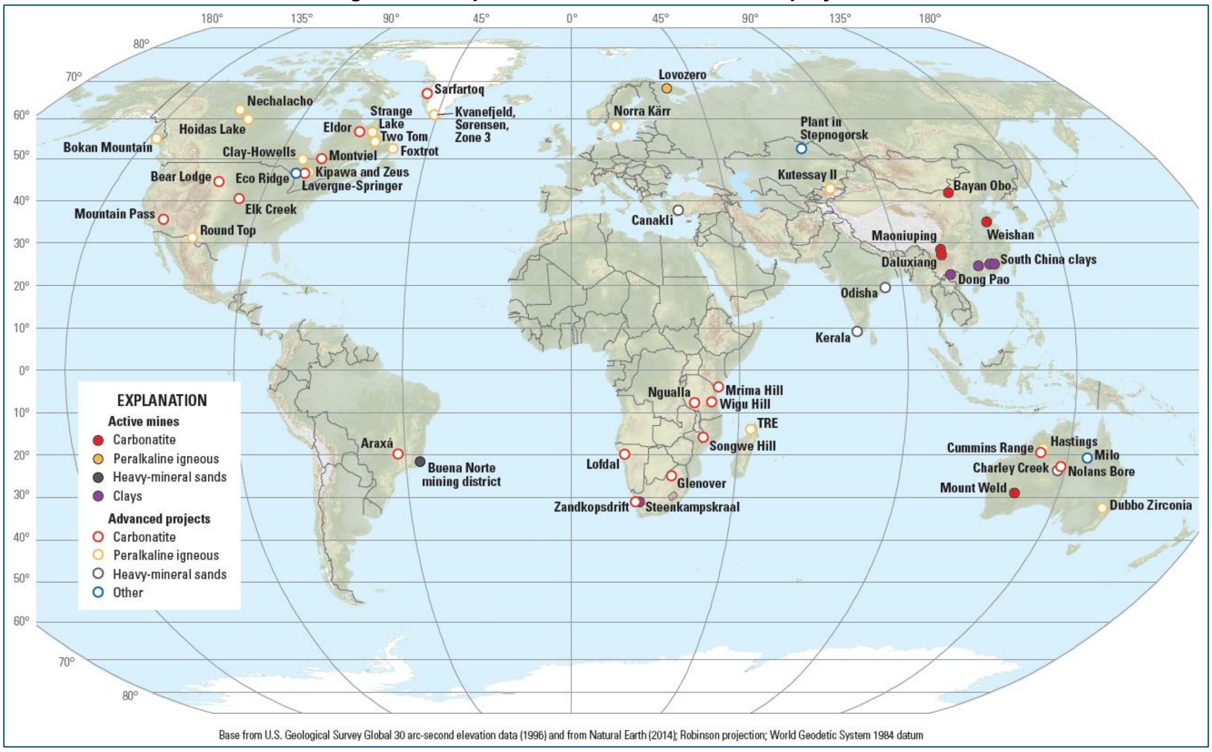
The two most common ore minerals are bastnaesite and monazite. Ionic clay deposits in southern China are also an important source of supply, particularly of heavier rare earths.

Bastnaesites (a fluoro-carbonate, (Ce, La, Y)CO_3F) contain low levels of uranium and thorium and are simpler to process. They are typically the most significant source of REEs in carbonatite-related deposits. They are of hydrothermal origin and typically occur as fine-grained or clay masses in vugs, microfractures and veinlets and are associated with quartz, fluorite, strontianite, barite and hematite.

Monazites (a phosphate, (Ce, La, Nd, Pr, Th, Sm, Gd)PO_4) are an important REE bearing mineral and are present in carbonatite related orebodies, in alluvial/placer accumulations and accumulations in mafic gneiss. Due to their high density, monazites originating from weathered pegmatites can accumulate in mineral sands deposits. In the 1960s placer monazite deposits were the main source of REE production but fell out of favour due to concern over radioactive thorium and, to a lesser extent, uranium gangue. Xenotime (YPO_4) is the main ore mineral for yttrium and is typically associated with monazite REE mineralization.

Ionic clay deposits are the most important source of heavy and medium REEs. They typically occur in tropical high rainfall environments under thick laterite soils. The REEs are leached from underlying granites by groundwater and are weakly adsorbed onto clay minerals near the intensely weathered zones. Though typically low grade, the REEs are soluble with weak acid and therefore can be extracted cheaply. The best known production sources are the small mines of southern China (Jiangxi, Hunan, Fujian, Guangdong and Guangxi Provinces) and Vietnam's Dong Pao mine. Though there is limited publicly available information or study of the producing mines, USGS reports that deposit grades are between 300 to 2000ppm. According to USGS, the key factors behind their economic viability are i) acid solubility even in weak acid; ii) enrichment in heavy REEs; iii) labour costs; iv) localized lower environmental standards.

Figure 20: Map of REE mines and advanced projects



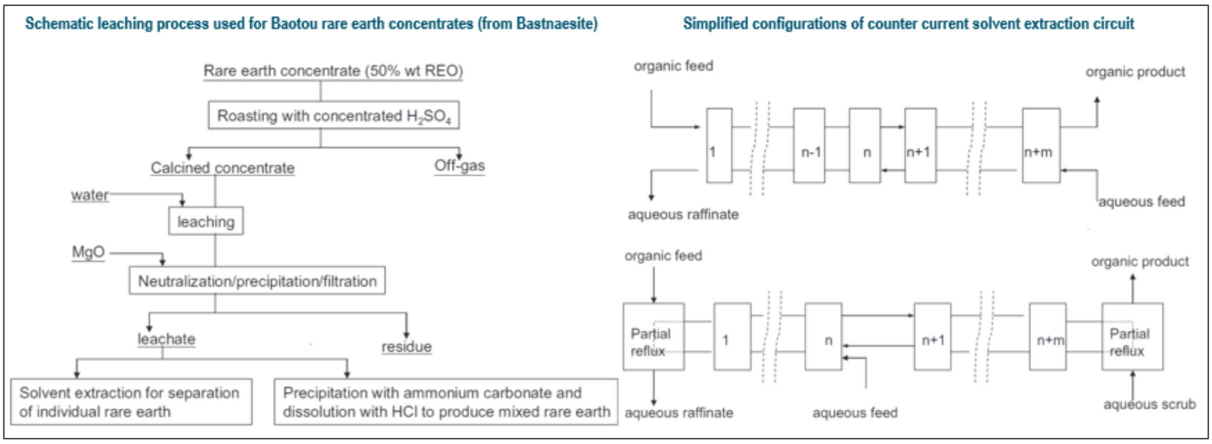
Source: USGS 2016

Metallurgy, processing and products

Mine site: At mine site ore is beneficiated using flotation, gravity, or electrostatic separation to produce a concentrate. Rare earths are then further processed from concentrate into single rare earth oxides using hydrometallurgical processes. Whether concentrate is processed into oxides at the mine site, or shipped to an offsite downstream facility depends on a number of factors, of which the most important are i) acid availability, ii) power availability/cost, and iii) permits for radioactive waste disposal if the ore contains high uranium and thorium. In general, bastnaesites have low uranium and thorium content so logistics play a determining role. Monazites have higher thorium content and therefore radioactive by-product disposal permits are more commonly an important factor. In all cases acid availability is a key parameter.

Downstream processing: Downstream capacity to process concentrates into single rare earth oxides is currently concentrated in China. Bastnaesites are often roasted to burn off carbonates to reduce acid consumption, and then leached with hydrochloric or sulphuric acid. Once in soluble form, REEs are precipitated out using solvent extraction (SX). Cerium usually composes ~50% of the REE content in a bastnaesite and may be oxidized to CeO_2 to prevent it from dissolving in acidic lixiviant, otherwise soluble cerium may reduce capacity to extract other lanthanides during SX. If oxidized, cerium reports to leachate residue after individual REEs are precipitated out of the leachate using solvent extraction or ion exchange, and can be removed last. As cerium prices are significantly lower than Nd and Pr, it is more economic to preference higher Nd and Pr recovery where trade-offs are required.

Figure 21: Schematics of (A) bastnaesite leaching circuit and (B) a counter current solvent extraction circuit

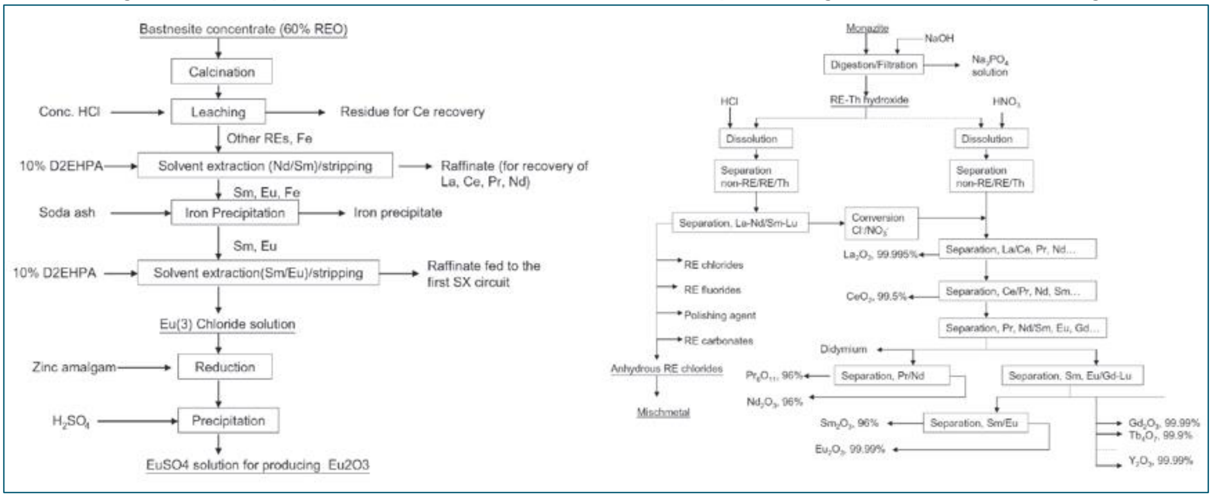


Source: Feng Xie, Ting An Zhang, David Dreisinger, Fiona Doyle, A critical review on solvent extraction of rare earths from aqueous solutions, Minerals Engineering, Volume 56, 2014

Monazites processing is more complex due to higher thorium content. Once in concentrate, REE content is "cracked" by heating to 120-150°C with acid or ~140°C with sodium hydroxide to convert the lanthanides to a water soluble form. An acidic cracking process, the thorium is then precipitated out and the REEs in solution are extracted using SX or IX. In the alkaline cracking route, hydrochloric or nitric acid is added to the REE-Th hydroxide, and thorium and REEs are precipitated out using SX or IX.

Tailings: Both bastnaesite and monazite are very low in sulphide minerals and therefore acid forming potential is a low risk from rare earths tailings processing. Bastnaesite contains between 0.00-0.30% ThO_2 and between 0.00-0.09% UO2 per USGS. Monazite can contain between 0-20% ThO_2 and 0-15%. UO_2. Xenotime can contain between 0.00-5.00% UO_2. As thorium is generally insoluble, solid state contamination such as windblown dust or physical erosion of tailings into bodies of water are the major risk factor for thorium. Uranium dioxide is soluble therefore the primary risk is groundwater related.

Figure 22: Example flowsheets for bastnaesite concentrate processing and monazite processing



Source: Feng Xie, Ting An Zhang, David Dreisinger, Fiona Doyle, A critical review on solvent extraction of rare earths from aqueous solutions, Minerals Engineering, Volume 56, 2014

Existing mine case studies:

Mt Weld, Western Australia (Lynas Resources): was developed in 2009 and commenced concentrate production in 2011. The rare earths resource is contained in secondary phosphates and aluminophosphates, believed to be derived from the Mt Weld carbonatite intrusion. The pre-production resource totalled 17.5Mt at 8.1% TREO including 7.9% in-situ lanthanide content. At the mine site, ore is concentrated by flotation with nameplate capacity of 242ktpa. Concentrate is processed at Lynas's separation facility in Kuantan, Malaysia, known as the Lynas Advanced Materials Plant (LAMP,) to produce single rare earth oxides. LAMP's flowsheet includes cracking, leaching and SX with throughput capacity of ~20-25ktpa of concentrate grading 40% TREOs to produce 16-18ktpa of separated REOs.

Figure 23: (A) Mt Weld Mine, Western Australia and (B) REE separation facility in Kuantan, Malaysia

Source: Lynas Minerals

Key takeaways: The mine is very high grade at 8% TREO with high quantities of mid and heavy rare earths. The LAMP facility in Malaysia is located in an industrial area with access to acid, other key reagents, low cost power, and superior waste product logistics.

Mountain Pass, California, USA (MP Minerals): Mountain Pass is associated with the large Mountain Pass carbonatite and ultrapotassic alkaline intrusions emplaced into a suite of Paleoproterozoic metamorphic gneiss and schist. The carbonatite is a large tabular mass with dimensions of 700x150m in plan view and up to 150m thick with additional carbonatite dykes that are up to 3m thick. The composition of the carbonatite varies but is generally bastnaesite-barite-solvite with 5% or higher REO content.

Mountain Pass began producing in 1952 using a repurposed gold mill and flotation cells and at that time ran at 80-120tpd at grades of >15% REO and recoveries of 68-73%. A solvent extraction plant was added in 1982 to produce high purity samarium and gadolinium oxides. In 1990, lanthanide processing facilities were expanded to produce REO oxides. Production ceased in 2002 and was restarted by Molycorp in 2012. The ramp up took longer than expected with difficulties in HCL production and Molycorp filed for bankruptcy in 2015. The assets were purchased out of bankruptcy and restarted by MP Materials in 2017 and re-listed. Currently the mine produces rare earth concentrates which it sells to Shanghe, a Chinese company, for downstream processing. The company plans to restart chemical processing operations.

Figure 24: Mountain Pass Mine and July 2020 Mineral Reserve Estimate

	Mt (short)	Mt (metric)	TREO (%)	Assemblage LA	Ce	Nd	Pr	Sm
Proven	20.8	18.9	8.2%	33.4%	49.1%	11.5%	4.3%	1.7%
Probable	0.3	0.3	7.0%	33.4%	49.1%	11.5%	4.3%	1.7%
Total	21.1	19.2	8.2%	33.4%	49.1%	11.5%	4.3%	1.7%

Source: MP Materials, MRE by SRK as at 1 July 2020

Source: MP Materials

Key takeaways: The advantages of the projects are size, grade and high medium and heavy rare earth content for a bastnaesite. The project's key challenges are relatively high strip ratio at >12.5x and availability and cost of reagents, particularly acid, which resulted in high costs to produce single rare earth oxides in the context of modern Chinese competition. Operationally MP Materials believes that the circuit changes made by Molycorp resulted in suboptimal operations and intends to optimize the flowsheet to target higher NdPr and lower Ce production.

Bayan Obo, Inner Mongolia, China: Bayan Obo is a large open pit mine which produces REEs from bastnaesite and monazites, as well as niobium and magnetite. The resource is extremely large at 1.5bn tonnes at 35% Fe and 48Mt at 6% TREO with the REE deposit closely associated with the iron deposit. The deposit is located at the margin of the North China Craton and is believed to be related to a large Proterozoic-aged carbonatite intrusion.

Key takeaways: Bayan Obo has numerous advantages. It is very large, even relative to other world class deposits globally. The mine produces REEs as well as iron and therefore has multiple revenue streams to cover its central infrastructure. While its location in China is not in the primary industrial areas, it still benefits from relative proximity to and availability of reagents, power and skilled labour.

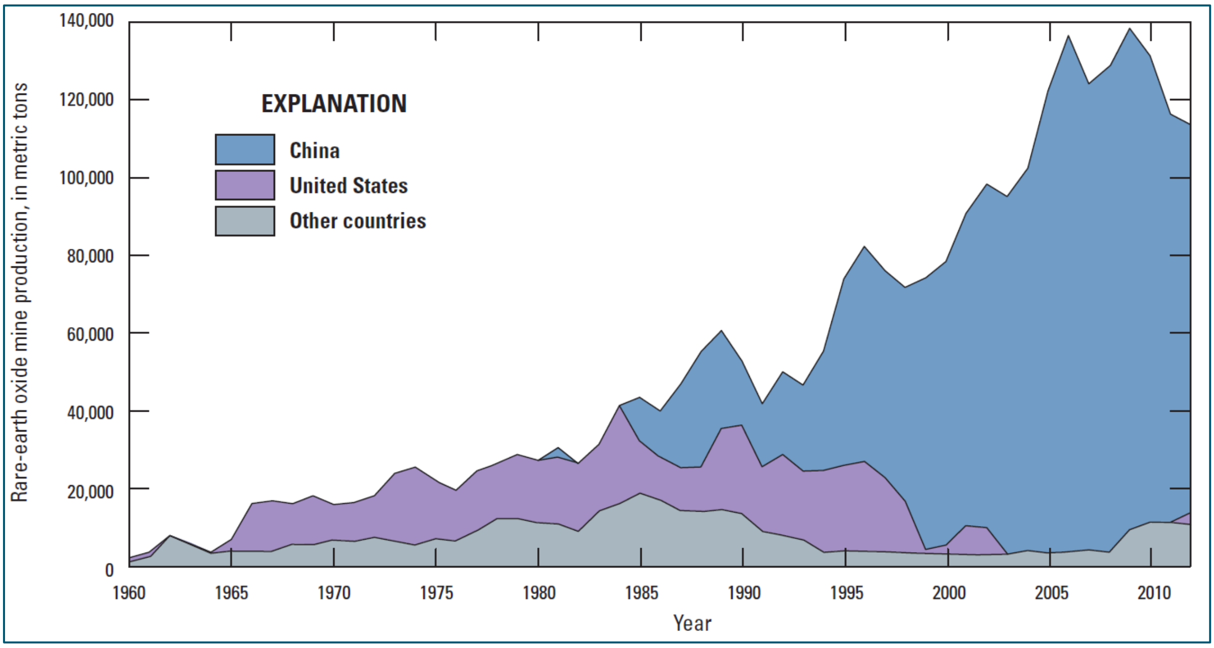
Figure 25: Mountain Pass Mine and July 2020 Mineral Reserve Estimate

Source: Environmental Justice Alliance

Geopolitical importance

Global production reached 132kt of rare earth oxides in 2017 per USGS. Starting in the 1980s, China's market shares of global production increased sharply and has been >90% of global supply since the 1990s. The factors behind this include China's strategic prioritisation of the industry, low power costs, high quality deposits located in China (unlike most mainstream industrial metals such as Cu, Fe), and a willingness to tolerate high radioactivity and chemical waste levels. In 2010 China began to impose export quotas and in 2013, China used export permits as a foreign policy tool during a dispute with Japan, which brought mainstream market and media attention to China's dominant market share. Concern over China's market share has continued to increase with growing geopolitical tensions between China and western democracies, and potential for China to use rare earths, and associated export quotas, as a strategic policy tool.

Figure 26: Global REE production including China, USA, and other



Source: United States Geological Survey (USGS) 2016

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