



Major capital cost reductions

Kvanefjeld's cost position improves regularly

Greenland Minerals' Kvanefjeld project holds the world's largest undeveloped rare earths deposit. Recently completed optimization studies have firmed up what is, by rare earth industry standards, a remarkably simple process flow sheet and a highly competitive cost-structure. Greenland Minerals and its collaborators have progressively driven down the estimated project cost base since completion of Kvanefjeld's initial feasibility study in 2015. The most recent feasibility study in July 2019 highlights further improvements to project metrics. The project's capital cost estimate (US\$505m) has been reduced by a further ~40% from the US\$832m reported in 2016's update of the initial feasibility study. This note revisits our 5 February 2019 update report on GGG.

Investment case

The Kvanefjeld project, which we believe can potentially start production in 2022, is particularly valuable because of its duration, its scale, its favourable metallurgy and the fact that its critical rare earth production profile mirrors long term demand forecasts. A steady increase in rare earth and U₃O₈ prices, potential supply disruptions resulting from a US-China trade war and the completion of permitting in Greenland can help drive favourable sentiment and re-rate the stock into our valuation range.

New valuation range of A\$0.50-A\$0.84 per share

Using the new estimates from the July 2019 update, we now value Greenland Minerals at 50 cents per share base case and 84 cents per share optimistic case using a DCF approach with conservative assumptions on rare earth prices.

Year to June (AUD)	2018a	2019f	2020f	2021f	2022f
Sales (mn)	0.0	0.0	0.0	0.0	637.4
EBITDA (mn)	-2.5	-3.2	-4.2	-4.0	265.3
Net Profit (mn)	-2.5	-2.8	-4.0	-1.1	179.5
EBIT Margin (%)	NM	NM	NM	NM	41.6%
ROCE (%)	-3.0%	-3.4%	-2.3%	-0.5%	20.8%
Net Gearing (%)	-12.2%	-7.3%	-51.5%	194.1%	158.7%
EPS before extr. & amort.	-2.3	-2.5	-2.1	-0.6	95.3
EPS	-2.3	-2.5	-2.1	-0.6	95.3
DPS	NM	NM	NM	NM	NM
EV/Sales	NM	NM	NM	NM	1.9
EV/EBITDA	NM	NM	NM	NM	0.0
P/E	NM	NM	NM	NM	0.2

Source: Company, Pitt Street Research

Share Price: A\$0.15

ASX: GGG

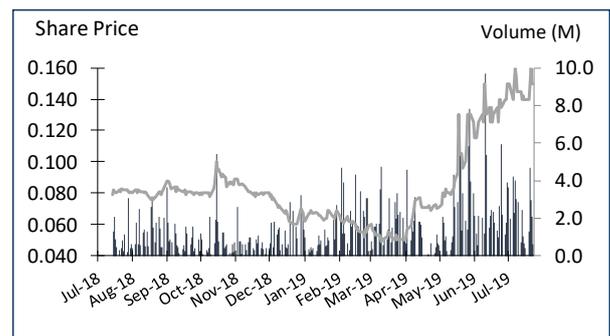
Sector: Materials

29 July 2019

Market Cap. (A\$ m)	169.9
# shares outstanding (m)	1,132.6
# share fully diluted	1,150.6
Market Cap Ful. Dil. (A\$ m)	172.6
Free Float	100%
12 months high/low	0.16 / 0.049
1 / 3 / 12-month performance	20% / 111% / 83%
Website	ggg.gl

Source: Company, Pitt Street Research

Share price (A\$) and avg. daily volume (k, r.h.s.)



Source: Thomson Reuters, Pitt Street Research

Valuation metrics	
DCF fair valuation range (A\$)	0.50 –084
WACC	10%
Assumed terminal growth rate	None

Source: Pitt Street Research

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Table of Contents

Kvanefjeld – Emerging as a world-class project	3
<i>Shenghe playing a vital role in lowering costs at Kvanefjeld</i>	<i>3</i>
<i>US-China trade war talks to provide support to rare earths prices.....</i>	<i>3</i>
<i>If Greenland Minerals is so good, why does it remain undervalued given the apparent potential?</i>	<i>4</i>
The feasibility study update from July 2019 highlights a number of positive outcomes	4
<i>Greenland Minerals is now aiming to achieve other milestones</i>	<i>5</i>
<i>The path to market for Greenland Minerals is getting easier</i>	<i>5</i>
Upgraded valuation – New DCF-based range \$0.50/\$0.84 per share	6
General advice warning, Disclaimer & Disclosures	8



Kvanefjeld – Emerging as a world-class project

Greenland Minerals is a Perth-based resources company focused on the Kvanefjeld rare earths project. This project, located in southern Greenland, has been worked on by Greenland Minerals since 2007 and has been 100%-owned by the company since 2012. Over the past 11 years Kvanefjeld has emerged as one of the largest undeveloped rare earth resources in the world, with a current JORC 2012 resource of 1.01 billion tonnes grading 1.1% total rare earth oxide. The project also has substantial uranium (593 million pounds) and zinc resources

Shenghe playing a vital role in lowering costs at Kvanefjeld

An initial feasibility study of the Kvanefjeld project was prepared in 2015 and the results of the study were published in May 2015. The study was based on a mine life of 37 years and a primary product of 'critical' rare earths, 'critical' in this context being the particular suite of rare earths expected to be in short supply in the future. The initial study was updated in April 2016 and the update demonstrated an improved cost profile for the project and estimated an average free cash flow of US\$376m p.a, an increase of 14% on the estimates contained in the initial feasibility study. The 2016 update also demonstrated a significant decline in expected capital costs, from US\$1.36bn in 2015 to US\$832m in 2016.

A key step forward for the project occurred late in 2016 when Shenghe Resources, a major Chinese rare earths company, became a significant shareholder in Greenland Minerals. Shenghe currently owns 11% of Greenland Minerals. Shenghe has a growing international presence and is notably playing a key role in the restart of the Mountain Pass rare earth mine in the US. Shenghe are also a shareholder in Mountain Pass. For Greenland Minerals, Shenghe has brought considerable technical expertise and deep industry knowledge into the Kvanefjeld project as a collaborator as well as a shareholder and the positive impact of the relationship can be seen in the latest feasibility study update, the results of which were released on 9 July 2019. The capital cost estimate for the Kvanefjeld project has been reduced by a further ~40% from US\$832m (announced on 6 April 2016) to US\$505m. Capital cost savings have been identified across the all elements of the project from the flowsheet to civil construction. Civil construction costs constituted a very significant component of the overall capital costs in the 2016 feasibility study. As such the cost of civil works was a key focus area for the 2019 update. In the recently completed update the estimate of civil construction costs has been reduced by 44% to US\$175m. With the 2019 feasibility study update now complete, Greenland Minerals and its collaborators will move to bankable feasibility study.

We previously envisaged a start-up of production at Kvanefjeld around 2021. We now think that expectation is too aggressive given the large scale of Kvanefjeld at half a billion US dollars in capital costs. We are therefore shifting the start-up date to 2022.

US-China trade war talks to provide support to rare earths prices

In the past two months, rare earth prices increased significantly, up ~16% (stock price has galloped 100%) after speculation in the markets that China may curb the supply of rare earths to the US in retaliation for tariff hikes and the Huawei ban. Thus, any potential supply disruptions of these metals would augur well for the prices of these metals as well as the share price.

*Capital costs reduced by ~40%
to US\$505m led by ongoing
efforts supported by Shenghe*



If Greenland Minerals is so good, why does it remain undervalued given the apparent potential?

We think that the main reason for the apparent undervaluation of Greenland Minerals in recent years is concern that environmental and related permitting issues have some years to progress. Significant progress has been made on this front through 2018, with impact assessments completed by highly reputed specialist consultants and submitted to regulators. In addition to this there are concerns that the US-China trade war may impact the long-run outlook for rare earth pricing given China's dominance of the rare earths field. We believe that these sentiment issues can be overcome once the permitting has been completed for the Kvanefjeld project. In many respects Kvanefjeld is a unique project and in its optimized form its strengths are becoming increasingly visible; a long-life, low cost producer of magnet metals, with backing of a key player in the rare earth industry.

The feasibility study update from July 2019 highlights a number of positive outcomes

The initial feasibility study, announced in May 2015, suggested an NPV for Kvanefjeld of US\$1.4bn, using a discount rate of 8%. The IRR in this analysis was 21.8%. However, by April 2016, Kvanefjeld's estimated NPV was up 13% at US\$1.5bn (@ 10% discount rate) with an IRR >40%.

In July 2019, Greenland Minerals released an updated feasibility study wherein the capital cost estimate for the Kvanefjeld project has been reduced by a further to US\$505m. This represents a reduction of ~40% from the US\$832m announced in April 2016. The reduction in the capital costs estimate is driven by optimisation studies across different all elements of the project from the flowsheet to civil construction. We believe that the following key highlights of the 2019 study update demonstrate the impact of the steps taken by the company to continuously improve the metrics of the project

- **Capital cost estimate has been significantly reduced.** The original capital cost estimate of the project in 2015 was US\$1.36bn. The estimate was reduced to US\$832m in 2016 and further reduced to US\$505m in 2019.
- **Process optimisation.** A key focus of optimisation programmes, the result of which was the 2019 update, was to produce a smaller volume of a higher-grade concentrate. Guided by Shenghe, an optimised flotation circuit was designed to produce rare earth mineral concentrates containing REO in the range of 22-25%. In the 2016 study, the flotation circuit produced a mineral concentrate containing only 14% REO. A further area of key focus was the refinery circuit. Optimisation work has resulted in the development of a significantly simpler refinery circuit. The refinery is now a single stage circuit with fewer solid-liquid separation steps. The higher concentrate grade and the simplification of the refinery circuit have resulted in a reduction of the scale of the refinery circuit and the size of processing equipment in the refinery.
- **Civil works.** Civil construction costs constituted a major portion of the total capital costs in the 2016 feasibility study and were another focus area of the optimisation programme. Cost reductions on this front were primarily achieved through reductions in civil earth works for site preparation, updated port design by specialist groups and greater use of local materials. The revised civil costs were US\$175m, down 44% from the civil construction cost estimate in 2016, including indirect costs and contingency.

Follow-up studies have resulted in a 40% reduction in capital cost estimates including a 44% drop in civil construction costs



*Rare earth production increased
by ~8% to 32,000 tpa of REO*

- **Kvanefjeld is poised to become a low-cost producer of rare earth products.** Process optimisation has led to significant reductions in operating costs. In the 2016 feasibility study update, operating costs were estimated to be US\$8.50/kg of REO, inclusive of by-product credits. In the current update operating costs are estimated to be below US\$4/kg of REO. These costs position Kvanefjeld as one of the lowest-cost undeveloped ASX-listed rare earth project.
- **Improvement in rare earth recoveries.** Continued development of the refinery circuit through 2018 has increased rare earth recoveries to 94%, up 8% from recoveries in the 2016 study. Improved recoveries have increased estimated rare earth production by 8% to ~32,000 tpa of rare earth intermediate product assuming the same processing rate used in the 2016 study - 3Mtpa. The project will be a major supplier of magnet metals – neodymium, praseodymium, terbium and dysprosium – each of which is critical to the electrification of transport systems, wind energy and green technologies.

Greenland Minerals is now aiming to achieve other milestones

We foresee two major events happening during 2019-2020 that can drive Kvanefjeld forward.

*Mining License application
lodged with Government of
Greenland*

- **Completion of permitting.** In June, the company lodged its application for a mining license (in the Greenland framework described as an Exploitation License) with the MLSA, the relevant authority of the Government of Greenland. An application for an Exploitation License must be accompanied by environmental and social impact assessments (EIA, SIA) for the proposed project together with a Navigational Safety Investigation Study (NSS). The impact assessments and the NSS, which were also translated into Greenlandic and Danish, were submitted with the Exploitation License application. Receipt of the application has been acknowledged by the MLSA.

In March 2019, the municipal authority in southern Greenland, Kommune Kujalleq, and the Kujalleq Business Council signed a Memorandum of Understanding with the company to negotiate a participation agreement to cover community involvement in the development of the Kvanefjeld project. After a period of public consultation, a White Paper will be produced which will collate feedback received during this consultation period. Following the White Paper and final update of the project's impact assessment and post this step, we expect the relevant permits to be granted.

- **Initial project financing discussions,** which will take place in the context of the improved project economics, arising from an optimised flowsheet.

The path to market for Greenland Minerals is getting easier

One of the most critical aspects of Shenghe's involvement with Greenland Minerals is that it provides a path to market through access to rare earths separation technology and capacity. Other emerging projects in this space do not have a comparable relationship with a partner with the capability to process output from their projects. In addition to the technological benefits coming from the collaboration, Shenghe's involvement in the Kvanefjeld project has proved fruitful from a regulatory perspective. On 23 January 2019, Shenghe announced a joint venture with China National Nuclear Corp.



Greenland Minerals Limited

(CNNC), a state-owned nuclear power operator. The joint venture company (Hua Sheng) can be fully licensed for the import of rare earth concentrates containing radioactive material. This complements regulatory work that has been previously undertaken by Greenland and Denmark through which Greenland has become a signatory to IAEA conventions, and regulations legislated to manage the production and export of uranium.

Such endeavours to address regulatory issues are not undertaken for insignificant projects and are all part of the foundation that is now in place to see Kvanefjeld developed effectively.

Upgraded valuation – New DCF-based range \$0.50/\$0.84 per share

In September 2018 we valued Greenland Minerals at 18 cents per share, base case, 43 cents per share, optimistic case. With this note we upgrade our valuation to take account of the July 2019 feasibility update. As in September 2018, our basic valuation approach is as follows:

- We created Discounted Cash Flow (DCF) models of Kvanefjeld broadly based on the assumptions of the 2015 feasibility study and Greenland Minerals' 2016 update to that study. Our DCFs used a 10% WACC and a long run AUD/USD exchange rate of 0.75.
- We assumed mine startup in 2022.
- We assumed initial selling prices and mining/processing costs and escalated these at a 2.5% p.a. inflation rate.
- We assumed a 37-year mine life based on the current 108 million-ton JORC reserve.
- We assumed a 30% corporate tax rate.
- We assumed that the government of Greenland would collect a 2% royalty on product sales.
- We assumed an equity capital raising by Greenland Minerals of A\$90m in order to provide the standard equity buffer in the project's capital budget.
- We assumed that after the A\$90m equity buffer, Kvanefjeld is debt-funded at an interest rate of 8%. We assume debt is amortized over a seven-year period after start-up.
- We assumed mining costs of US\$3/t for both base and optimistic cases, while for processing costs we assumed US\$65/t base case coming down to US\$55/t for an optimistic case.
- We assumed in each case that fixed costs would be 8% of the projected capital costs.

Capital costs. In September 2018 we assumed US\$850m for a base case assumption and US\$700m for an optimistic case. We now change this to US\$650m base case and US\$500m optimistic case.

Equity buffer. We increased the assumed raising price for the A\$90m buffer to 12 cents to take account of the re-rating in Greenland Minerals' share price.

Mine output. We adjusted our assumptions on concentrate recoveries to accord with Greenland Minerals' latest expectation on REO production of ~32,000 t.p.a.

*Clear scope for savings on
capital costs*



Rare earths pricing. In September 2016, for both our base and optimistic cases, we assumed US\$42,000/t REO for the critical rare earth basket which will be the mainstay of the mine. We believed at the time that this was conservative (Figure 1), with our estimate significantly below the levels used in the original 2015 feasibility study. In its July 2019 feasibility study update Greenland Minerals referred to a forecast basket price for rare earth intermediate product of US\$19.55/kg. We believe that our model estimate for REO pricing translates to a basket price of US\$14.20-\$14.89/kg and therefore remains conservative.

Figure 1: Initial selling prices

	Base	Optimistic
Intermediate REO Price	\$14.20	\$14.89
Uranium Price (US\$/t)	45,000	55,000
Fluorspar Price (US\$/t)	270	350
Zinc Price (US\$/t)	1,800	2,400

Source: Pitt Street Research

The resulting DCF valuations have been summarized in Figure 2 below with our base case and optimistic scenario yielding a value per share of A\$0.50 and A\$ 0.84 per share. The mid-point of this range is A\$ 0.67 per share.

Figure 2: Discounted Cashflow valuation for Greenland Minerals

	Base	Optimistic
Value of Kvanefjeld	868.9	1,497.6
Corporate overhead	-14.7	-13.2
Cash now (A\$m)	5.8	5.8
Cash to be raised (A\$m)	90.0	90.0
Option exercises (A\$m)	0.6	0.6
Total value (A\$m)	950.6	1,580.8
Total diluted shares (million)	1,892.6	1,892.6
Value per share (A\$)	0.50	0.84
Valuation midpoint	\$0.669	
Share price now (A\$ per share)	\$0.150	
Upside to midpoint	345.7%	

Source: Pitt Street Research

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