



Continuous improvement

Kvanefjeld's cost position improves regularly

Greenland Minerals' Kvanefjeld Rare Earths Project in Greenland covers the world's largest undeveloped Rare Earths deposit. A notable aspect of the Kvanefjeld story has been the way in which Greenland Minerals and its collaborators have progressively driven down the estimated project cost base since the initial Feasibility Study was published in 2015. Recent announcements have suggested that Kvanefjeld's costs can be lower than previously thought and point to a strong Feasibility Study update in 2019. A joint venture by Greenland Mineral's partner Shenghe related to rare earths concentrates containing uranium also eases the path to project start up. This note updates our 20 September 2018 initiation report on Greenland Minerals.

Investment case

The Kvanefjeld Project, which we believe can potentially start production in 2021, is valuable in part because of its favorable metallurgy and wide spread of critical Rare Earths. A steady increase in Rare Earth and U3O8 prices, further progress on the Kvanefjeld flowsheet, and completion of permitting in Greenland can help drive favourable sentiment and re-rate the stock into our valuation range.

Valuation range of A\$ 0.18 – 0.43 per share

As per our 20 September analysis we value Greenland Minerals at 18 cents per share base case and 43 cents per share optimistic case using a DCF approach with conservative assumptions on Rare Earths.

Year to Dec. (AUD)	2017A	2018f	2019f	2020f	2021f
Sales (mn)	0.0	0.0	0.0	0.0	590.1
EBITDA (mn)	-2.5	-4.5	-3.5	-4.0	197.2
Net Profit (mn)	-2.5	-4.2	-3.2	-0.9	83.0
EBIT Margin (%)	NM	NM	NM	NM	33.4%
ROCE (%)	-3.0%	-4.7%	-1.9%	-0.4%	12.4%
Net Debt/Equity (%)	-12.2%	-11.0%	-52.7%	259.5%	345.1%
EPS before extr. & amort.	-2.3	-3.7	-1.2	-0.4	32.7
EPS	-2.3	-3.7	-1.2	-0.4	32.7
DPS	NM	NM	NM	NM	NM
EV/Sales	NM	NM	NM	NM	2.4
EV/EBITDA	NM	NM	NM	NM	0.4
P/E	NM	NM	NM	NM	0.2

Source: Company, Pitt Street Research

Share Price: A\$0.066

ASX: GGG

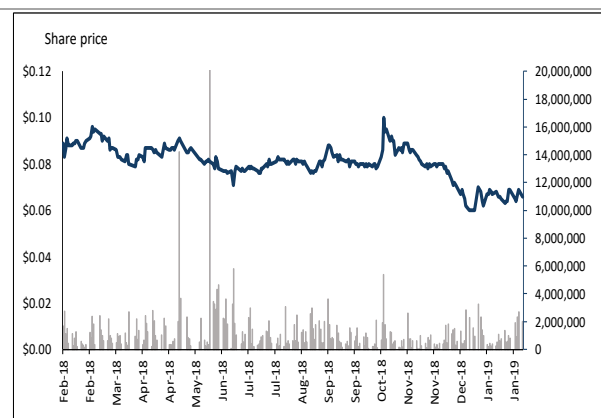
Sector: Materials

5 February 2019

Market Cap. (A\$ m)	74.8
# shares outstanding (m)	1,132.6
# share fully diluted	1,142.6
Market Cap Ful. Dil. (A\$ m)	75.4
Free Float	100%
12 months high/low	\$0.06 / \$0.10
1 / 3 / 12-month performance	-1.4% / -20.7% / -26.6%
Website	www.ggg.gl

Source: Company, Pitt Street Research

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



Source: FactSet, Pitt Street Research

Valuation metrics	
DCF fair valuation range (A\$)	0.18 – 0.43
WACC	10%
Assumed terminal growth rate	None

Source: Pitt Street Research

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Profit & Loss (A\$m)	2017A	2018f	2019f	2020f	2021f	2022f	2023f	2024f	2025f
Sales Revenue	0.0	0.0	0.0	0.0	590.1	604.9	620.0	635.5	651.4
Other Income	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs	0.0	0.0	0.0	0.0	388.9	413.3	423.6	434.2	445.1
Exploration Exp.	0.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Corporate/Admin	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0
EBITDA	(2.5)	(4.5)	(3.5)	(4.0)	197.2	187.6	192.4	197.3	202.3
Depn & Amort	0.1	0.0	0.0	0.0	42.4	42.4	42.4	42.4	42.4
EBIT	(2.6)	(4.5)	(3.5)	(4.0)	154.9	145.2	150.0	154.9	160.0
Net Interest	0.1	0.3	0.3	3.1	(71.9)	(70.5)	(60.5)	(50.3)	(39.7)
Operating Profit	(2.5)	(4.2)	(3.2)	(0.9)	83.0	74.8	89.5	104.6	120.3
Tax expense	0.0	0.0	0.0	0.0	0.0	22.4	26.8	31.4	36.1
Abnormals + Minorities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NPAT	(2.5)	(4.2)	(3.2)	(0.9)	83.0	52.3	62.6	73.2	84.2
Cash Flow (A\$m)	2017A	2018f	2019f	2020f	2021f	2022f	2023f	2024f	2025f
Total Revenue	0.0	0.3	0.3	3.1	608.4	611.7	623.8	636.7	650.3
Oper,Corp,Other Expenses	0.0	2.5	2.5	3.0	391.9	416.3	426.6	437.2	448.1
Feasibility & Exploration	1.8	10.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Tax Expense	0.0	0.0	0.0	0.0	0.0	22.4	26.8	31.4	36.1
Interest Expense	0.0	0.0	0.0	0.0	90.1	77.3	64.4	51.5	38.6
Operating Cashflow	(1.8)	(12.2)	(4.2)	(1.9)	124.4	93.7	104.0	114.6	125.6
Capex (-asset sales)	2.5	0.0	0.0	566.7	566.7	25.0	25.0	25.0	50.0
Investments, Loans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investing Cashflow	(2.5)	0.0	0.0	(566.7)	(566.7)	(25.0)	(25.0)	(25.0)	(50.0)
- Dividends (ords & pref)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Equity raised	8.7	12.0	90.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Debt drawdown (repaid)	0.0	0.0	0.0	1043.3	83.5	(161.0)	(161.0)	(161.0)	(161.0)
Net Change in Cash	4.4	(0.2)	85.8	474.8	(358.8)	(92.3)	(82.0)	(71.3)	(85.4)
Cash at End Period	10.7	10.6	96.4	571.1	212.3	120.1	38.1	(33.2)	(118.7)
Net Cash/(Debt)	10.7	10.6	96.4	(472.2)	(914.5)	(845.8)	(766.8)	(677.1)	(601.6)
Balance Sheet (A\$m)	2017A	2018f	2019f	2020f	2021f	2022f	2023f	2024f	2025f
Cash	10.7	10.6	96.4	571.1	212.3	120.1	38.1	-33.2	-118.7
Total Assets	89.6	97.4	184.2	1227.2	1514.7	1406.7	1310.8	1225.7	1151.6
Total Debt	0.0	0.0	0.0	1043.3	1126.8	965.8	804.9	643.9	482.9
Total Liabilities	1.4	1.3	1.3	1045.2	1249.8	1089.4	930.9	772.5	614.3
Shareholders Funds	88.2	96.1	182.9	182.0	265.0	317.3	379.9	453.2	537.4
Ratios									
Net Debt/Equity (%)	-12.2%	-11.0%	-52.7%	259.5%	345.1%	266.6%	201.8%	149.4%	111.9%
Interest Cover (x)	-19.8	-13.1	-10.4	-1.3	2.7	2.7	3.2	3.9	5.1
Return on Equity (%)	-2.8%	-4.3%	-1.7%	-0.5%	31.3%	16.5%	16.5%	16.2%	15.7%



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Continuous improvement at Kvanefjeld

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 last 11 years Kvanefjeld has emerged as one of the largest undeveloped Rare Earth Oxide resources in the world, with a current JORC 2012 resource of 1.01 billion tonnes grading 1.1% REO. The project also has substantial uranium (593 million pounds) and zinc resources.

Kvanefjeld's story has been one of continuous lowering of costs, helped by Shenghe

Kvanefjeld has gone through an initial Feasibility Study that was published in May 2015 and updated in April 2016. These studies envisage a mine life of 37 years with a primary product of 'critical' Rare Earth Oxide, 'critical' meaning that these particular Rare Earths are expected to be in short supply in the future. An improved cost profile for Kvanefjeld in 2016 suggested average free cash flow of US\$376m p.a, up 14% on the 2015 estimates. In this update, expected capital costs came down markedly, from US\$1.36bn to US\$832m. Greenland Minerals is continuing to work hard on costs. A key step forward, from late 2016, has been the involvement of a major Chinese Rare Earths company called Shenghe Resources, which now 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 USA, where they are also a shareholder. 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 fruits of this has been a number of technical breakthroughs pointing to lower capital and operating costs in the next Feasibility Study update. The recent visit to Greenland of a number of civil engineering consultants has suggested that Kvanefjeld's civil constructions costs can be lower than previously thought.

We look for a Feasibility Study in the coming months

The company expects to work on a Feasibility update once the flowsheet has been optimized. We believe that this can happen in 2019 and that this update will feature another lowering of estimated capital and operating costs at Kvanefjeld. After the feasibility Study update, Greenland Minerals and its collaborators will move to Bankable Feasibility Study. We envisage a start-up of production at Kvanefjeld around 2021.

If Greenland Minerals is so good, why is it currently capitalized at only A\$80m?

We think that the main reason for the apparent undervaluation of Greenland Minerals in recent years is concerns that environmental and related permitting issues have some years to progress. Significant progress has evidently been made on this front through 2018, with updated impact assessments completed by highly reputed specialist consultants and returned to the regulators. Updates on the permitting status would be anticipated for early 2019 and will be an important guide and potential catalyst. More recently, Greenland Minerals has not been immune to the bearish frame of mind for equities markets generally. In addition to this there is concerns that the US-China trade war may impact the long-run outlook for rare earth pricing

*Involvement of Shenghe
was a major step forward*



given China's dominance of the rare earths field. We believe that these sentiment issues can be overcome once the company updates the Kvanefjeld Feasibility Study and permitting has completed.

Feasibility work at Kvanefjeld has been promising

The initial Feasibility Study painted a healthy future for Greenland Minerals. This 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 Greenland Minerals was able to recalibrate that study with lower selling prices for some metals and a higher discount rate of 10% but with a significantly higher NPV of A\$1.59bn and an IRR >40%.

By April 2016, Kvanefjeld's estimated NPV was up 13%. There were various cost savings across the Project between 2015 and 2016, but two key changes to the model are noteworthy (Figure 1):

- **Capital costs were reduced.** The original capital cost of the project as per 2015 was a high US\$1.36bn. In 2016 the capital budget was reduced to US\$832m. Part of this involved a reduction in civil works, with Greenland Minerals having found that the concentrator and refinery for Kvanefjeld could be consolidated in one place, saving US\$115m. However, a substantial part of the reduction had to do with items which the company decided to outsource to third-party providers.

Figure 1: 2015 vs 2016 costs and revenues from Feasibility Study

	2015	2016	Change
REVENUE (USDm)			
Uranium	73.2	51.0	-30.3%
cREO	584.7	611.8	4.6%
Lanthanum/Cerium	82.7	33.6	-59.4%
Other	14.5	14.5	0.0%
Total	755.1	710.9	-5.9%
COSTS (USDm)			
Project	237.4	252.1	6.2%
Separation	190.4	82.8	-56.5%
Total	427.8	334.9	-21.7%
MARGIN (USDm)			
	329.6	376.0	14.1%

Source: Company

- **Extraction rates were improved.** In September 2015 Greenland Minerals had announced that the first refinery pilot plant operation had achieved 95% Rare Earth extractions out of concentrate sourced from the beneficiation pilot plant operation several months earlier. The Feasibility Study work had been done on only 77%. This work suggested that atmospheric leaching with sulphuric acid was a viable refining method. Greenland Minerals now used a 90% extraction rate.

- **Revenue numbers came down, but costs came down more.** As we note in the Figure above, the average revenue of the Project was 6% lower, but, thanks to higher extraction rates, costs came down 22%.



Shenghe has driven further value increases since late 2016

We noted in our 20 September 2018 initiation report on Greenland Minerals that Shenghe's Chinese collaborators, IMUMR¹ and BTMR², have done a lot of work on both the concentrator and the refinery of the Project. This has resulted in some major steps forward in the last twelve months, notably;

- **The concentrator.** In December 2017 Greenland Minerals announced that Shenghe's work had markedly increased the estimated grade of the Rare Earth Phosphate mineral concentrate. Specifically, work by Shenghe and its IMUMR collaborators had established that, with different flotation reagents, the grade of the Rare Earths Phosphates rose to 23%, from the original 14% in Kvanefjeld's May 2015 Feasibility Study. This was particularly important from a capital cost perspective important because it opened up the possibility, now being investigated, that concentrate could be directly shipped to downstream customers, saving the capital cost on the refinery. In the 2015 Feasibility Study this refinery was budgeted at US\$371m. Greenland Minerals announced in April 2018 that a second collaboration, this time with BTMR, had achieved similar concentrate grade results with a different method to that used by IMUMR. The best method out of these two will be selected by Greenland Minerals and Shenghe for further pilot plant work. On 10 January 2019 the company announced that further testwork by BTMR on the flotation circuit had suggested flowsheet simplifications with the potential to lower reagent costs.

- **The refinery.** In January 2018 Greenland Minerals announced that the Shenghe collaborators had developed a new acid leach circuit for the refinery that used hydrochloric acid for direct concentrate leaching rather than sulphuric acid for direct leaching and hydrochloric acid for secondary leaching as per the 2015 Feasibility Study. This suggested lower capital costs would be required for any refinery that would be built at Kvanefjeld.

The potential for continued cost reductions is strong

The expected civil engineering costs for Kvanefjeld have now come down. We see Greenland Minerals' announcements of 18 September 2018, 22 October 2018 and 29 January 2019 as important indicators of the potential for further cost reductions at Kvanefjeld across the board ahead of a 2019 Feasibility Study update.

- Greenland Minerals reported in September that a team of civil engineering consultants from four different firms, including firms with expertise in arctic operations, had visited Greenland in September and conducted on-site studies as part of the project optimisation.
- In October this collaboration yielded a finding that, simply by matching the pad for the proposed processing plant to natural land contours, the amount of dirt and rock to be cut could be reduced by 60-80%.
- In January Greenland Minerals were able to announce that its consultant on port design had lowered the potential cost of the port through a design that made use of local aggregates.

Why weren't all these cost saving identified sooner? Critics of Greenland Minerals may argue that the company should have been aware of the pad contouring or local aggregates opportunities in 2015, as well as the numerous other cost-saving opportunities that have been reported since 2015, and

*Cost savings at Kvanefjeld
are emerging all the time*

¹ The Institute of Multipurpose Utilization of Mineral Resources of the Chinese Academic of Geological Sciences. Now you know why we prefer the abbreviation IMUMR.

² Baotou Meng Rong, a private engineering firm.



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acted to include them in its plans at that time. We argue that such criticism is unwarranted:

- Most mines in the world today have gone through several design versions before the optimal design goes to the Bankable Feasibility stage.
- Greenland Minerals has actively worked since 2015 to bring in the necessary expertise that a small team in Perth will not have in-house. The ability of CEO John Mair and his team to attract Shenghe as a collaborator speaks well not only of Kvanefjeld as a project but of the knowledge that Greenland Minerals has built internally with which to market the project.
- Unlike more common commodities such as copper or gold, rare earths mining require particular specialist expertise that is not easy to find outside of China.

The late 2018 and early 2019 announcements bode well for the current year.

It seems that every time Greenland Minerals looks at Kvanefjeld, it is able to cut costs somewhere. We think that this success can continue into 2019, given the commitment of Greenland Minerals and Shenghe to source other collaboration partners to work on processing infrastructure, capital works, and construction. There is also the potential for such collaborators to ease the Kvanefjeld funding process, through committing their own balance sheets to the project as part of obtaining the work they are bidding for.

Greenland Minerals is now working towards a Feasibility update

We see four things happening during the course of 2019 that can drive Kvanefjeld forward:

- **Continued technical optimization**, as Shenghe and its collaborators work towards the flowsheet that will optimally harness the unique metallurgical advantages of Kvanefjeld.
- **Completion of permitting**. As part of the Mining License Application process in Greenland the company has conducted Environmental and Social Impact Assessments for Kvanefjeld, as well as a Maritime Safety Study. The Maritime Safety Study was lodged with the Greenland government in October 2017 while the Environmental and Social Impact Assessments were lodged in mid-2018. The company is waiting on the Greenland government to officially accept the EIA and SIA, after which a public hearing will commence ahead of the completion of a White Paper to collate the response to queries received during this consultation. After this we expect the relevant permits to be granted.
- **Completion of a second Feasibility Study update**, based on all that has been learned by Shenghe and Greenland Minerals since late 2016.
- **Initial project financing discussions**, based on the improved project economics from a more optimal flowsheet, as well as, potentially, better product pricing than was the case two or three years ago.

*Permitting could
potentially be completed in
Greenland this year*

The path to market for Greenland Minerals is getting easier

Shenghe has worked out a solution to Kvanefjeld's uranium transport issue.

In our 20 September 2018 note we commented that *'One of the most critical aspects of Shenghe's involvement is it provides a path to market through access to Rare Earths separation technology and capacity. No other emerging project really has a comparable relationship with a large- scale refiner'*. One of the fruits of this relationship from a regulatory point of view came to light



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on 23 January 2019 with the announcement of a joint venture between Shenghe and China National Nuclear Corp. (CNNC), a state-owned nuclear power operator. Shenghe and CNNC have formed a joint venture company called Hua Sheng that can be fully licensed for the import of rare earths concentrates containing radioactive material. This complements regulatory work that has been previously undertaken by Greenland and Denmark to see Greenland 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 and inline with leading international collaborators and best practice.

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