

AUSTRALIAN

RESEARCH

INDEPENDENT INVESTMENT RESEARCH

TNG Limited (ASX:TNG)

November 2020

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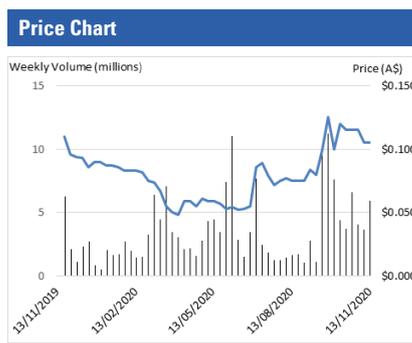


Note: This report is based on information provided by the company as at November 17, 2020

Investment Profile	
Share Price - Nov 17, 2020	A\$0.105
Per Share Valuation	A\$0.484
Issued Capital:	
Ordinary Shares (from 18/11/20)	1,212 m
Unlisted Options (from 18/11/20)	87.7 m
Fully Diluted	1,230 m
Market Capitalisation	A\$121.2 m
12 month L/H	A\$0.128 /\$0.039
Cash (September 30, 2020)	A\$3.69 m
Cash - Entitlements Issue	A\$8.77 m
Listed Investments (Nov 17, 2020)	A\$0.26 m

Board	
Mr John Elkington: Non-Executive Chairman	
Mr Paul Burton: Managing Director and CEO	
Mr Greg Durack: Non-Executive Director	
Mr Simon Morten: Non-Executive Director	

Major Shareholders (pre-rights)	
Deutsche Balaton and Associates	12.28%
V. M. Salgaocar (VIMSON Group)	9.84%
WWB Investments	7.47%
Aosu Investments	5.38%
Top 20	43.32%
Board	0.70%



The investment opinion in this report is current as at the date of publication. Investors and advisers should be aware that over time the circumstances of the issuer and/or product may change which may affect our investment opinion.

MAJOR PROGRESS

TNG Limited ("TNG" or "the Company") has made significant progress, despite the effects of COVID-19, on the 100% owned Mount Peake Vanadium-Titanium-Iron Project ("Mount Peake" or "the Project"), located in the Northern Territory ("NT") of Australia. The Project includes two components - the Mount Peake mine site located near Alice Springs, and the TIVAN[®] processing plant in Darwin. The Final Investment Decision ("FID") is now targeted for mid-2021.

The key advance has been the signing of further binding offtake agreements, with the result that 100% of planned production of all product streams is now covered under such agreements. This is crucial in the financing process.

Agreements finalised during the year include with Gunvor (Singapore) ("Gunvor") for 40% of the vanadium production, and with the VIMSON Group ("VIMSON") of India for 100% (~500,000 tpa) of the high grade iron ore fines product. These add to previously executed agreements, including for 100% of the planned pigment offtake with Swiss based global group, DKSH, and 60% of the planned vanadium products with WOOJIN Metals of South Korea.

On the financing front, TNG has mandated KPMG Corporate Finance ("KPMG") as global finance advisor to assist in obtaining total project finance. This is in addition to the ongoing mandate with the German Government owned KfW IPEX-Bank as the lead debt arranger (which should facilitate access to export credit agency ("ECA") debt finance), and engagement with the Northern Australian Infrastructure Facility ("NAIF"). As part of their mandate, KfW IPEX-Bank has continued to provide input, largely relating to costs, to the ongoing Front-End Engineering and Design ("FEED") Study being overseen by the Company's German strategic engineering and construction partner, SMS group GmbH ("SMS group").

As covered in our October 2019 update the FEED Study has resulted in an optimised delivery strategy that presents a single stage, 2 Mtpa project with a life of 37 years, in contrast to the two stage 3 Mtpa/6 Mtpa project as presented in the original and updated Definitive Feasibility Study ("DFS"). The FEED study was originally expected to be completed in mid-2020, however has been delayed due to COVID-19 affecting some work streams, which however have now recommenced. The ongoing study will further refine and optimise facets of the Project, including costs.

On the permitting front, the Company recently submitted a revised Mining Management Plan ("MMP"), and is advancing a supplement to the Draft Environmental Impact Statement ("EIS") for the proposed TIVAN[®] facility in Darwin. The Authority Certificate for the Mount Peake mine site area has also been issued by the Aboriginal Areas Protection Authority.

Two green technology initiatives have also been entered into, including a partnership with SMS group to develop a CO₂-neutral technology to develop hydrogen to be used as the reduction agent in the TIVAN[®] process. The second of these is the establishment of vanadium redox flow battery ("VRFB") business.

KEY POINTS

Offtake in place: Having 100% of the proposed production of vanadium, titanium and iron products under binding offtake agreements significantly de-risks the Project, and should help with facilitating project financing.

Financing advanced: The Company has advanced the financing process through the engagement with KPMG and the NAIF; in addition the proposals to develop "green" technologies may help attract a wider group of potential financiers.

Cashed up: TNG should now be funded through to a FID, following the recently completed 1 for 9 entitlements issue at A\$0.10/share, which was subscribed to 70%, and raised A\$8.77 million before costs. The issue included a 1 for 1, A\$0.18, 12-month option.

VALUATION SUMMARY

Our risked, after tax and funded technical valuation of TNG is updated to A\$0.484/share from our previous valuation of A\$0.369/share. Key changes include increasing debt to 80% from 70%, and increasing the equity price from A\$0.15/share to A\$0.20/share - this results in a diluted share structure of 2.1 billion shares.

TNG indicative base case technical valuation - funded and after tax					
Asset	Value (A\$m)	Risk Factor	Risked (A\$m)	Risked/Share	Notes
Mount Peake	\$1,444	70%	\$1,011	\$0.479	Post-tax NPV _g
Cash	\$12.28	100%	\$12.28	\$0.006	30/9/20 + Rights
Listed Investments	\$0.26	100%	\$0.26	\$0.000	Current
Total	\$1,456	N/A	\$1,023	\$0.484	

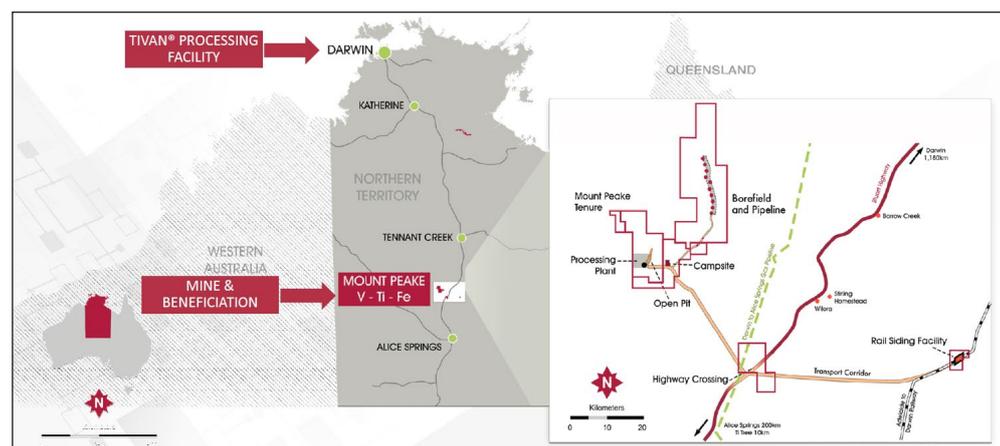
Please note that our valuation is based on interim cost figures as presented in the Company's release of September 11, 2019. As noted by TNG, estimated costs may change with progress of the FEED Study, and thus costs used, and hence the valuation should be treated as being indicative only.

ACTIVITIES UPDATE

BACKGROUND

- ◆ The report presents an update to our previous reports, available on the TNG and IIR websites - in this we will also reiterate important aspects of the Project as discussed in our earlier reports, including the October 2019 Update.
- ◆ TNG's strategy is the development of Mount Peake Project, which includes the mine and concentration plant near Alice Springs, and the planned TIVAN[®] processing plant in Darwin - concentrate will be trucked 85 km from the mine site and then railed 1,180 km to Darwin for downstream processing (Figure 1).

Figure 1: Project location map and Mount Peake site layout



Source: TNG

- ◆ The 100% TNG-owned TIVAN[®] is a proprietary hydrometallurgical process, initially developed by TNG, Perth based Metallurgical Engineering Technical Services ("METS") and the Commonwealth Scientific and Industrial Research Organisation ("CSIRO"), designed to extract high purity vanadium, titanium and iron oxide products from titaniferous magnetite concentrates; subsequent work has been carried out in conjunction with SMS group, a major European based global metallurgical engineering group.
- ◆ Advances on the Project made since our previous note include advancing the FEED study, finalising offtake agreements, advancing financing and ongoing permitting.
- ◆ The timing of some elements of the Project however have been affected by COVID-19, with issues largely related to some streams of the FEED study.
- ◆ This has led to the deferral of a number of the study streams (particularly those in Europe), however these have now restarted - this has resulted in the delay of completion of the study and hence a FID.

CORPORATE

- ◆ TNG has recently completed a 1 for 9 entitlements issue, with this having a 70% take-up, raising A\$8.77 million through the issue of 87.7 million shares.
- ◆ Each share has a free attaching A\$0.18 option, with an expiry date of November 30, 2021 - the Company will look to list the options.
- ◆ On February 17, 2020, TNG announced the appointment of Mr Simon Morten as Non-Executive Director.
- ◆ Mr Morten has over 30 years experience in the titanium pigment industry, spending much of this time with Cristal, including most recently as Vice President - Titanium Production. Cristal has subsequently been acquired by Tronox.

OFFTAKE AND FINANCING

- ◆ The Company now has 100% of the planned production of all products under offtake agreements, with those including;
 - A Binding LOM Offtake and Marketing Agreement for a minimum of 75% and up to 100% of titanium dioxide pigment production with DKSH, a Swiss based Market Expansion Services Provider,

- A Binding LOM Offtake Agreement for 60% of vanadium products with WOOJIN Metals of South Korea (this incorporates a "Technology Transfer Agreement" whereby TNG has access to WOOJIN's V₂O₅ to ferrovanadium production technology, with the potential to install this on site sometime in the future),
 - A binding LOM Offtake Agreement for 40% of the vanadium products with Gunvor; and,
 - A binding LOM Offtake Agreement for 100% of the high grade iron ore fines product with VIMSON.
- ◆ The two latest agreements were released to the market on July 27, 2020 (VIMSON) and October 15, 2020 (Gunvor).
 - ◆ VIMSON is a family owned Indian conglomerate with interests in a number of industries - the offtake agreement will be operated through its Singapore based, wholly owned subsidiary V. M, Salgaocar & Bro. (Singapore) Pte. Ltd, who will purchase 100% of the iron product on an FOB basis - VIMSON is currently a significant shareholder in TNG.
 - ◆ Likewise, Gunvor, a Singapore based global commodity trader, will purchase 40% of the planned vanadium production on an FOB basis for global marketing for a fixed discount.
 - ◆ On the financing front, the Company has mandated KPMG as global financial advisor to assist TNG in obtaining a total financing package for the Project - KPMG has worked previously with both KfW IPEX-Bank and the NAIF in sourcing and structuring project finance packages
 - ◆ As mentioned in previous notes, the Company has mandated KfW IPEX-Bank to structure the total debt package of up to US\$600 million (~A\$850 million) - this is part of the broader KfW Group, a leading global provider of export credit and project financing - in December 2019 the mandate letter was extended to December 2020.
 - ◆ KfW IPEX-Bank is working with SMS group and the Company on the ongoing FEED study for Mount Peake, with part of this including providing inputs into the opex and capex assumptions for the Project.
 - ◆ One advantage of KfW IPEX-Bank is that it should provide access to export credit agency ("ECA") cover, which can result in very attractive debt finance terms.
 - ◆ Due to the hands-on approach and thorough due diligence by KfW IPEX-Bank, projects that have been through their process should be regarded as being robust.
 - ◆ There are also ongoing discussions with the NAIF regarding applicable funding processes.

FEED STUDY

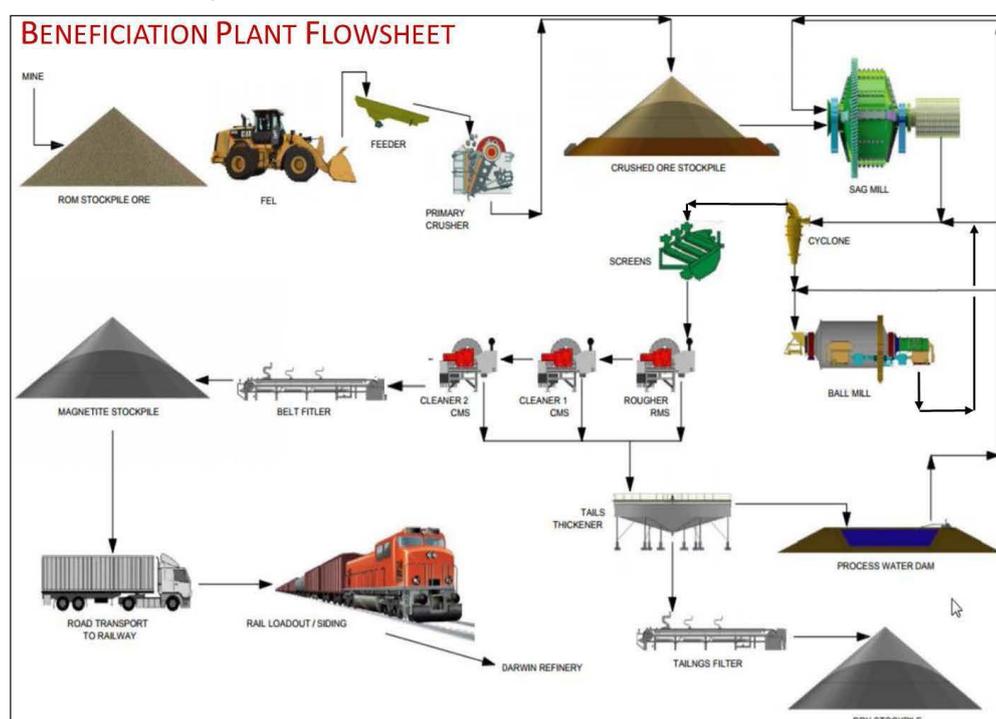
- ◆ KfW IPEX-Bank is working with SMS group, the Company and other key consultants on the ongoing FEED Study for Mount Peake, with part of this including providing inputs into the opex and capex assumptions for the Project.
- ◆ A number of the work streams supporting the study were deferred for a time due to COVID-19, however as advised to the market on August 10, 2020, these have restarted.
- ◆ The expected completion date for the study (which the Company estimates is now ~75% complete) is now early 2021, with an expected FID by mid-2021 - these dates are dependent on work not being affected by circumstances outside of the Company's control.
- ◆ On completion of the study, SMS will provide TNG with a fixed price engineering, procurement and construction ("EPC") proposal for delivery of the mine site Beneficiation Plant and the Darwin TIVAN® Processing Facility - the latter will be subject to reaching agreement with the Northern Territory Government on acquisition of the land site, and the outcomes of the current EIS, both of which are expected in early 2021.
- ◆ As discussed in our November 2019 Update, work on the FEED Study to date has resulted in the development of an optimised single stage, 2 Mtpa project delivery strategy, as released to the market on September 11, 2019, and detailed later in this report - it is noted that this is an interim study, which will be updated on completion of the FEED Study and due diligence by KfW IPEX-Bank.
- ◆ The revised strategy is designed around the production of 100,000 tpa of TiO₂ pigment, 500,000 tpa of high grade (+64%) Fe₂O₃ fines and 6,000 tpa of high purity vanadium pentoxide flake.
- ◆ This replaces the previous two stage strategy as presented in both the initial (July 2015) and updated (November 2017) DFS - the different studies are compared in Table 1.
- ◆ The ongoing FEED Study has included the review and optimisation of both the concentrator and TIVAN® plant - the proposed flowsheets are presented in Figures 2 and 3.

Table 1: Mount Peake development study results comparison

Mount Peake development study results comparison			
Key Physicals	Optimised Strategy, September 2019	Updated DFS, November 2017	Initial DFS, July 2015
Pre-production Capex (Stage 1 infrastructure, mine site, concentrator, process plant)	A\$824 million	A\$853 million	A\$970 million
Stage 2 Capex (largely funded out of Cash Flow)	N/A	A\$969 million	A\$792 million
IRR pre-tax	33%	44%	41%
NPV (at 8% discount)	A\$2.8 billion	A\$4.7 billion	A\$4.9 billion
NPV (at 10% discount)	N/A	A\$3.8 billion	A\$4.0 billion
NPV (at 12% discount)	N/A	A\$3.1 billion	A\$3.3 billion
Pay back	2.8 years	3 years	4 years
Pre-tax net annual average cash-flow	A\$359 million	A\$738 million	A\$785 million
Life-of-mine net cash-flow	A\$12.2 billion	A\$11.7 billion	A\$11.6 billion
Product Prices	US\$11.50/lb V ₂ O ₅ , US\$102/tonne Fe ₂ O ₃ , US\$3,600/tonne TiO ₂ pigment	US\$10.00/lb, V ₂ O ₅ , US\$410/tonne pig iron, US\$3,500/tonne TiO ₂ pigment	US\$6.28/lb V ₂ O ₅ , US\$388/tonne pig iron, US\$3,573/tonne TiO ₂ pigment
A\$-US\$ Exchange Rate	0.7	0.75	0.75
Total Operating costs	A\$210 per tonne of ore processed	A\$185 per tonne of ore processed	A\$167 per tonne of ore processed
Year 1-4 - ore feed	N/A	3 Mtpa	3 Mtpa
Year 5-17 - ore feed	N/A	6 Mtpa	6 Mtpa
Year 1 - 35 ore feed	2 Mtpa	N/A	N/A
Scheduled mined material (Mt)	69	81	78
Strip Ratio	1.1:1	0.9:1	0.9:1
Head Grade	0.37% V ₂ O ₅ , 26.38% Fe, 6.87% TiO ₂	0.37% V ₂ O ₅ , 26.38% Fe, 6.87% TiO ₂	0.38% V ₂ O ₅ , 27.1% Fe, 7.04% TiO ₂
Overall Metallurgical Recovery	90% V ₂ O ₅ , 70% Fe, 65% TiO ₂ IIR analysis - calculated from mining inventory (cell above) and published LoM production	82% V ₂ O ₅ , 66% Fe, 63% TiO ₂	84% V ₂ O ₅ , 66% Fe, 69% TiO ₂
Magnetic concentrate (Mt)	23.3	24.3	21.7
LoM Fe ₂ O ₃ (Mt)	17.6	10.6	9.6
LoM V ₂ O ₅ (Mt)	0.23	0.24	0.27
LoM Titanium Pigment (Mt)	3.5	3.5	3.6

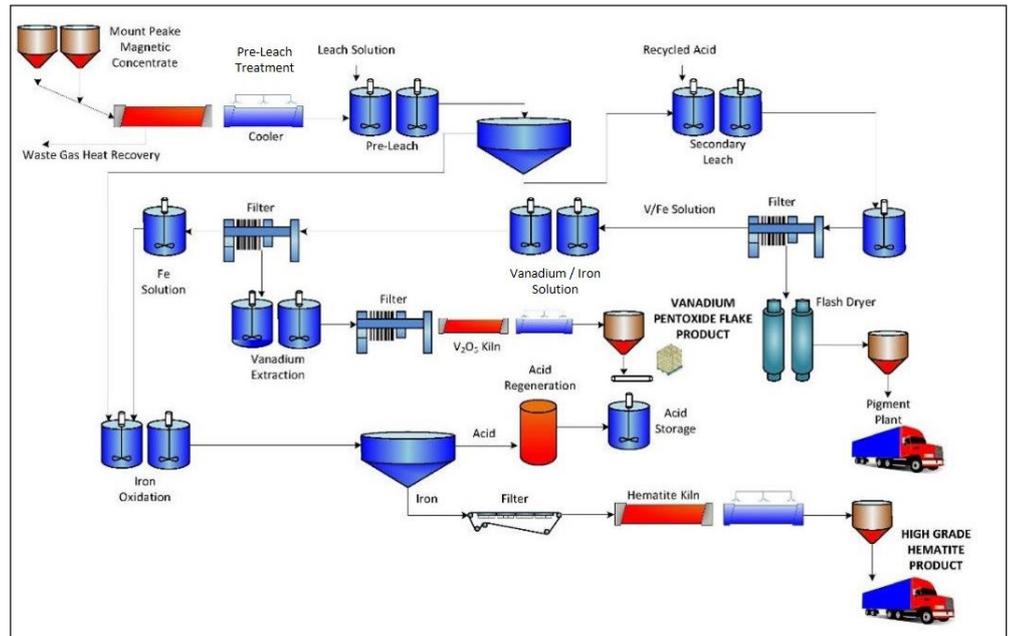
Source: TNG, IIR analysis

Figure 2: Beneficiation plant flowsheet



Source: TNG

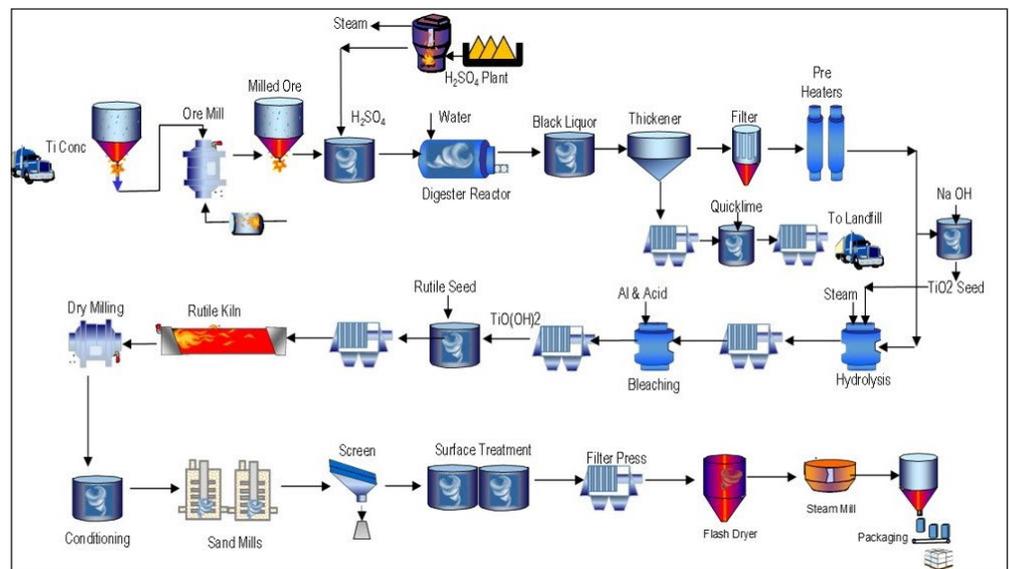
Figure 3: TIVAN® flowsheet



Source: TNG

- ◆ The Darwin facility includes the titanium dioxide pigment technology developed by German company Ti-Cons (Figure 4), a key partner of TNG - the Company has trademarked the high quality pigment product as TNG360™.
- ◆ A key aspect of the pigment production is the very low iron content of the TiO₂ feedstock - this is in contrast to most other pigment plants which have high iron in the feedstock, and which ends up as waste material.

Figure 4: TNG360™ pigment flowsheet



Source: TNG

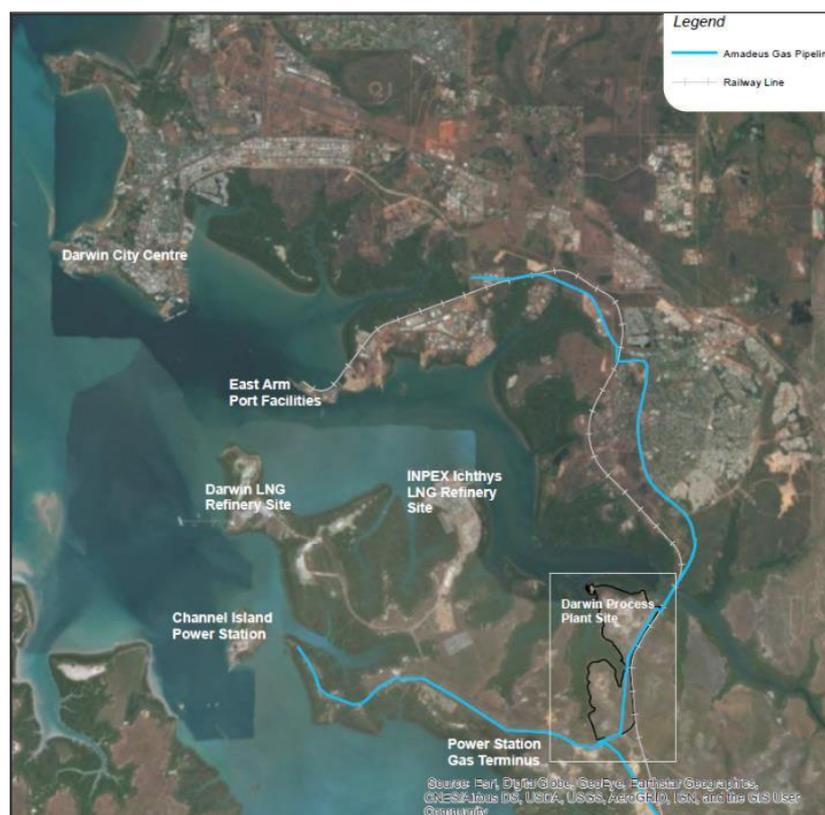
NON-PROCESS INFRASTRUCTURE AND MISCELLANEOUS

- ◆ In parallel with the FEED study, TNG has progressed activities, largely tendering, for non-process infrastructure (“NPI”) works at both the Mount Peake and Darwin sites, with this estimated to be 90% complete as of the time of writing.
- ◆ Works include utilities, camps and logistics amongst others.
- ◆ TNG has also been assessing the economics of undertaking owner-operated mining as compared to contract mining.

PERMITTING AND LAND ACQUISITION

- ◆ The Company has progressed permitting, including responding to requests for further information for some elements - some activities have been held up due to COVID-19 related border closures.
- ◆ A new Project Facilitation Agreement (“PFA”) was also executed with the Northern Territory Government (“NTG”), which demonstrates a coordinated whole-of-government planning and development approach to the Project.
- ◆ The final stage in the mine approval process is the lodgement and approval by the Department of Industry, Tourism and Trade (“DITT”) and other departments of the Mine Management Plan (“MMP”).
- ◆ The MMP was lodged in October 2019, however following review, there has been a request for further information - as advised to the market on November 5, 2020 the revised MMP has now been lodged with the DITT, and with the MMP expected to be finalised in early 2021.
- ◆ Likewise, further information was requested for the Draft EIS for the Darwin site - the Company has progressed a number of work streams required for the Supplement to the Draft EIS, with finalisation of the EIS expected in December 2020.
- ◆ The request to prepare a Supplement was provided to the Company in April 2020, following the receipt of three comments from the public and 52 from various NTG agencies in response to the exposure period of the Draft EIS.
- ◆ A critical document that has been finalised is the “Authority Certificate” over the Mount Peake site with the Aboriginal Areas Protection Authority.
- ◆ The Authority Certificate is a legal document recognised under the Northern Territory Sacred Sites Act 1989, and protects sacred sites in setting out the conditions for operating in the area of sacred sites - it also provides indemnity to the Company provided the conditions are adhered to.
- ◆ The Company is in discussions with the NTG regarding an acquisition proposal for a ~150 acre block of Crown Land for the Darwin processing plant - this again is expected in December 2020 (Figure 5).
- ◆ The block, which is zoned heavy industrial, was formerly used for building materials extraction, is located 10 km from the Port of Darwin, and is adjacent to rail and the Amadeus Gas pipeline hub.

Figure 5: Darwin site location and infrastructure



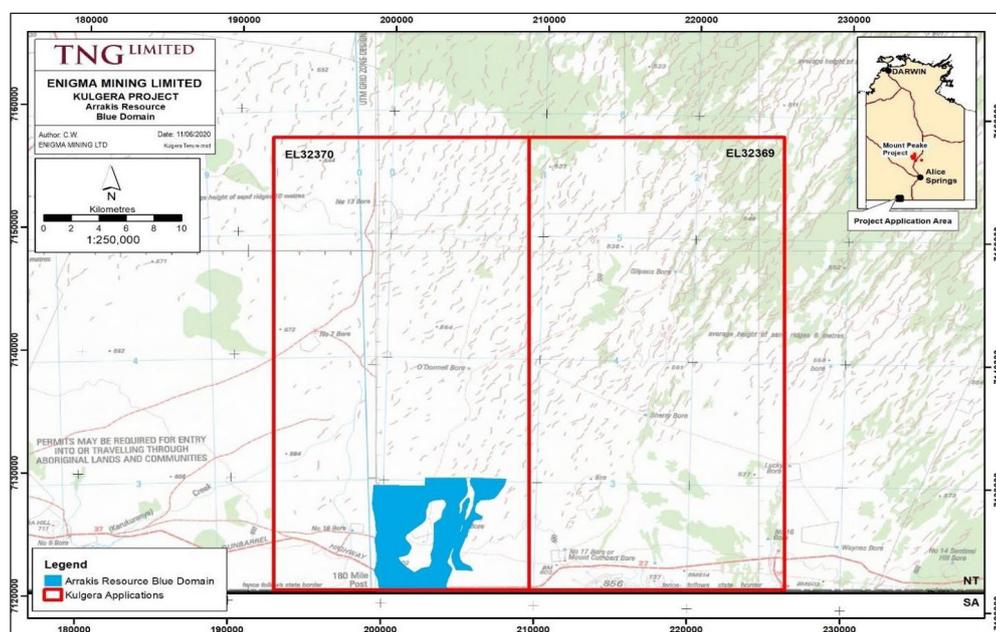
GREEN INITIATIVES

- ◆ Over the last few months TNG has entered into two what could be regarded as “green” initiatives, and which, in our view, could entice a new group of investors into the Company and the development of Mount Peake.
- ◆ The first of these, as announced to the market on September 17, 2020, is a partnership with SMS group to develop carbon-neutral technology to produce hydrogen.
- ◆ The Company has stated that SMS is advanced in the understanding of the plasma pyrolysis technology, which has the potential to produce hydrogen using ~1/3 of the electricity that is required for hydrogen production through the conventional water hydrolysis process.
- ◆ The hydrogen would be used as a reductant agent for the TIVAN® process, with potential by-products including high purity carbon black.
- ◆ This however is not being considered in the current FEED study - it will be progressed in parallel, and any development and application would be subject to the technical and commercial viability of the process.
- ◆ As part of a vertical integration strategy, TNG has established a VRFB business, to produce vanadium electrolyte and become a commercial supplier of VRFBs - the Company has successfully produced vanadium electrolyte from the high purity Mount Peake vanadium pentoxide.
- ◆ We have a discussion on VRFBs below, however their widespread development has been hamstrung by the lack of availability of high purity and reasonably priced vanadium pentoxide that is required to produce the electrolyte, the key component of these potentially grid scale batteries that could be transformative in power grid developments over coming years.

KULGERA PROJECT EXPLORATION LICENCES

- ◆ In the 2020 September quarter the Company was granted two exploration licences (“EL”) for a total area of 1,231 km² on the border with South Australia (Figure 6).

Figure 6: Kulgera tenements



Source: TNG

- ◆ The area contains dune-hosted mineral sands mineralisation, with work by previous operators resulting in a JORC 2012 compliant for the Arrakis Prospect of 346 Mt @ 6.3% HM, with relatively low oversize and slimes contents, and with 61% in the Indicated category.
- ◆ Initial metallurgical work has indicated a valuable heavy mineral content of 55%, with this largely comprised of ilmenite - the Company will assess the suitability for the mineralisation to be treated by the TIVAN® process.
- ◆ Further detail is provided in the Company’s release of July 8, 2020.

SUMMARY OF PLANNED ACTIVITIES

- ◆ Upcoming activities will be concentrated on finalisation of the FEED Study, permitting, offtake and financing, with a FID expected by mid-2021.
- ◆ Once numbers are firmed up, these will be incorporated into the financial model, which will be used in finalising the optimal finance structure for the Project.
- ◆ The majority of permits and licences are in place, with all major documents being lodged - the Company is now awaiting assessment of the revised mine site MMP and Supplement to the Darwin EIS.
- ◆ At Kulgera, an assessment of the suitability of the V-Ti heavy mineral concentrate to be treated by the TIVAN® is to be undertaken.
- ◆ These activities should result in ongoing newsflow in the months leading up to the expected FID - the key piece of news will be the finalisation of the FEED Study.

VALUATION

- ◆ We have updated our November 2019 valuation for TNG to account for the recent 1 for 9 entitlements issue and a change in funding scenario. The valuation includes a risked DCF valuation for Mount Peake, and current valuations for cash and listed investments - our base case valuation is shown in Table 2.
- ◆ We have increased the debt proportion of financing to 80%, and increased the equity price to A\$0.20/share - we have included exercise of the recently issued 87.7 million A\$0.18 options in our total equity funding - the effect of the A\$0.02/share price difference on the total funding is immaterial.
- ◆ The effects of the above have increased the per share valuation from A\$0.369/share to A\$0.484/share - in all other aspects the valuation is unchanged from that in our November 2019 note.

Table 2: TNG indicative base case technical valuation

TNG indicative base case technical valuation					
Asset	Value (A\$m)	Risk Factor	Risked (A\$m)	Risked/Share	Notes
Mount Peake	\$1,444	70%	\$1,011	\$0.479	Post-tax NPV ₈
Cash	\$12.28	100%	\$12.28	\$0.006	30/9/20 + Rights
Listed Investments	\$0.26	100%	\$0.26	\$0.000	Current
Total	\$1,456	N/A	\$1,023	\$0.484	
Diluted Shares	2,112 m	Tax Status	Post Tax		20% equity funding, A\$0.20/share
Mount Peake Prices	V ₂ O ₅	Fe ₂ O ₃	TiO ₂	AUD:USD	
	\$20,000/tonne	\$90/tonne	\$3,250/tonne	0.7	IIR scenario

Source: IIR analysis

- ◆ We note that the Company has stated that both operating and capital costs as presented in the latest study are interim, and may change with progress of the FEED Study - the potential for adverse changes in costs is covered partly by the risk factor we have used, as well as the sensitivity analysis as presented in Tables 4 and 5.
- ◆ The sensitivity of the project valuation to changes in capital costs is reasonably low, and, in our view, it is capital changes that are most likely to change with progress of the FEED Study, largely due to equipment selection.
- ◆ We have used a total funding requirement of A\$900 million in our modelling, which includes the estimated A\$824 million capex, and A\$76 million to cover possible working capital requirements and financing fees amongst others - the actual funding requirement and mix will be estimated as part of the ongoing financial modelling and optimal financing structure determination by KfW IPEX-Bank.
- ◆ We note that at an equity price of A\$0.20/share, our conceptual A\$180 million of equity funding will be dilutive for shareholders.
- ◆ As was the case in our previous valuations, project inputs are largely those as provided by TNG; there were major changes from our 2018 valuation to the 2019 (and hence current) valuation, with the change in project strategy.

- ◆ Table 3 highlights the similarities in our pre-tax valuation using TNG's forecast metal prices to the results as presented in the optimised strategy, and also shows the effect of the different pricing scenarios, with the NPVs using the TNG scenario being around 1.5 x those using the conservative IIR scenario - this multiplier can be applied to all subsequent figures, including sensitivity tables - prices used by the Company in the optimised study were US\$25,400/tonne for V₂O₅, US\$3,600/tonne for titanium pigment and US\$102/tonne for iron oxide, and are based on independent forecasting.
- ◆ We have based our metal prices on the following (we do not have access to the confidential forecasts as used by the Company, and on which their prices are based), with these being the same as in our October 2019 valuation:
 - V₂O₅ - average real prices over the past 14 years, taking into account the spike in 2019 (this was updated from US\$16,500/tonne in our November 2018 report),
 - Fe₂O₃ - this is an estimate for fines, and takes into account the premium paid for 65% Fe₂O₃ over the 62% product - 62% iron ore prices have steadily increased since the nadir of US\$40/tonne in late 2015, to current prices of ~US\$120/tonne, however have kept the price conservatively at US\$90/tonne - we note that the Project is least sensitive to iron prices, given that this provides ~10% of the expected revenue; and,
 - TiO₂ pigment- Despite some recent weakness in pricing due to COVID-19 affecting demand, we have maintained our pigment price at US\$3,250/tonne.
- ◆ Although there has been a recent spike in the price of vanadium to over US\$30,000/tonne followed by a fall, our view is that the price we have used could be more indicative of longer term pricing; the metal has a history of volatile pricing (refer Figure 8); we have taken a similar approach to titanium pigment prices.
- ◆ The first four columns of the sensitivity tables are considered revenue factors, with these also being proxies for other revenue factors, including grade and metallurgical recovery; for example a 15% change in vanadium grade or recovery will have a similar effect on project economics as a 15% change in price as shown above; in the case of exchange rates, this can be considered as a proxy for changes in revenue factors for the combined metals.
- ◆ As can be seen the project is most sensitive to exchange rates (and hence to combined falls in metals prices), with changes in operating costs coming second; the project is least sensitive to changes in capital costs.
- ◆ On the individual product front, the Project is most sensitive to changes in titanium pigment prices.
- ◆ Changes in the capital cost will also lead to changes in the diluted share structure, and thus have a compound effect on the per share valuation.

Table 3: TNG comparative valuations

TNG comparative valuations					
Asset	Unrisked Project NPV _g		Risked NPV _g /Share		Notes
	Pre Tax, Unfunded	Post Tax, Funded	Pre Tax, Unfunded	Post Tax, Funded	
Pricing - IIR scenario	\$1,747 m	\$1,444 m	\$1.01	\$0.48	The per share values in the post tax, funded valuation take into account dilution due to the 20% equity portion
Pricing - TNG scenario	\$2,760 m	\$2,176 m	\$1.59	\$0.72	

Source: IIR analysis

- ◆ Tables 4 and 5 present sensitivity analyses for our valuation of the Mount Peake Project on a conceptually funded, after tax basis.

Table 4: Post-tax, funded and un-risked Mount Peake sensitivity analysis

Post-tax, unfunded and un-risked Mount Peake sensitivity analysis						
Change	V ₂ O ₅ Price	TiO ₂ Price	Fe ₂ O ₃ Price	Exchange Rate	Opex	Capex
-15%	\$1,241	\$997	\$1,393	\$2,268	\$1,873	\$1,504
-10%	\$1,308	\$1,146	\$1,410	\$1,963	\$1,730	\$1,484
-5%	\$1,376	\$1,295	\$1,427	\$1,690	\$1,587	\$1,464
0%	\$1,444	\$1,444	\$1,444	\$1,444	\$1,444	\$1,444
5%	\$1,512	\$1,593	\$1,461	\$1,221	\$1,301	\$1,425
10%	\$1,579	\$1,742	\$1,478	\$1,019	\$1,158	\$1,405
15%	\$1,647	\$1,890	\$1,495	\$835	\$1,015	\$1,385

Table 5: Risked Mount Peake per share sensitivity analysis

Risked Mount Peake per share sensitivity analysis						
Change	V ₂ O ₅ Price	TiO ₂ Price	Fe ₂ O ₃ Price	Exchange Rate	Opex	Capex
-15%	\$0.411	\$0.331	\$0.462	\$0.752	\$0.621	\$0.529
-10%	\$0.434	\$0.380	\$0.467	\$0.651	\$0.573	\$0.511
-5%	\$0.456	\$0.429	\$0.473	\$0.560	\$0.526	\$0.495
0%	\$0.479	\$0.479	\$0.479	\$0.479	\$0.479	\$0.479
5%	\$0.501	\$0.528	\$0.484	\$0.405	\$0.431	\$0.462
10%	\$0.523	\$0.577	\$0.490	\$0.338	\$0.384	\$0.448
15%	\$0.546	\$0.626	\$0.495	\$0.277	\$0.336	\$0.433

Source: IIR analysis

RISKS

- ◆ We view the key risk now as being associated with the outcomes of the FEED Study, and the magnitude of any potential operating and capital cost increases that may effect the financial viability and ability to fund the Project.
- ◆ As the Company has mentioned, the recently released optimised delivery strategy uses interim numbers, which will be updated as the FEED Study progresses and is completed.
- ◆ One key factor specifically mentioned by TNG is that there may be the requirement to source a larger than presently assumed portion of capital equipment from fixed countries of origin by lenders, say under an ECA-backed financing structure - the interim capex figure is based on maximising sourcing of largely pre-manufactured modules from qualified vendors from manufacturing hubs with attractive labour costs.
- ◆ Mitigating this is the relative insensitivity of the Project financials to changes in capital costs, however any such changes will affect the financing strategy.

BACKGROUND – COMMODITIES AND MARKETS

TITANIUM DIOXIDE

Uses and Production

- ◆ The majority (90%) of titanium dioxide is used in the pigment industry, being used in various products, including paints, coatings, paper and inks.
- ◆ It is a key white pigment in that it has a high refractive index (whiteness), provides UV protection and is non-toxic.
- ◆ Other uses include as a metal (military, aerospace and speciality applications) and for welding rod core wire.
- ◆ The bulk of feedstock currently comes from the mineral sands industry, with the remainder being produced from blast furnace slag from titanium bearing ores - there is currently no hydrometallurgical production directly from titanomagnetite concentrate as is planned for Mount Peake.
- ◆ There are two main pigment production routes – chloride and sulphate, with chloride generally being cleaner and requiring higher grade feedstocks.
- ◆ The majority of Chinese capacity is for sulphate grade feedstock; western producers generally use the chloride process, however, given the nature of the feedstock, a sulphate process has been developed for Mount Peake - the low iron content of the TIVAN® titanium product alleviates the requirement to dispose of iron waste, a key environmental issue of other pigment processors.
- ◆ According to the USGS, installed pigment production capacity in 2019 was 7,660,000 t, with 3,250,00 t (42%) being in China, and with the US coming second with 1,370,000 t (18%) of installed production capacity; current Australian capacity is 260,000 t (~3%).
- ◆ Current global demand is in the order of 6,500,000 tpa, with the planned average annual production from Mount Peake accounting for some 1.5% of global capacity.
- ◆ Actual global production is closely aligned to world economic conditions, which can result in significant swings in demand and hence pricing; the cost and availability of feedstocks also affects pigment pricing.

Table 6: Titanium dioxide products sold

Titanium dioxide products sold			
Product, approx market share	TiO ₂ %	Notes	End Uses
Rutile – 10%	95-97	Mined product	Pigments, metal
Synthetic rutile – 3%	88-95	Upgraded from ilmenite in a furnace	Pigments
Ilmenite			
Sulphate – 42%	52-54	Processed to pigment - sulphate processing	Pigments
Chloride – 12%	8-62	Processed to pigment - chloride processing	
Slag			
Sulphate – 11%	80-85	Upgraded from sulphate ilmenite in a furnace	Pigments
Chloride – 19%	85-90	Upgraded from chloride ilmenite in a furnace	
Upgraded – 3%	95	Upgraded from ilmenite	

Source: Iluka

Pricing

- ◆ The mineral sands and downstream pigment markets are relatively opaque – prices are generally fixed between the producer and buyer, and until 2009-2010 were largely on long term contracts, leading to relatively stable prices.
- ◆ More recently, changes in demand and supply have led to contracts more commonly being negotiated quarterly or half yearly.
- ◆ A recent feature of pricing was a sharp decrease in prices in 2013, which continued into 2016 – this followed slowing in demand during 2012, largely due to weakening global economic conditions.
- ◆ This followed on from significant price increases in feedstocks starting in 2010 - this was as a result of supply constraints enabling producers to renegotiate prices away from long term contracts, which were a disincentive for bringing on new production, with feedstock prices feeding into pigment prices.
- ◆ More recently, the period from 2016 to 2018 saw sharp rises in both US and European prices, with these now forecast to rise at a steady rate over coming years.
- ◆ This has resulted in prices of ~US\$3,300/tonne in early 2020, however with some recent falls being reported due to COVID-19 affecting demand - it is expected that demand will again increase as the situation eases, and governments put in place economic programmes to drive the recovery after COVID-19.

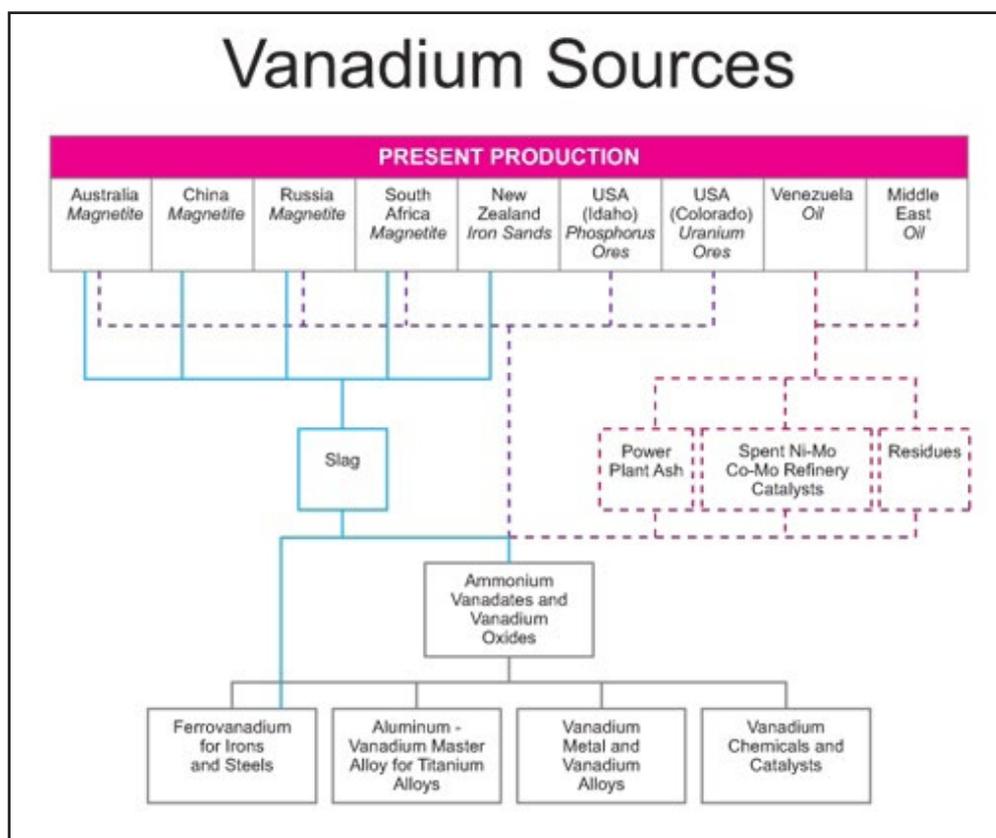
VANADIUM AND VRFBs

Background

- ◆ The main use of vanadium is as a steel additive in high-strength steel, which accounts for about 90% of the current global demand of ~113,000 t of vanadium metal (equivalent to ~202,000 t V₂O₅, with the oxide containing 56% V) - China was the largest consumer, accounting for ~50% of total demand.
- ◆ Other uses include chemicals, catalysts and in batteries - vanadium is produced as two main products – FeV for steel-making and V₂O₅ for chemical and battery applications.
- ◆ Global production was reportedly ~106,000 t in 2019, with the largest source being as a by-product from slag produced from the smelting of titaniferous magnetite ores for steelmaking (Figure 7) – it is estimated that this accounts for ~69% of total supply, with 19% being derived from mining as a primary product and the remainder from secondary sources, including oil residues and fly ash.
- ◆ Supply is concentrated, with ~90% of vanadium products produced in South Africa, China, Europe, Russia and Brazil - of these China is by far the largest producer, accounting for 59% of global production, and also being a next exporter.
- ◆ Demand exceeded supply from 2016 to 2019, with successive drawdowns on inventory; part of this has been due to industry rationalisation and environmental constraints in China, as well as new regulations in China mandating an increase in the minimum vanadium content of rebar - this resulted in a sharp increase in prices from 2016 to 2018.
- ◆ However, there has been a retracement of this most recent rise in prices, which highlights the volatile nature of vanadium pricing at times.

- ◆ One of the outcomes of the demand/supply balance is that Chinese exports have almost dried up - this has the potential to be exacerbated as extra high cost Chinese supply came into the market in 2016 to 2018, and, with lower prices, will not be able to compete.
- ◆ As such, we may see the world outside of China looking for alternative sources of supply.

Figure 7: Vanadium sources



Source: Vanitec

Demand Drivers

Steelmaking

- ◆ The current key demand driver is as an additive in steel – demand for vanadium closely follows the production of steel. This includes two factors – firstly the natural organic growth in steel production and secondly increasing vanadium intensity in steel with the move to lighter weight and higher strength steels – the addition of just 0.2% vanadium to steel increases steel strength by up to 100% and reduces the weight of steel required in relevant applications by up to 30%.
- ◆ This second factor is particularly relevant in China, where there is increasing vanadium intensity in rebar due to changes in building standards (with new regulations becoming effective in November 2018), partly following on from the 2008 earthquake - there is still a some way to go with this, with it being estimated in 2019 that 30% of Grade 3 rebar (~61Mt) and 20% of grade 4 rebar (~8Mt) was illegal quench and tempered steel.
- ◆ It is estimated that elimination of the illegal products should result in the demand for an additional 12,000 to 20,000 tonnes per annum of demand for vanadium metal (on top of that required for growth in rebar production) - this however will depend somewhat on the comparative pricing between vanadium and niobium, with the ability to use niobium as a substitute in grade 3 rebar - this is not ideal however, as vanadium is easier to use.
- ◆ Total Chinese rebar production has more than doubled from around 100 Mt in 2012 to over 200 Mt in 2019; over the same period vanadium use in rebar has tripled from 20,000 tonnes to 60,000 tonnes per annum - this has accounted for the majority of growth in global demand over the same period, with RoW demand staying basically flat.

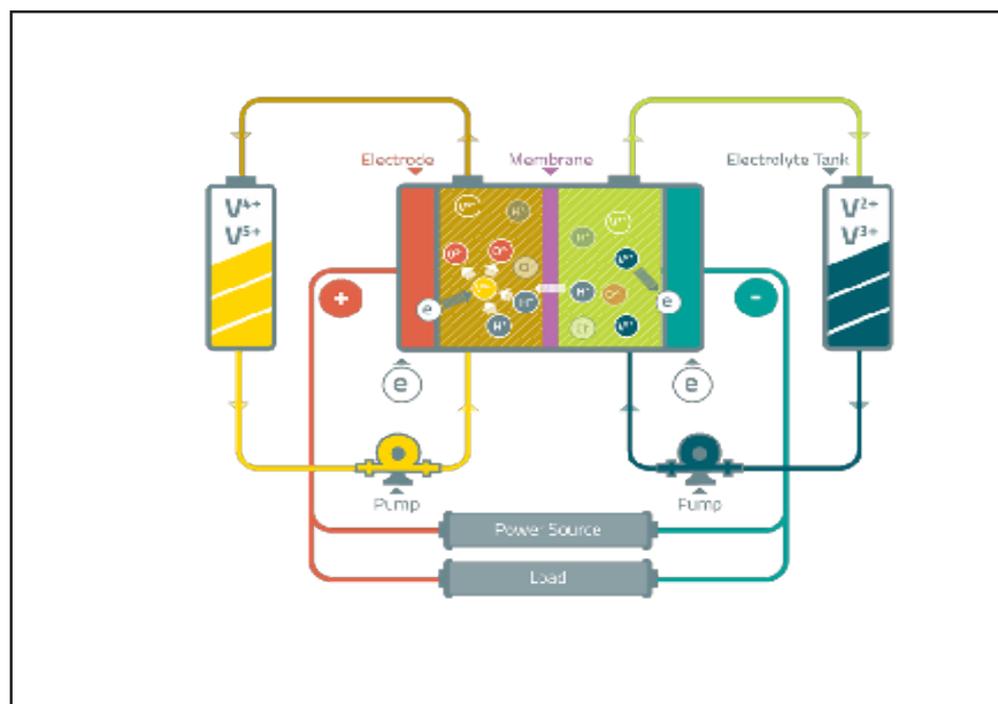
Energy Storage – VRFB's and Li-Ion Batteries

- ◆ The blue sky in demand, and the potentially disruptive technology is in grid scale battery usage - the key here will be the adoption of VRFB's that have the capacity for multi-megawatt scale storage - this makes them useful for grid scale applications, including grid

balancing and storing energy from variable output sources, including wind turbines and solar cells.

- ◆ The batteries are inherently simple, relying on the changing redox state of vanadium to store and then supply power (Figure 8).
- ◆ Other attributes of these batteries include:
 - Scalability
 - Long life span – up to 20 years
 - Up to a 1 year charge retention
 - 100% discharge without damage, and,
 - Only one element – V in various oxidation states – in electrolyte.

Figure 8: VRFB schematic



Source: Vanitec

- ◆ There are widely differing forecasts on the growth in VRFB's, however some commentators see the potential for VRFBs to provide up to 30% of the growing energy storage market, with some forecasting an additional demand of 300,000 t of vanadium over coming years to meet this need.
- ◆ There are a number of active VRFB developments globally at the moment, reportedly with the largest being the development of a 200 MW/800 MWh battery in Dalian, China, which reportedly uses 6,950 tonnes of V_2O_5 , at an intensity of 8.7 t/MWh; we have also seen documentation for other batteries with a usage intensity of 7.25 t of V (12.94 t of V_2O_5) per MWh of capacity.
- ◆ Other recent developments include the ordering 17 MW/51 MWh facility for a wind farm to be built by Sumitomo on the Japanese island of Hokkaido - this follows on from the 2015 installation of a US\$200 million, 15 MW/60 MWh facility by Sumitomo in the same region.
- ◆ Development of VRFBs has been partly hamstrung by the lack of a suitable battery grade V_2O_5 supply – batteries require a higher purity product than that used in steelmaking, and hence arises the opportunity for manufacturers of high purity material.
- ◆ Some forecasts see the Australian energy storage market reaching 3,000 MWh by 2030 – should the VRFB penetration reach an estimated 30% of the market this will result in the requirement of 900 MWh of VRFB capacity over the same period.
- ◆ Australia is an ideal market for fringe-of-grid and off-grid storage facilities given the extended power networks and large off-grid areas, thus potentially providing a domestic market for any V_2O_5 producers.
- ◆ Assuming a capital intensity of A\$1,000,000/MWh, this equates to a A\$900 million market, and using an average V_2O_5 intensity of ~10t/MWh (this intensity will vary depending upon the battery producer), this results in a potential domestic demand for an additional 9,000 t of V_2O_5 by 2030.

- ◆ There is also significant forecast demand (~1/3 of that for VRFB's) for vanadium in Li-ion batteries.

Pricing

- ◆ As mentioned earlier the price spiked US\$30/kg (US\$14 - US\$14.50/lb) in 2016 - 2018 due to a number of factors, including demand increasing due to the November 2018 Chinese regulations regarding the vanadium content of steel.
- ◆ The price then fell to around US\$9/lb by July 2019, however the price has subsequently stayed steady at this level, despite COVID-19, and is also forecast to remain at these levels.
- ◆ The 30 year average price has been US\$11/kg V₂O₅, with the inflation adjusted mean since 2004 being ~US\$16/kg.
- ◆ The market is not particularly transparent, and also prices also do not closely correlate with steel production even though this is the key demand driver.
- ◆ As mentioned earlier wide acceptance of VRFBs may go some way to breaking the price "spike-collapse" pattern over recent times, due to the requirement for a consistent supply of high purity V₂O₅ for the electrolyte.
- ◆ However, there is a Catch 22 here, with the consistently higher prices for V₂O₅ required to get new projects funded and up and running leading to batteries being comparatively expensive, and hence slowing demand.

IRON OXIDE

- ◆ Although initially looking at producing pig iron on site, the Company now plans to produce hematite fines for export into the seaborne iron ore market and as such has signed the offtake agreement with VIMSON.
- ◆ The current seaborne demand for iron ore is ~ 1,450 Mtpa, with this including fines, lump and pellets - fines make up 76% of the total, lump 16% and pellets 8%.
- ◆ Iron ore pricing is based on 62% Fe fines, generally cfr China - different products, including lump and pellets attract a premium, with these premiums affected by various market conditions.
- ◆ Prices reached a nadir of ~US\$40/tonne in early 2015, however have subsequently improved to over US\$100/tonne, although prices are again forecast to reduce to around US\$80/tonne over the next few years.
- ◆ In addition a premium or discount will be applied to reflect the grade - currently 65% Fe hematite attracts an 8% premium to the benchmark 62% Fe product, with premiums widening given the shortage of high grade material.

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