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# The Australian Vanadium Project

Corporate Update

March 2019 | ASX: AVL

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## COMPETENT PERSON REFERENCES

**Competent Person Statement – Mineral Resource Estimation** The information in this presentation that relates to Mineral Resources is based on and fairly represents information compiled by Mr Lauritz Barnes, (Consultant with Trepanier Pty Ltd) and Mr Brian Davis (Consultant with Geologica Pty Ltd). Mr Davis is a shareholder of Australian Vanadium Limited. Mr Barnes and Mr Davis are members of the Australasian Institute of Mining and Metallurgy and Mr Davis is a member of the Australian Institute of Geoscientists and both have sufficient experience of relevance to the styles of mineralisation and types of deposits under consideration, and to the activities undertaken to qualify as Competent Persons as defined in the 2012 Edition of the Joint Ore Reserves Committee (JORC) Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Specifically, Mr Barnes is the Competent Person for the estimation and Mr Davis is the Competent Person for the database, geological model and site visits. Mr Barnes and Mr Davis consent to the inclusion in this presentation of the matters based on their information in the form and context in which they appear.

**Competent Person Statement – Ore Reserves** The scientific and technical information in this presentation that relates to Ore Reserve estimates for the Project is based on information compiled by Mr Roselt Croeser, an independent consultant to AVL. Mr Croeser is a member of the Australasian Institute of Mining and Metallurgy. Mr Croeser has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a competent person as defined in the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Mr Croeser consents to the inclusion in the presentation of the matters related to the ore reserve estimate in the form and context in which it appears.

**Competent Person Statement – Metallurgical Results** The information in this presentation that relates to Metallurgical Results is based on information compiled by independent consulting metallurgist, Brian McNab (CP. B.Sc Extractive Metallurgy). Mr McNab is a member of the Australasian Institute of Mining and Metallurgy. Mr McNab is employed by Wood Mining and Metals. Mr McNab has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which is undertaken, to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Mr McNab consents to the inclusion in the presentation of the matters based on the information made available to him, in the form and context in which it appears.

The information is extracted from the announcement entitled "Gabanintha Pre-Feasibility Study and Maiden Ore Reserve" released to ASX on 19 December 2018 and is available on the Company website at [www.australianvanadium.com.au](http://www.australianvanadium.com.au).

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcement and, in the case of estimates of Mineral Resources or Ore Reserves, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. The Company confirms that the form and context in which the competent person's findings are presented has not been materially modified from the original market announcement.

## FORWARD LOOKING STATEMENTS










This presentation may contain certain "forward-looking statements" which may not have been based solely on historical facts, but rather may be based on the Company's current expectations about future events and results. Where the Company expresses or implies an expectation or belief as to future events or results, such expectation or belief is expressed in good faith and believed to have a reasonable basis. However, forward looking statements are subject to risks, uncertainties, assumptions and other factors which could cause actual results to differ materially from future results expressed, projected or implied by such forward-looking statements. Such risks include, but are not limited to Resource risk, metal price volatility, currency fluctuations, increased production costs and variances in ore grade or recovery rates from those assumed in mining plans, as well as political and operational risks in the countries and states in which we sell our product to, and government regulation and judicial outcomes. For more detailed discussion of such risks and other factors, see the Company's Annual Reports, as well as the Company's other filings. Readers should not place undue reliance on forward looking information. The Company does not undertake any obligation to release publicly any revisions to any "forward looking statement" to reflect events or circumstances after the date of this announcement, or to reflect the occurrence of unanticipated events, except as may be required under applicable securities laws.

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# The Australian Vanadium Project



-  **HIGH-GRADE RESOURCE**  
96.7MT at 1% V<sub>2</sub>O<sub>5</sub>
-  **MINERAL RESOURCE ESTIMATE**  
183.6Mt at 0.76% V<sub>2</sub>O<sub>5</sub>
-  **MINE LIFE**  
17+ Years
-  **OPEX**  
US\$4.15/lb V<sub>2</sub>O<sub>5</sub>
-  **VANADIUM PRODUCTION**  
22.5Mlbs per Annum
-  **60%**  
Average Yield
-  **CAPITAL COSTS**  
US\$354M
-  **PROVED RESERVE**  
9.82Mt at 1.07% V<sub>2</sub>O<sub>5</sub>
-  **PROBABLE RESERVE**  
8.42Mt at 1.01% V<sub>2</sub>O<sub>5</sub>



## The Australian Vanadium Project

At a vanadium price of  
US\$13/lb, the project has  
a post-tax NPV<sub>8%</sub> of:

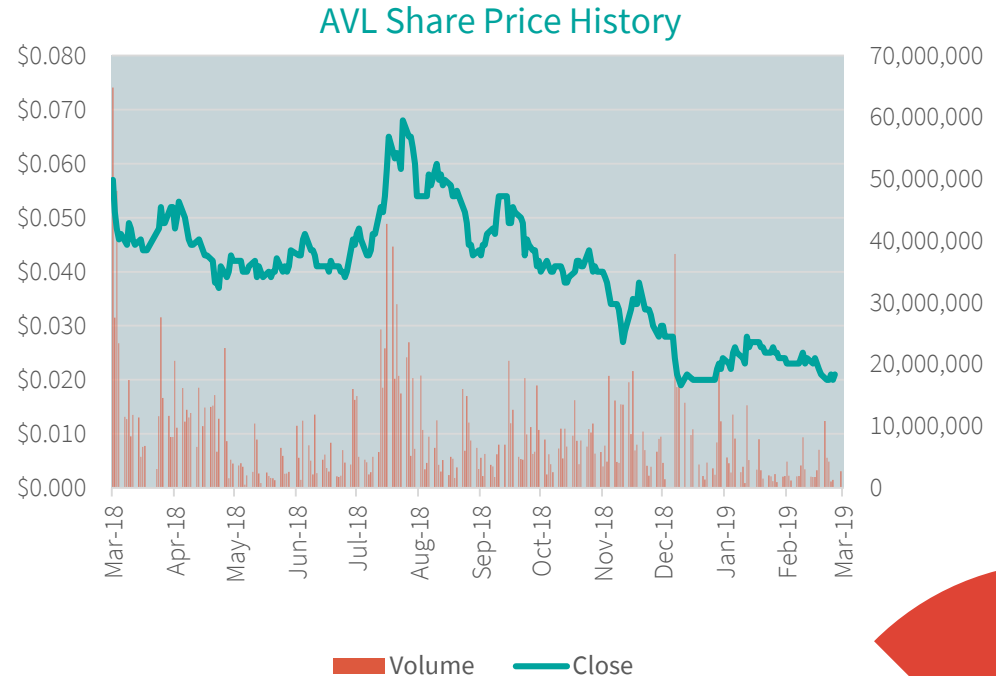
**US\$616 million**

# The Australian Vanadium Project | Investment Summary



Globally significant vanadium resource with a team of experts experienced in the extraction of vanadium using conventional processing of vanadium magnetite

- Significant project with high-grade Measured, Indicated and Inferred vanadium resources hosted in magnetite-bearing rocks
- Energy subsidiary VSUN Energy actively developing Australian energy storage market for vanadium redox flow batteries
- AVL offers investors exposure to entire vanadium value chain
- Focus offers leverage to rising vanadium prices and new applications in energy storage
- High quality asset and team, capable of delivering through all price cycles



ASX: AVL Mkt Cap \$40M

# Expert Vanadium Team

Vanadium expertise separates AVL from other explorers

At Australian Vanadium Limited, our management is committed to fast-track this significant global resource.

Our team brings together experts in geoscience, mining, chemical engineering, marketing and corporate governance and has an extensive vanadium network and processing knowledge.



Vincent Algar  
Managing Director



Daniel Harris  
Technical Director



Todd Richardson  
Technical Manager

# Expert Vanadium Team

Vanadium expertise separates AVL from other explorers

AVL is supported by a group of highly skilled external consultants, including:



# Resource Table

Material	JORC Resource Class	Million Tonnes	V <sub>2</sub> O <sub>5</sub> %	Fe%	TiO <sub>2</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	LOI%
High Grade	Measured	10.2	1.11	42.7	12.6	10.2	8.0	3.9
	Indicated	12.1	1.05	43.8	11.9	10.6	7.6	3.5
	Inferred	74.5	0.97	42.1	11.2	11.6	7.6	3.4
	<b>Subtotal – High Grade</b>	<b>96.7</b>	<b>1.00</b>	<b>42.4</b>	<b>11.4</b>	<b>11.3</b>	<b>7.7</b>	<b>3.5</b>
Low Grade	Indicated	28.6	0.5	24.6	6.9	27.5	17.9	8.6
	Inferred	53.9	0.49	25.3	6.7	27.5	16.4	7.3
	<b>Subtotal – Low Grade</b>	<b>82.5</b>	<b>0.49</b>	<b>25.1</b>	<b>6.8</b>	<b>27.5</b>	<b>16.9</b>	<b>7.7</b>
Transported	Inferred	4.4	0.65	28.2	7.2	24.7	16.7	8.5
	<b>Subtotal – Transported</b>	<b>4.4</b>	<b>0.65</b>	<b>28.2</b>	<b>7.2</b>	<b>24.7</b>	<b>16.7</b>	<b>8.5</b>
TOTAL	Measured	10.2	1.11	42.7	12.6	10.2	8.0	3.9
	Indicated	40.7	0.66	30.3	8.3	22.5	14.8	7.1
	Inferred	132.7	0.77	34.8	9.2	18.5	11.5	5.1
	<b>TOTAL</b>	<b>183.6</b>	<b>0.76</b>	<b>34.3</b>	<b>9.2</b>	<b>18.9</b>	<b>12.1</b>	<b>5.5</b>

Note: Mineral Resource estimate by domain and resource classification using a nominal 0.4% V<sub>2</sub>O<sub>5</sub> wireframed cut-off for low grade and nominal 0.7% V<sub>2</sub>O<sub>5</sub> wireframed cut-off for high grade (total numbers may not add up due to rounding).

## Ore Reserve

Reserve classification	t	V <sub>2</sub> O <sub>5</sub> %	Co ppm	Ni ppm	Cu ppm	S %	SiO <sub>2</sub> %	Fe <sub>2</sub> O <sub>3</sub> %	V <sub>2</sub> O <sub>5</sub> produced t
Proved	9,820,000	1.07	172	571	230	0.06	9.47	58.7	65,000
Probable	8,420,000	1.01	175	628	212	0.08	10.07	59.5	56,000
<b>Total</b>	<b>18,240,000</b>	<b>1.04</b>	<b>173</b>	<b>597</b>	<b>222</b>	<b>0.07</b>	<b>9.75</b>	<b>59.1</b>	<b>121,000</b>



# The Australian Vanadium Project

Location Diagram

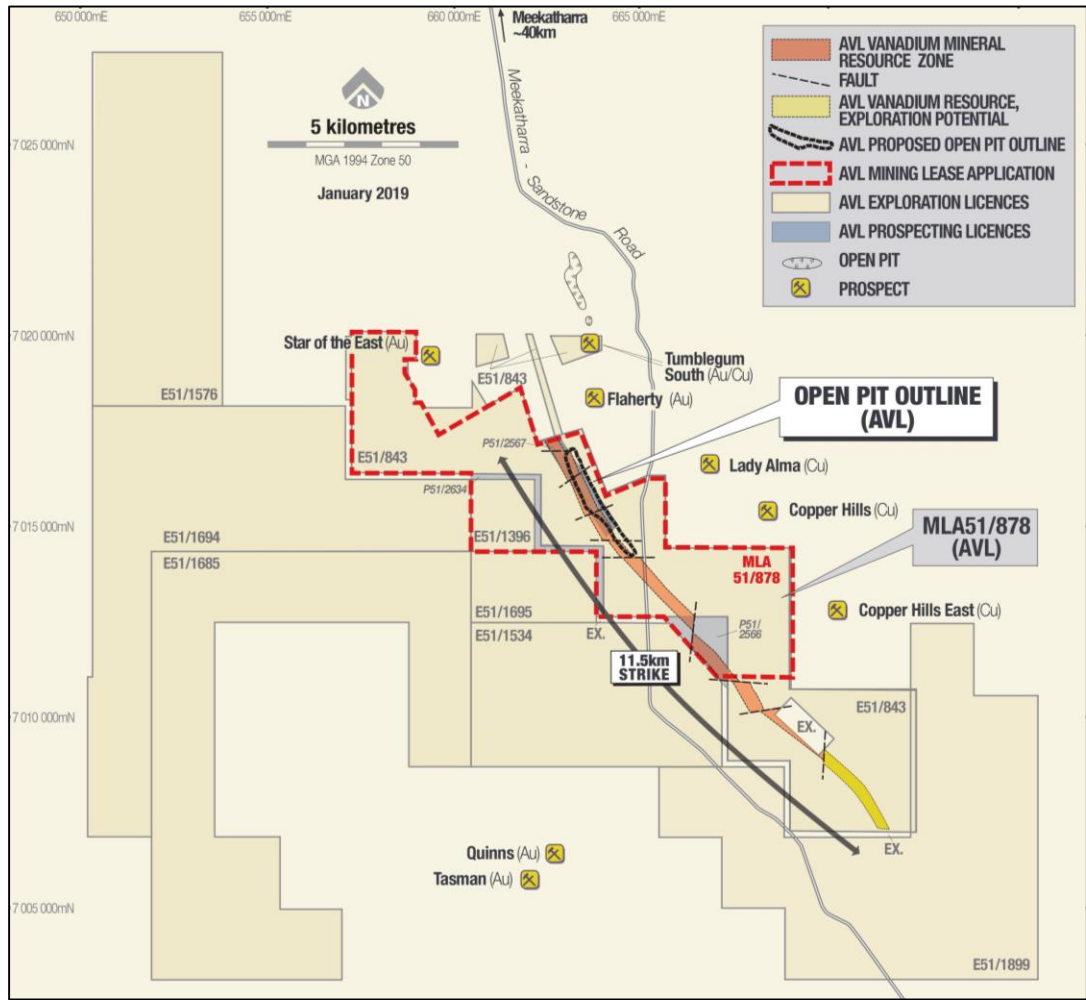
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# The Australian Vanadium Project

## Tenure and Location Plan

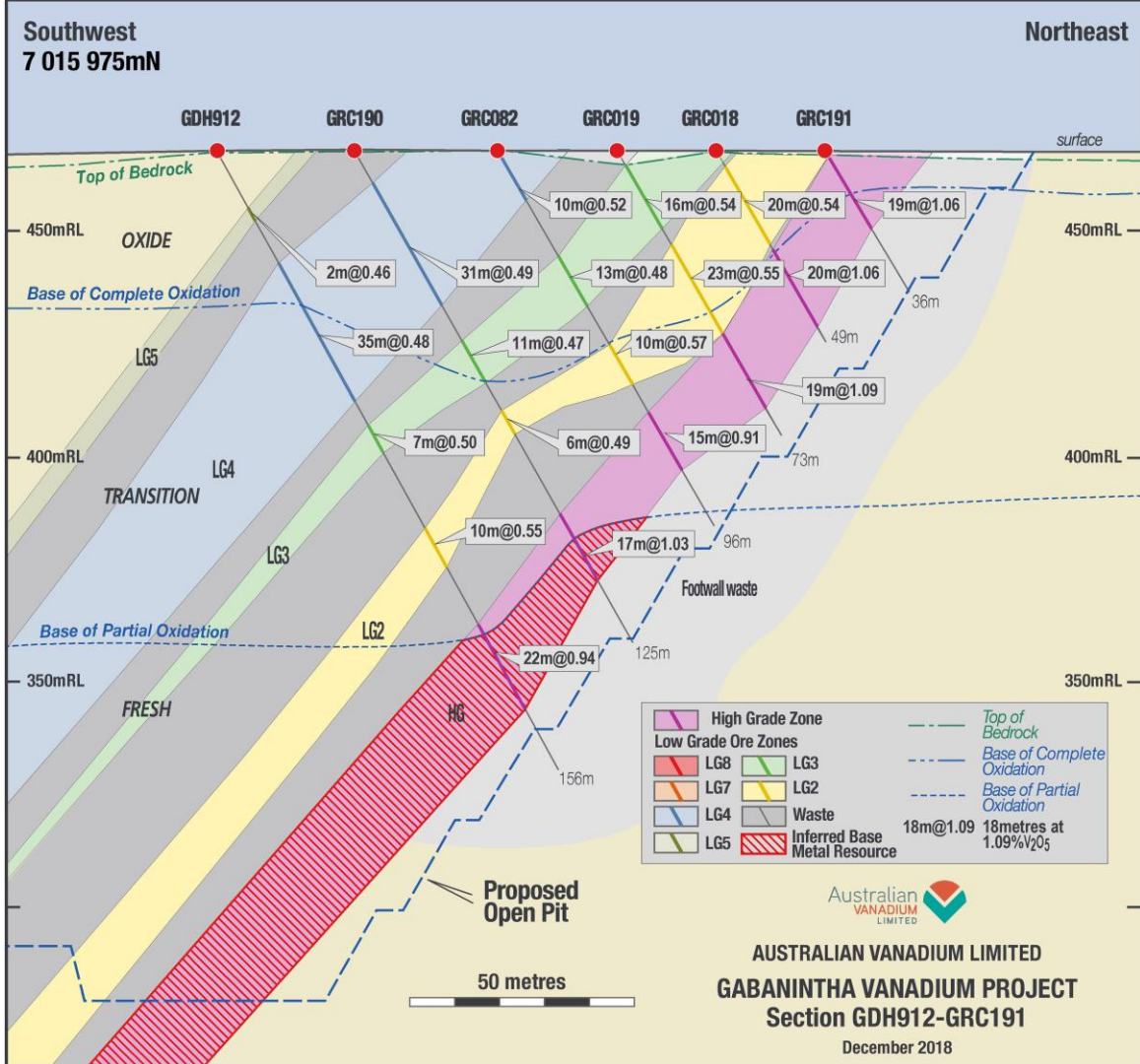


# The Australian Vanadium Project

## Geology

- Bushveld-type VTM deposit, drilled over 11km of AVL controlled strike
- AVL holds significant ground position for project development
- Consistent geology over 11km of AVL controlled strike
- Massive magnetite averaging 15–20m in true thickness

ASX: AVL



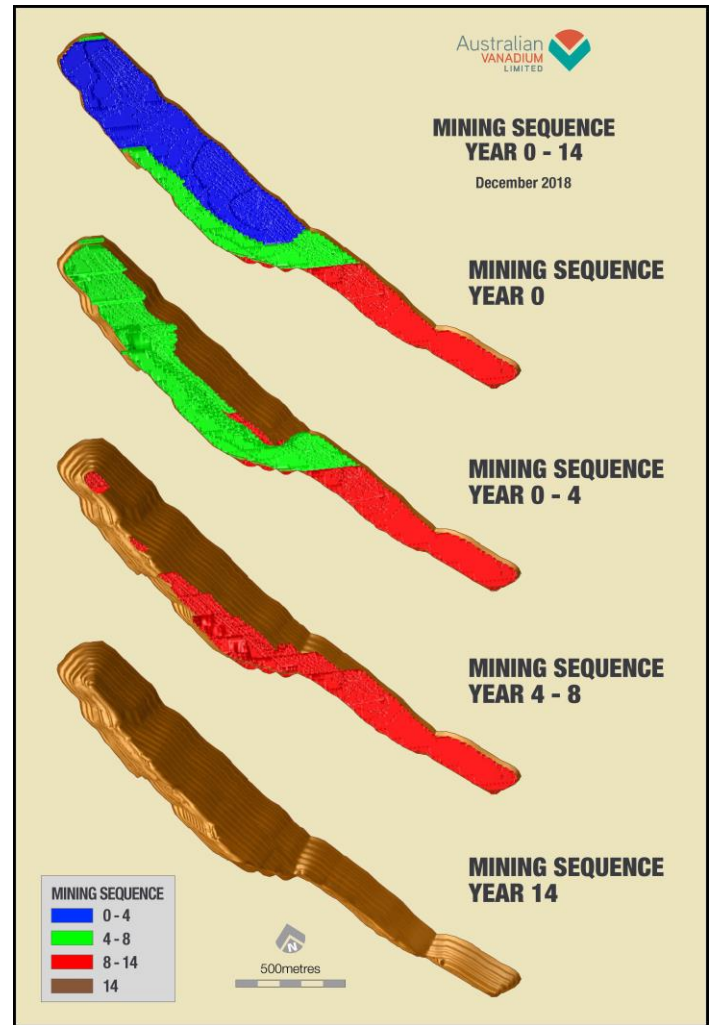




**THE AUSTRALIAN VANADIUM PROJECT  
GEOTECHNICAL HOLES  
TO TEST WESTERN PIT WALL**

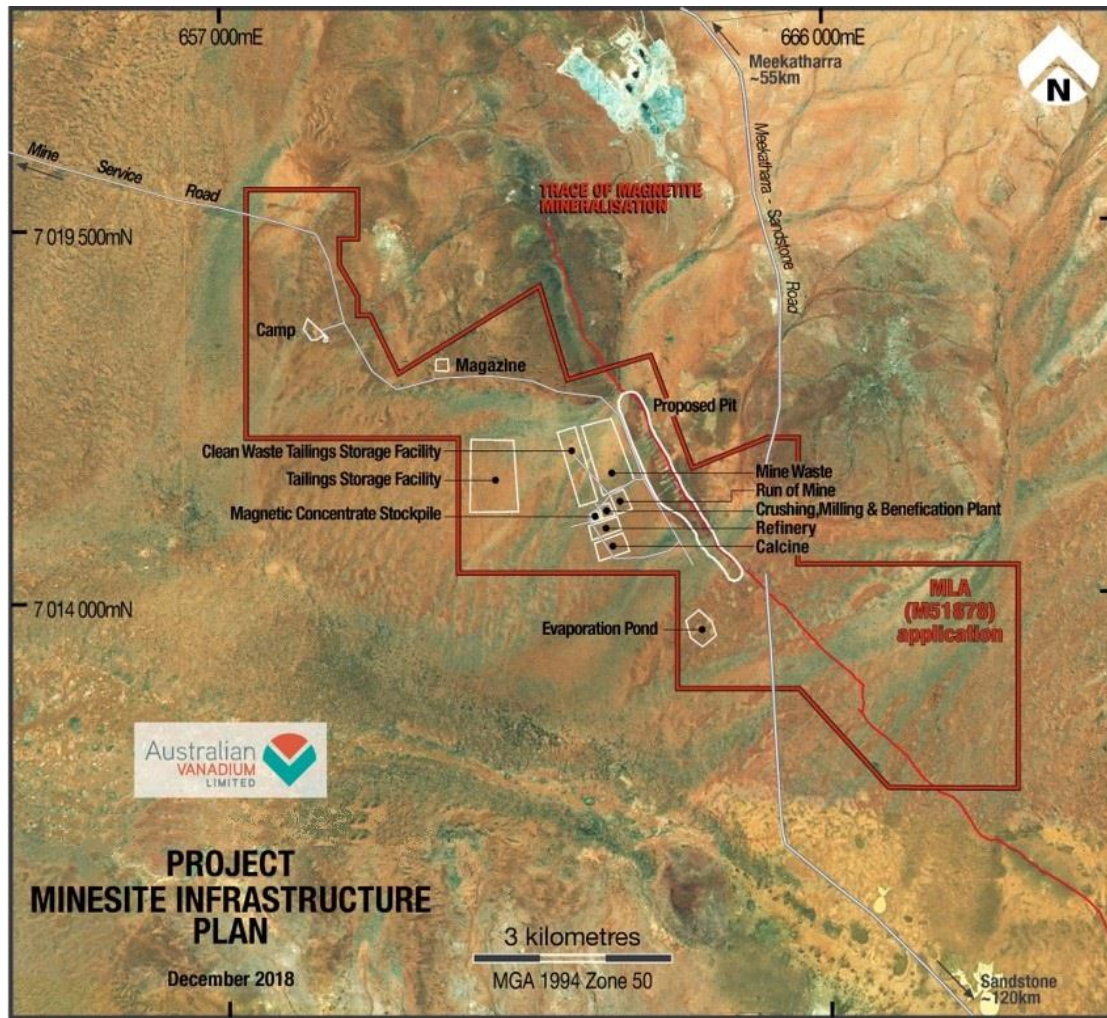
March 2019

ASX: AVL



# The Australian Vanadium Project

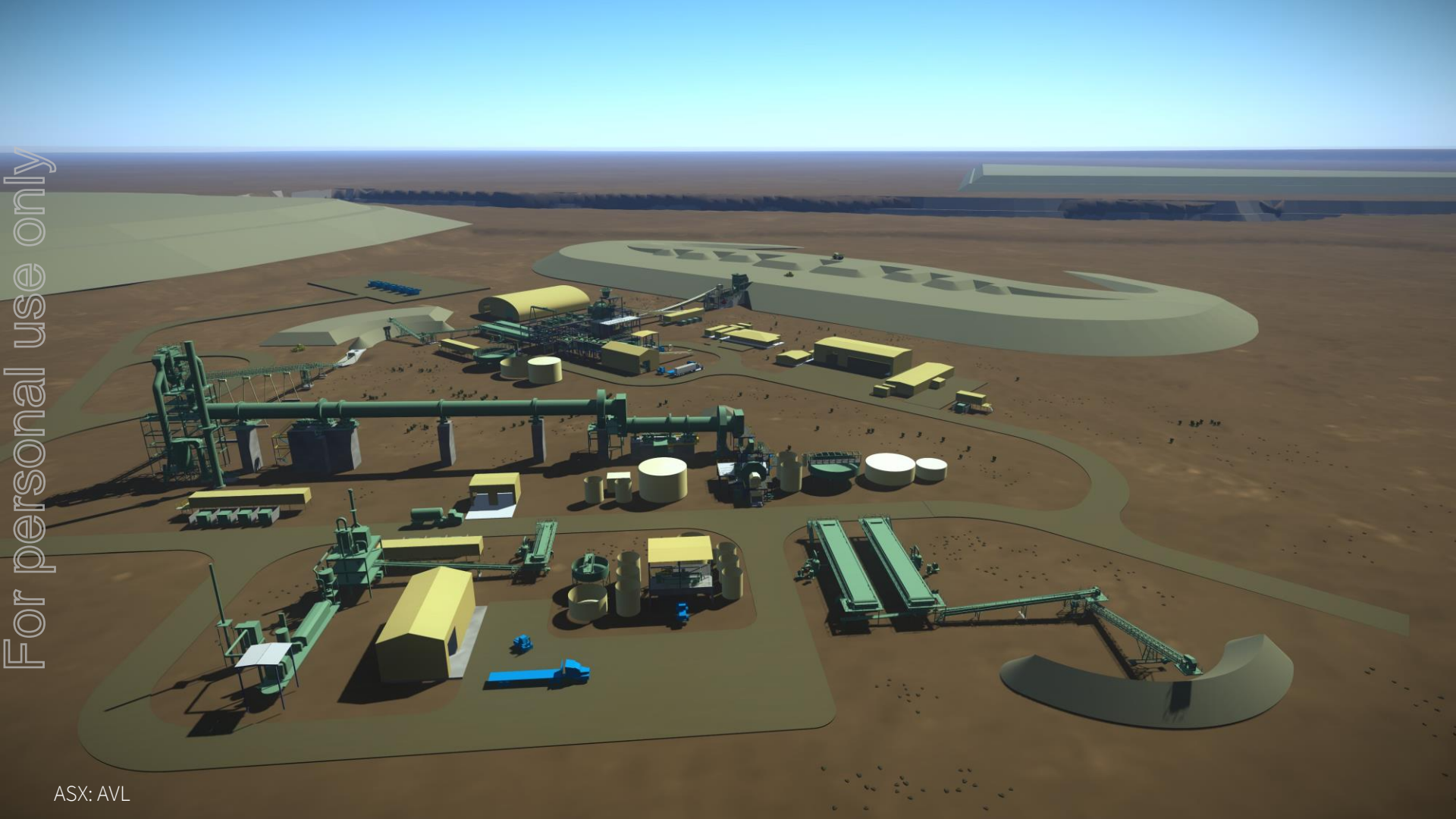
## Planned Infrastructure





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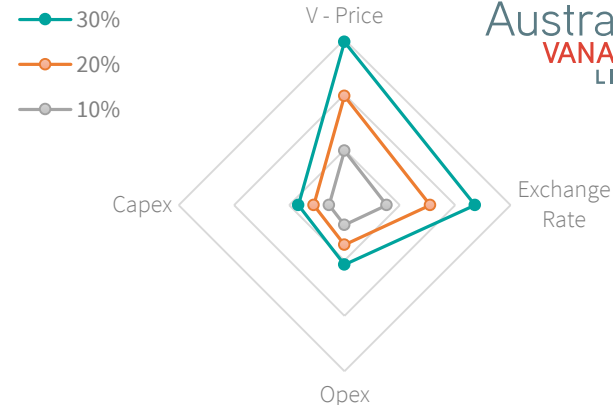
# Financial Model Results

- C3 costs \$6.05/lb
- Well defined orebody and well understood processing route
- US\$616M NPV project assuming V pricing scenario of \$13/lb over initial project life
- Significant potential to improve project economics identified and being actively investigated

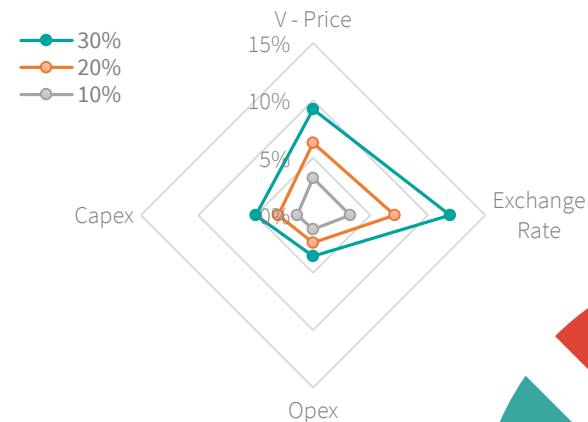
	V <sub>2</sub> O <sub>5</sub> Product Pricing Scenarios			
Pricing Year 1–5	\$8.67/lb V <sub>2</sub> O <sub>5</sub>	\$13/lb V <sub>2</sub> O <sub>5</sub>	\$13/lb V <sub>2</sub> O <sub>5</sub>	\$20/lb V <sub>2</sub> O <sub>5</sub>
Pricing Year 6–17	\$8.67/lb V <sub>2</sub> O <sub>5</sub>	\$8.67/lb V <sub>2</sub> O <sub>5</sub>	\$13/lb V <sub>2</sub> O <sub>5</sub>	\$20/lb V <sub>2</sub> O <sub>5</sub>
Pre-tax NPV <sub>8%</sub>	\$230M	\$444M	\$912M	\$2,013M
Post-tax NPV <sub>8%</sub>	\$125M	\$280M	\$616M	\$1,410M
IRR	12.4%	19.7%	27.2%	47.5%
Pre-tax UDCF	\$1,232M	\$1,634M	\$3,166M	\$6,292M
Post-tax UDCF	\$867M	\$1,148M	\$2,221M	\$4,409M



## NPV Sensitivity



## IRR Sensitivity



# Highlights

- Processing plant Capital US\$260M ( $\pm 25\%$ ), total cost \$US\$354M
- Production rate of 22.5Mlb  $V_2O_5$ , or 5,650MTV
- Ability to produce high purity  $V_2O_5$  powder for superalloys and energy storage
- 17-year initial mine life defined, potential for extension
- Resource strike covers 11km, current mine plan based on 2.5km
- Opex of \$4.23/lb  $V_2O_5$ , or \$4.15/lb  $V_2O_5$  equivalent
- Low cost base metal recovery circuit improves overall operating expenses by US\$0.07/lb  $V_2O_5$

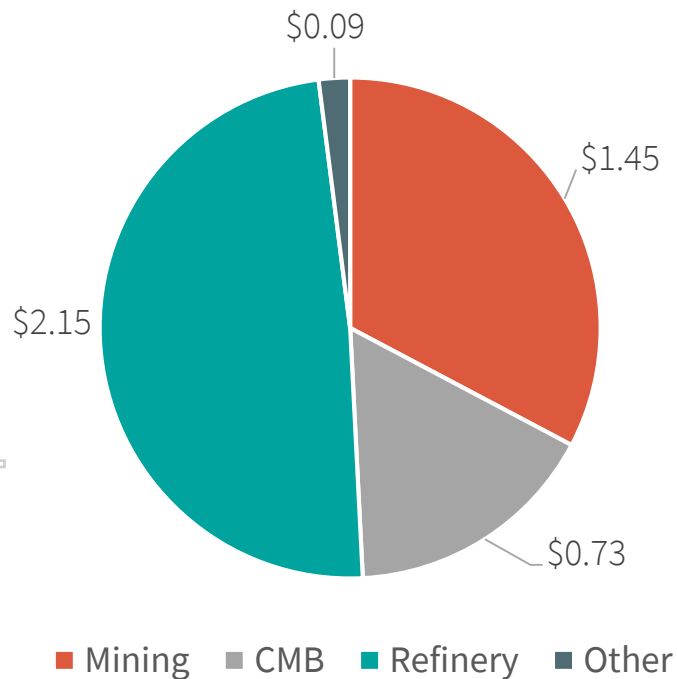


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# Total PFS Opex Breakdown

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US\$/lb V<sub>2</sub>O<sub>5</sub>

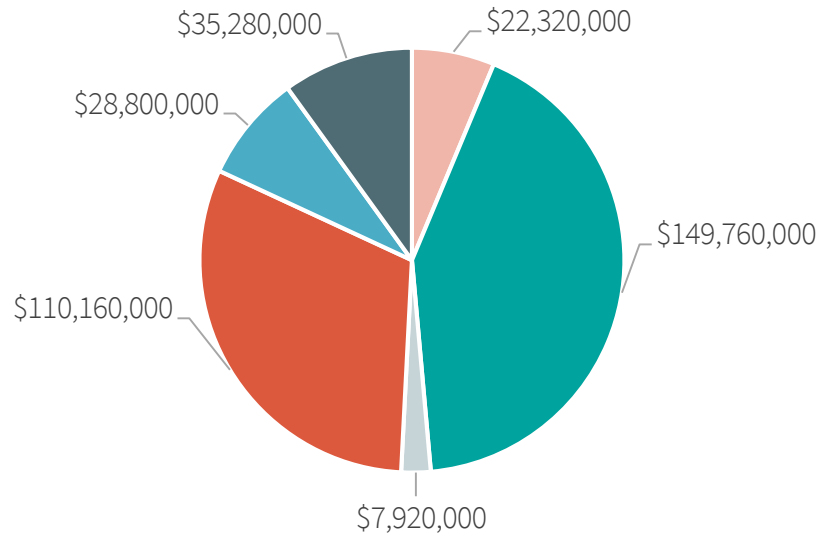


Total Opex	US\$/lb V <sub>2</sub> O <sub>5</sub>	\$/a
Mining *	\$1.37	\$31M
CMB*	\$0.71	\$16M
Refinery*	\$2.05	\$46M
Other*	\$0.10	\$2M
By-product credits*	-\$0.07	-\$2M
<b>Total</b>	<b>\$4.15</b>	<b>\$93M</b>

\* Identified opportunities to improve in DFS

# Total Capex Breakdown

US\$

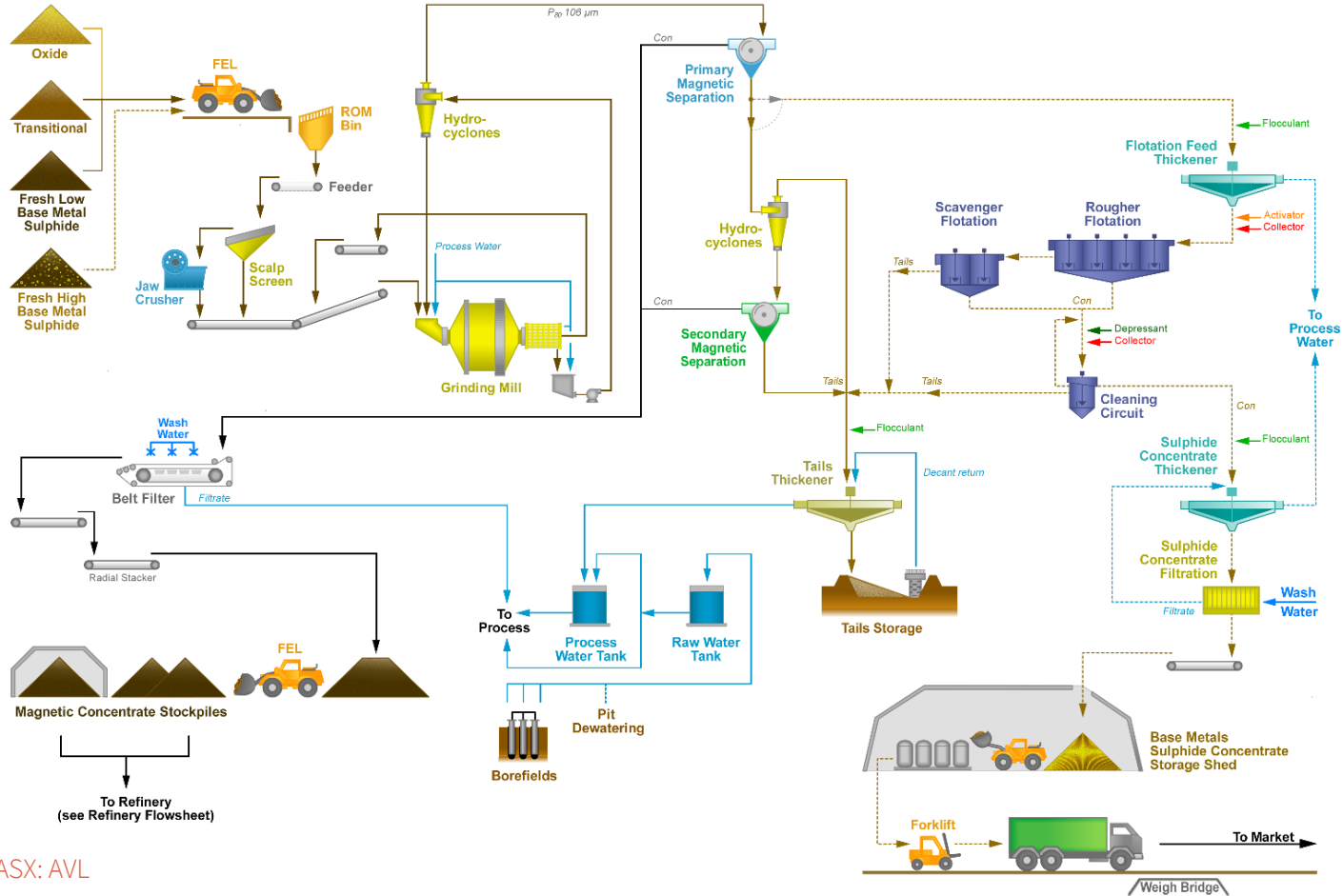


- Mining & Pre-Strip
- Processing Plant
- Sulphide Float
- Infrastructure
- Gas Pipeline
- Owner's Contingency

Total Capex	US\$	Comment
Processing Plant	\$149.76M	
Infrastructure	\$110.160M	
<b>Subtotal</b>	<b>\$259.92M</b>	
Mining & Pre-Strip*	\$22.32M	Improve in DFS
Gas Pipeline	\$28.8M	Own 50%
Sulphide Float	\$7.92M	Starts in Yr 3
Owner's Contingency	\$35.28M	
<b>Total</b>	<b>\$354.24M</b>	

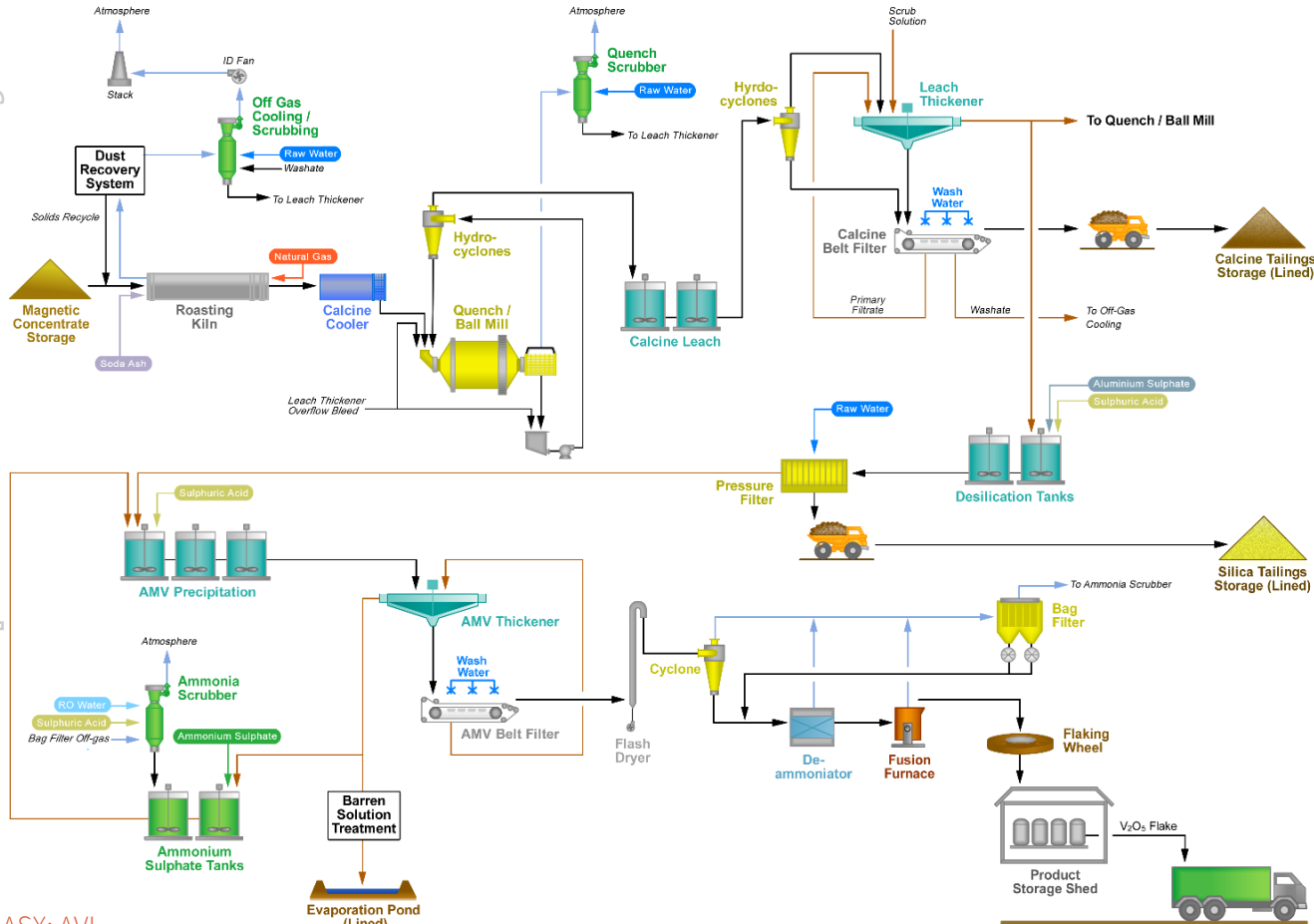


# Crushing, Milling and Beneficiation (CMB)



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# Refining – V<sub>2</sub>O<sub>5</sub> Production



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## Ongoing Testwork

- 2019 drill program collecting 30 tonnes nearing completion to support large scale pilot program
- Pre-pilot testwork underway to refine parameters
- Focus is on refining test conditions and optimisation opportunities
- Life-of-mine blends and recoveries being tested to confirm globally unique vanadium mass yields of over 60%
- Testwork at scale a key differentiator of successful projects

# Social Responsibility

Alongside the legal responsibilities for native title claims and environmental regulations, AVL is keen to ensure that its mining activities in the Meekatharra region bring additional benefits to the region

AVL sponsors the Stephen Michael Foundation which helps to engage children in school and improve their lives through sport

Subsidiary VSUN energy is sponsoring the inimitable *Meeka Howler* through ongoing advertising

AVL is continuously analysing its processes to see where emission reduction can occur, including the use of solar plus VRFBs and non-traditional fuel sources for haulage



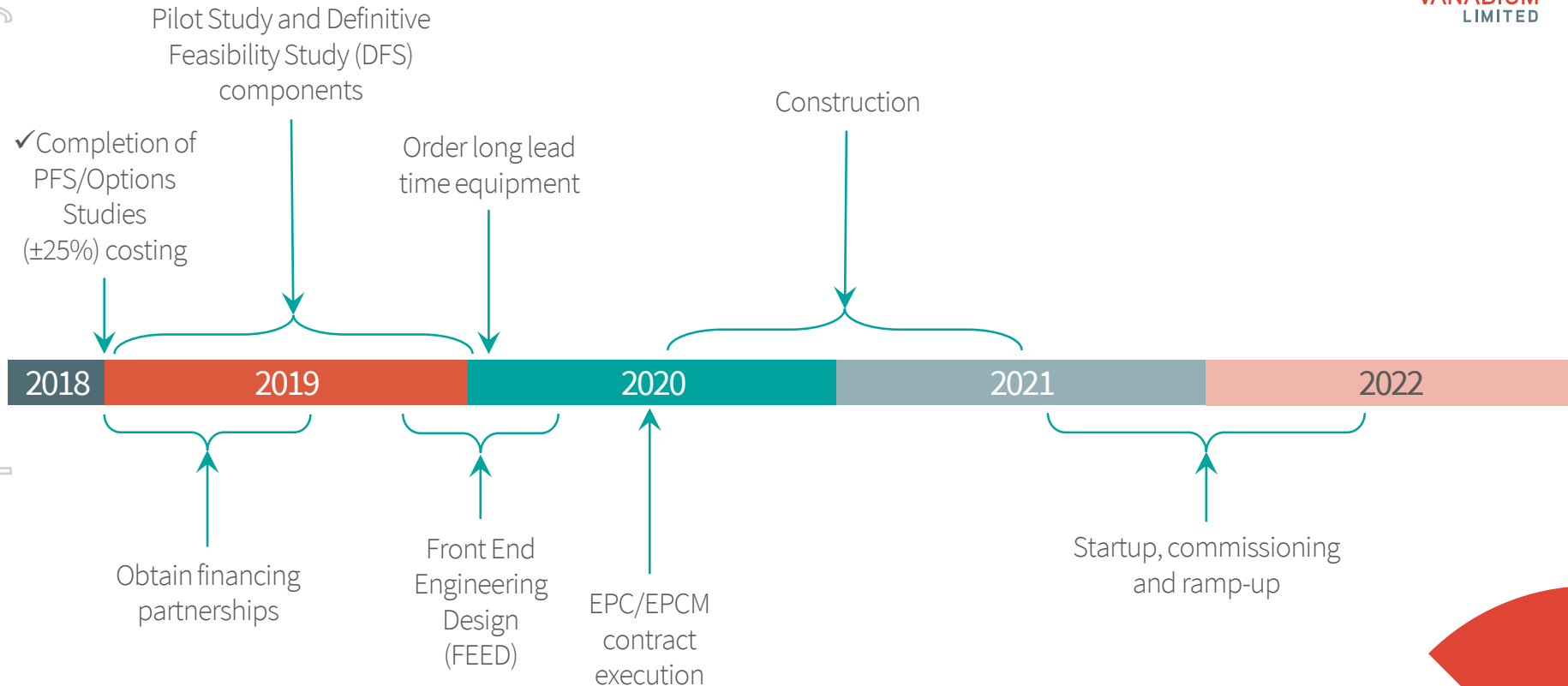
# The Australian Vanadium Project Path Forward

- ✓ Completion of PFS, options studies, Mineral Reserve – completed December 2018
- ✓ Pilot Study sample collection (30t) – commenced January 2019
- Pilot Study, Environmental Impact Studies, Heritage review – August 2019
- Financing – partnership agreement /MOUs in place – August 2019
- Definitive Feasibility Study completion – December 2019
- Detailed design engineering completion – April 2020
- Order long lead time equipment – April 2020
- EPC/EPCM contract execution – June 2020
- Construction, startup, commissioning and ramp-up – 2020/2021



# The Australian Vanadium Project Path Forward

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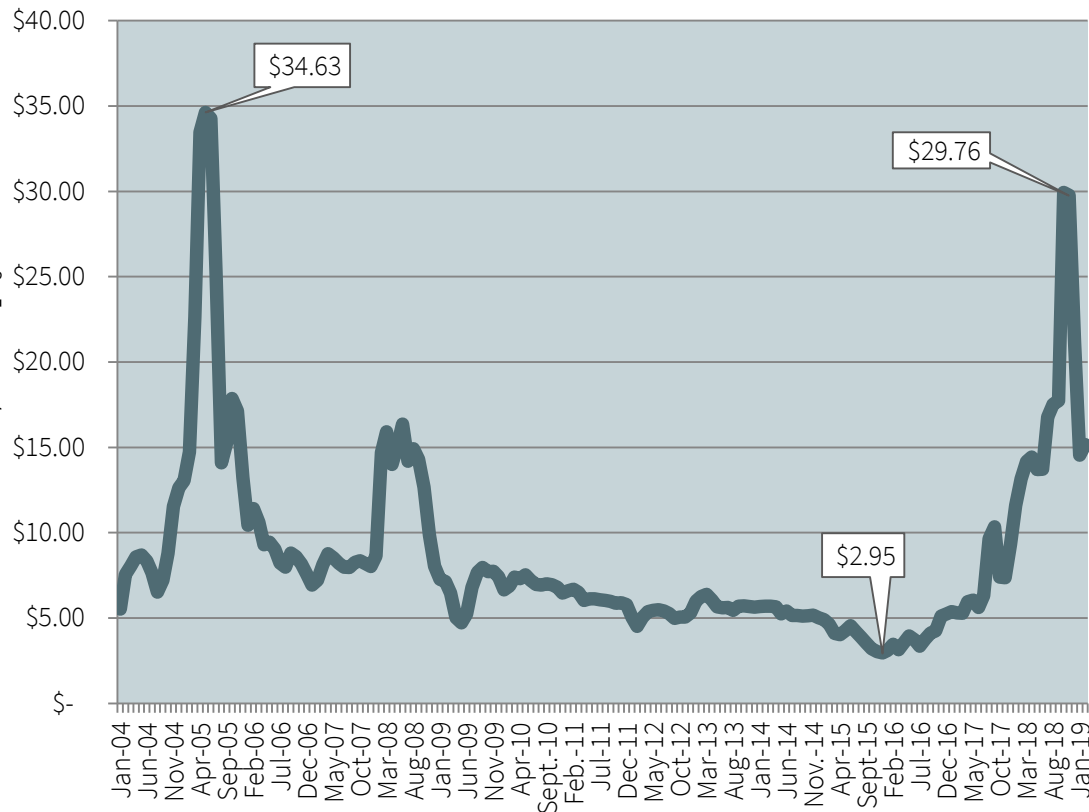
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# Vanadium Markets

Steel

## Metal Bulletin V<sub>2</sub>O<sub>5</sub> Monthly Midpoint Average Price Inflated to January 2019 US\$

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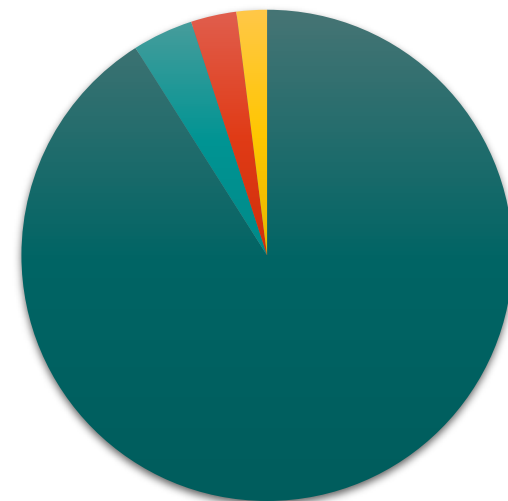
- 15-year average price US\$8.67 in 2018 dollars
- Historically, vanadium pricing has experienced long periods of low price followed by periods of price rises
- Competitive vanadium producers in lowest quartile are best positioned to survive downturns and therefore benefit from high price periods
- Fundamental changes in vanadium market have tightened supply. New vanadium production must be competitive with the lowest cost primary producers

Source: Metals Bulletin publication

# Vanadium Markets – Steel

Steel remains the price driver and primary market for vanadium (92% of vanadium consumption)

- Key metric is Chinese rebar consumption
- New standards for Chinese rebar require increased vanadium use, doubling to rest-of-world standards (implemented today)
- Risk of substitution minimal due to unique micro-alloy effects
- New markets in steel will increase demand, such as:
  - Materials for automotive, aviation and aerospace
  - Powerlines and power pylons
  - High-strength steel structures





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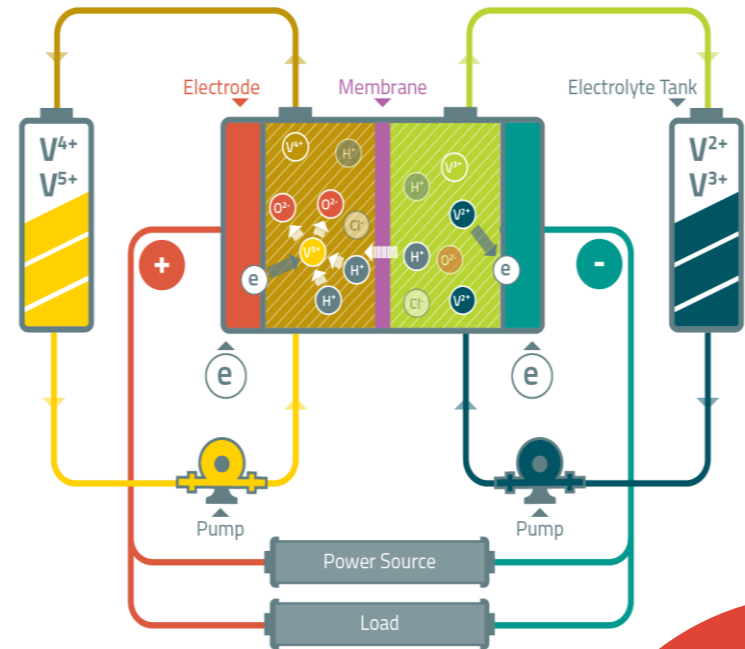
# Vanadium Markets

Energy Storage

# Vanadium Markets – Energy Storage

## Unique characteristics of Vanadium Redox Flow Batteries (VRFBs)

- VRFBs provide a way to store and re-supply renewable energy. Their very high capacity is ideal for large-scale energy storage applications, unlocking the full potential of renewables while maintaining grid security
- VRFBs have unique advantages over other batteries:
  - Easily scaled into large MW scale solutions
  - Lifespan of 20 years with very high cycle life and no capacity loss over time
  - A key feature of using only one element in electrolyte,  $V_2O_5$  which can be recycled
  - Immediate and rapid energy release
  - Non-flammable
  - Suitable for grid connection or off-grid use
  - Can discharge 100% with no damage
  - Improved safety and low replacement rate compared to Li-ion (lower lifetime LCOE)



# VSUN Energy

## Vertical integration strategy

- AVL's 100% owned subsidiary VSUN Energy is focused on growing the market for VRFBs
- Involvement in Future Battery Industries Cooperative Research Centre application
- First VRFB installed in Western Australia at a native tree nursery with 2.5 years continuous operation with no issues and no degradation in performance
- Potential for electrolyte production in Australia, with either assembly or manufacture of VRFBs
- Markets include utility, industrial, commercial, education, agricultural, mining, remote, tourism, manufacturing and residential



# VRFB Manufacturers

The number of manufacturers continues to grow, with a wide range of sizing available





# Status of VRFB market

Vanadium price rises have led to innovations from manufacturers, with new entrants also entering the market

- Stack technology advancements, utilising welded stack technology
- Leasing of electrolyte, reducing capex and transferring some of the cost to opex
- Changing power to energy ratio to compete directly with lithium
- Incorporating VRFBs into solar farms to provide dispatchable energy
- Government incentive programs in countries such as China and Korea



# Status of Australian VRFB market

Australian installations increasing, with universities leading the way

Year	Size	Location	Customer	Status
2015	30kW-130kWh	Sydney, NSW	University of NSW	Operational
2016	10kW-100kWh	Busselton, WA	Native tree nursery	Operational
2018	180kW-900kWh	Melbourne, VIC	Monash University	Operational
2019	120kW-600kWh	Heron Island, QLD	University of Queensland	Construction
2019	135kW-450kWh	Adelaide, SA	University of Adelaide	Tender

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# Vanadium Market Future

## Vanadium supply currently in deficit

- Current global producers can increase their supply to provide up to half of the current supply deficit
- Increased demand from VRFBs and tightened environmental controls in China mean a change from the previous cycle – new supply is required
- Deposits with high in-situ grade combined with high concentrate grade will have the best chance of success
- Utilising proven methodology on magnetite-hosted vanadium deposits

# Summary

AVL has a globally significant vanadium resource with a team of experts experienced in the extraction of vanadium using conventional processing of vanadium magnetite



- Significant project with high-grade Measured, Indicated and Inferred vanadium resources hosted in magnetite-bearing rocks
- Energy subsidiary VSUN Energy actively developing Australian energy storage market
- AVL offers investors exposure to entire vanadium value chain
- Focus offers leverage to rising vanadium prices and new applications in energy storage
- High quality asset and team, best able to deliver through all price cycles
- Potential to become the world's lowest cost vanadium producer



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