

# QUARTERLY ACTIVITIES REPORT

Period ending 31<sup>st</sup> December 2020

## HIGHLIGHTS



- Technical and Financial PFS Update reflects robust economics, incorporated a revised layout and location, an updated process design and a new extended Ore Reserve.
- Launch of green hydrogen strategy and MOU with ATCO for supply of green hydrogen.
- Confirmation of high purity vanadium pentoxide production from pilot scale testwork.
- Strategic vanadium offtake MOU signed with U.S. Vanadium LLC.
- Option to acquire Geraldton region processing plant land extended.
- MOU for collaboration with UK company GSA Environmental on vanadium products.
- Geotech drilling to gather data for the BFS completed.
- Company set to complete externally reviewed Bankable Feasibility Study by mid-2021, focusing on dedicated vanadium pentoxide production for steel and battery industries.

## VSUN Energy

- MOU for vanadium electrolyte supply and battery sales agency for Australia signed with V-Flow Tech, commercial vanadium redox flow battery (VRFB) manufacturer based in Singapore.
- Residential VRFB product development underway.

## Corporate

- Board renewal with Cliff Lawrenson appointed as Chair, former Chair Brenton Lewis stepped down at the AGM in November.
- \$973,000 R&D refund received.
- Cash at bank on 31<sup>st</sup> December 2020 was \$7.15 million.

## Management Comment

During the December quarter, the Company released a key technical and financial update to the original PFS which was released in December 2018. The December 2020 update incorporates work that has been undertaken to improve the Project's economics and minimise risk. Underpinned by an increased Ore Reserve of 32 Mt at 1.05%  $V_2O_5$ , the Project's life has been extended to 25 years and processing layout and improvements have resulted in an operating cost estimate of \$3.66/lb  $V_2O_5$ , comparable to other global primary vanadium producers. Pilot scale testwork performed on samples designed to be indicative of average early years and life of mine process feed, has verified AVL's process flowsheets and their capability to deliver high quality vanadium products and an improvement in vanadium recovery at an industry competitive low operating cost.

These key developments, coupled with AVL's strategy to de-risk the Project by locating the processing plant closer to a port, human resources and existing gas infrastructure in WA's Mid-West, drove the decision to update the Project economics of the PFS.

During the quarter, the Company has made significant progress with offtake agreements, signing three MOUs, one with a US based speciality chemical supplier and two with VRFB manufacturers.

Developing the Company's environment, social and governance (ESG) practises and plans is a key driver as AVL moves towards production. An MOU has been signed with ATCO for offtake of green hydrogen and the Company has released a strategy which incorporates green hydrogen and renewable energy.

The AVL team was joined by experienced company executive Cliff Lawrenson in early October who became the Chair of the Board at the AGM. Cliff's extensive fund raising, corporate and deal experience are excellent additions to the skillset of the Company's Board of Directors, as AVL enters the next critical phase of BFS delivery, funding and Project development.



**Figure 1 Project Location Map**

Activities for the quarter ended 31<sup>st</sup> December 2020 for Australian Vanadium Limited (“AVL” or “the Company”) are as follows:

## THE AUSTRALIAN VANADIUM PROJECT

### PFS Update

See ASX announcement dated 22<sup>nd</sup> December 2020 ‘Technical and Financial PFS Update’

On 22<sup>nd</sup> December 2020, the Company announced an update to the 2018 PFS, incorporating technical and financial information from the work undertaken during the past two years.

Highlights from the updated PFS were:

- Project pre-tax **NPV<sub>8</sub> of A\$909M** increased from A\$320M (↑ 184%).
- Project **IRR rises to 17.5%** (↑ 41%).
- Project payback of 6.6 years (↓ 17.5%).
- C1 operating cost of **US\$3.66/lb V<sub>2</sub>O<sub>5</sub>** competitive with world primary vanadium producers, includes iron titanium (FeTi) coproduct credit (↓ US\$0.49/ lb V<sub>2</sub>O<sub>5</sub>).
- Project annual EBITDA average for 25 years of A\$144M (↑ 31%).
- Plant and associated infrastructure capital cost of **US\$253M**.
- Total Project capital cost of US\$399M (↑ 13%) includes area and regional infrastructure, indirects, EPCM, growth and owner’s costs.
- **Ore Reserve increased to 32.1Mt at 1.05% V<sub>2</sub>O<sub>5</sub>** (↑ 76%) comprised of a **Proved Reserve of 9.8Mt at 1.08% V<sub>2</sub>O<sub>5</sub>** and a **Probable Reserve of 22.4Mt at 1.04% V<sub>2</sub>O<sub>5</sub>** (rounding is applied). See Table 4 and 5 For Resource/Reserve details.
- Increased anticipated **mine life from 17 to 25 years**, supporting a long-life, consistent ore feed operation on AVL’s granted mining lease.
- **Increased nominal vanadium production** to 24.3 Mlbs V<sub>2</sub>O<sub>5</sub> annually (↑ 8%).
- Forecast vanadium **ore recovery to concentrate of 74.8%** life of mine, supported by pilot testing.
- New innovative flowsheet for processing plant recovers **88% V<sub>2</sub>O<sub>5</sub>** utilising tried-and-tested grate kiln technology.
- Separation of processing plant from minesite provides access to cheaper competitive natural gas near Geraldton, local workforce and FeTi coproduct sales opportunities for **900,000 dry tonnes per annum** over the mine life.
- Positive economic results give grounds for completion of Bankable Feasibility Study (BFS) mid-2021, finalising offtake, obtaining final approvals and securing project finance.

The PFS was updated to enable the Company to discuss the improved metrics with greater confidence to a wider investment audience. The Company considers the outcome positive, supported by a highly attractive future for the vanadium market and it plans to complete a BFS which will be released in mid-2021.

## Comparative Summary of Updated PFS (December 2020) vs Original PFS (December 2018)

Category	Updated PFS (Dec 2020)	Original PFS (Dec 2018)	Change
Mine Life	25 years	17 years	↑ 8 years
Mineral Resource	208.2Mt	183.6Mt	↑ 24.6Mt
Ore Reserve	32.1Mt @ 1.05% V <sub>2</sub> O <sub>5</sub>	18.24Mt @1.04% V <sub>2</sub> O <sub>5</sub>	↑ 13.86Mt
Magnetic concentrate produced pa	900,000 t	900,000 t	None
V <sub>2</sub> O <sub>5</sub> production pa	24.3M lbs	22.5M lbs	↑ 1.8M lbs
FeTi coproduct sales pa	900,000 t	-	↑ 900,000 t
Pre-tax NPV <sub>8</sub> @ US\$8.67/lb V <sub>2</sub> O <sub>5</sub>	A\$909M	A\$320M	↑ 184%
Post-tax NPV <sub>8</sub> @ US\$8.67/lb V <sub>2</sub> O <sub>5</sub>	A\$542M	A\$174M	↑ 211%
IRR	17.5%	12.4%	↑ 41.1%
EBITDA annual average	A\$144M	A\$110M	↑ A\$34M
EBITDA (project)	A\$3.55 Billion	A\$1.8 Billion	↑ A\$1.75 Billion
Net Profit After Taxes (project)	A\$2.09 Billion	A\$0.85 Billion	↑ A\$1.24 Billion
Payback	6.6 years	8 years	↓ 17.5%
Total Capex	US\$399M <sup>1</sup>	US\$354M	↑ 13%
Average annual C1 <sup>2</sup> cost	US\$3.66/lb V <sub>2</sub> O <sub>5</sub>	US\$4.15/lb V <sub>2</sub> O <sub>5</sub>	↓ US\$0.49/lb V <sub>2</sub> O <sub>5</sub>
Average annual C3 <sup>3</sup> cost	US\$5.04/lb V <sub>2</sub> O <sub>5</sub>	US\$6.05/lb V <sub>2</sub> O <sub>5</sub>	↓ US\$1.01/lb V <sub>2</sub> O <sub>5</sub>

### Key outcomes include:

- Improved Project metrics including an overall Project pre-tax NPV<sub>8</sub> of A\$909M, and a post-tax NPV<sub>8</sub> of A\$542M.
- A substantial increase in IRR to 17.5% from 12.4%, driven by lower overall costs, higher recoveries through the processing plant, and a longer mine life.
- Operating expenses (C1 costs) have significantly improved to US\$3.66/lb V<sub>2</sub>O<sub>5</sub> equivalent<sup>4</sup> (±25%), placing AVL firmly in the bottom quartile of current vanadium producers. This

<sup>1</sup> Total capital cost is at an accuracy of ±25%. Figure includes provision for estimated indirect costs, EPCM costs, owner cost and capital growth of A\$101M. (For more details see Table 2).

<sup>2</sup> C1 costs are direct costs, including costs incurred in mining and processing (labour, power, reagents, and materials) plus local G&A, freight and realisation and selling costs. Any by-product revenue is credited against costs at this stage.

<sup>3</sup> C3 costs are the fully allocated costs for the project. It is the sum of the (C1) costs, depreciation, depletion, and amortisation, indirect costs and net interest charges.

<sup>4</sup> V<sub>2</sub>O<sub>5</sub> equivalent pricing is determined by subtracting average by-product credits from average operating expenses through the life of mine.

significantly reduces project risk, achieving AVL's goal for low-cost operation that will be healthy throughout the vanadium market price cycles.

- Fully realised cost of production (C3 costs) of US\$5.04 on a zero-debt basis.
- Forecast average vanadium recovery to concentrate of 74.8% for life of mine, as confirmed in the CMB pilot testwork. This is exceptionally high versus other current operating vanadium operations, allowing for a compact and effective crushing and milling operation.
- Operationally robust flowsheets have been developed and tested, providing assurance that the CMB and vanadium processing plant can perform treating a managed blend of feed.

## Financial Modelling

Table 1 below reflects the economic metrics of the Project at various market pricing scenarios for the sale of V<sub>2</sub>O<sub>5</sub>. The price of US\$7.96/ lb V<sub>2</sub>O<sub>5</sub> is the 15 year weighted average based on published FastMarkets vanadium pricing. Prior to COVID-19, this 15 year price was US\$8.67/lb V<sub>2</sub>O<sub>5</sub>.

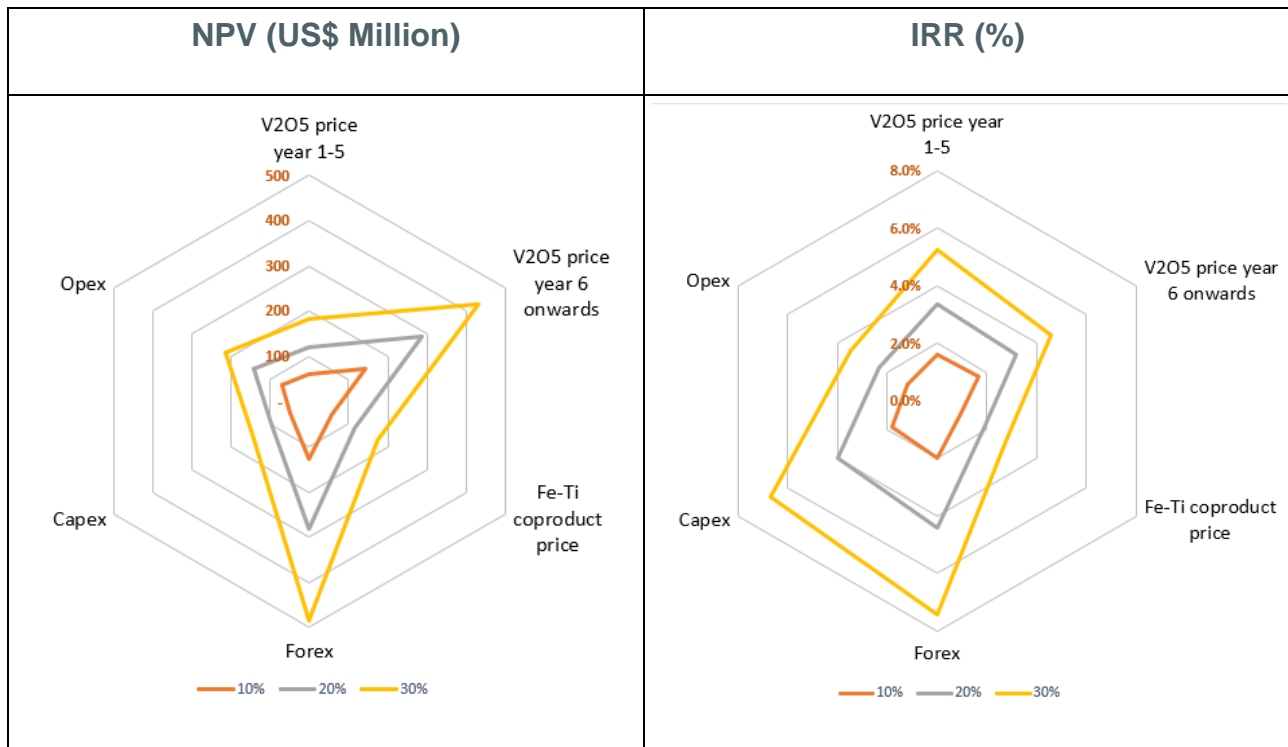
**Table 1 Project Vanadium Pricing Sensitivity (A\$)**

	V <sub>2</sub> O <sub>5</sub> Pricing Scenarios				
	(US\$)	\$7.96/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>	\$13/lb V <sub>2</sub> O <sub>5</sub>
Year 1-5	(US\$)	\$7.96/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>	\$13/lb V <sub>2</sub> O <sub>5</sub>
Year 6-25	(US\$)	\$7.96/lb V <sub>2</sub> O <sub>5</sub>	\$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>
pre-tax NPV <sub>8%</sub>	(A\$)	\$669M	\$909M	\$1,342M	\$2,370M
post-tax NPV <sub>8%</sub>	(A\$)	\$375M	\$542M	\$844M	\$1,562M
IRR	%	14.8%	17.5%	27.0%	33.1%
Payback period	years	7.6	6.6	4.1	4.1

Results show that at a sub US\$8/lb pricing, the Project fundamentals assure acceptable rates of return on investment, with a potential for exceptional performance in scenarios where the price achieves US\$13/lb.

## Project Sensitivities

The spider diagrams in Figure 2 demonstrate the Project sensitivities to the US\$8.67/lb V<sub>2</sub>O<sub>5</sub> base case for six key variables: Opex, V<sub>2</sub>O<sub>5</sub> price (short-term and long-term), FeTi coproduct pricing, A\$:US\$ exchange rate, and Capex. NPV is sensitive to V<sub>2</sub>O<sub>5</sub> price and exchange rate, while being relatively insensitive to Capex, Opex and FeTi coproduct pricing. Project IRR is relatively insensitive to fluctuations of all variables.



**Figure 2 NPV (US\$) and IRR (%) Sensitivities Relative to the Basecase**

### Operating Costs

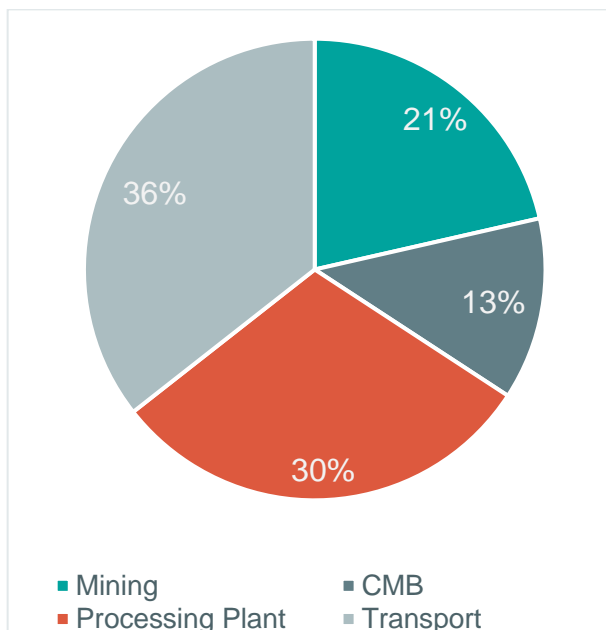
Life of mine C1 costs average US\$3.66/lb  $V_2O_5$ . Included in the C1 cost is a FeTi coproduct credit, which is based on market quotations for transport, port fees, and other shipping charges, along with market research on FeTi coproduct.

The average fully allocated cost (C3) for life of mine is equivalent to US\$5.04/lb  $V_2O_5$ . This includes production costs (C2), taxes, royalties, and estimates for overhead staffing and general administrative (G&A).

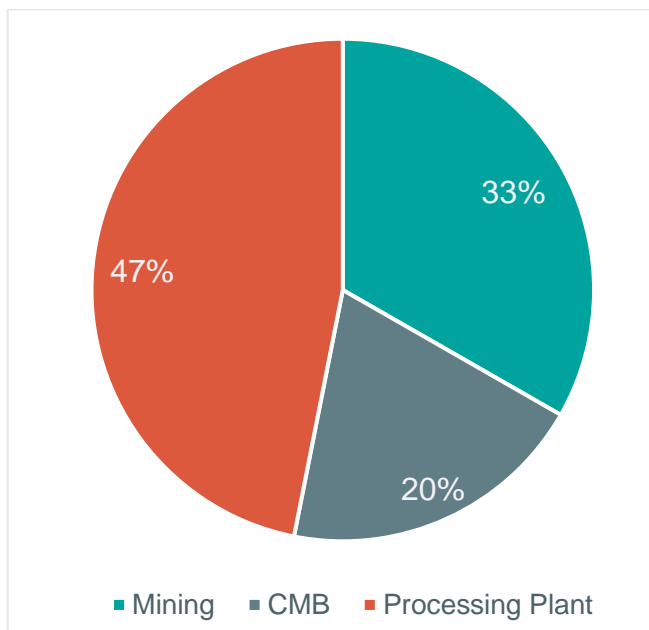
AVL's projected costs are similar to existing global vanadium producers.



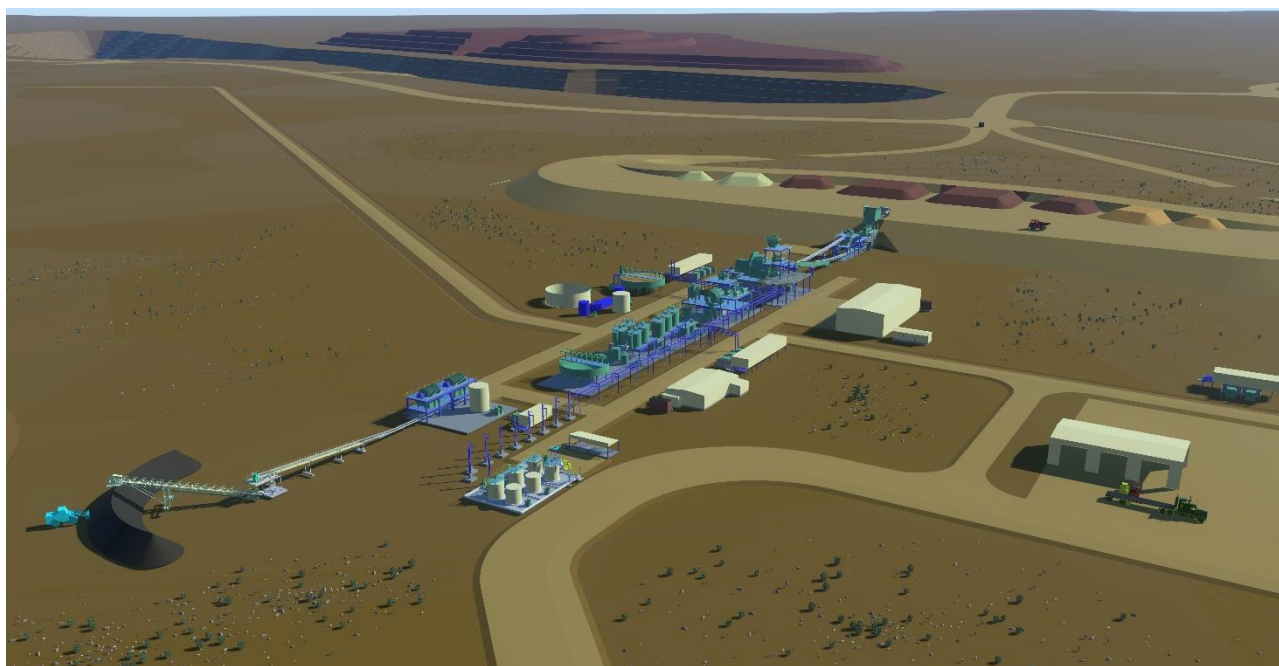
**Average Operating Costs including Transport**



**Average Operating Costs excluding Transport**



**Figure 3 Direct Operating Expenses by Area**



**Figure 4 CMB Plant Layout (view to the North)**

## Capital Costs

A summary of capital costs is given in Table 2 below. Capital is broken down by the two primary locations for the Project. All costs are estimated in Australian dollars (A\$) to  $\pm 25\%$  as of 15 December 2020 and are converted to US dollars (US\$) for the purposes of this report.

**Table 2 Capital Cost Estimate (by Area)**

<b>Gabanintha Location (Mine and CMB)</b>		<b>(US\$ M)</b>
Mining		21
CMB Plant		51
CMB Infrastructure		18
Area Infrastructure		19
Regional Infrastructure		23
Miscellaneous		5
<i>Sub-Total</i>		<b>137</b>
<b>Tenindewa Location (Processing Plant)</b>		
Processing Plant		128
Processing Plant Infrastructure		20
Area Infrastructure		3
Regional Infrastructure		
Miscellaneous		10
<i>Sub-Total</i>		<b>161</b>
<b>Project Direct Capital Costs</b>		<b>298</b>
<b>Other Project Capital</b>		
Indirects and EPCM		42
Growth		40
Owner's Cost		19
<i>Sub-Total</i>		<b>101</b>
<b>Project Total</b>		<b>399</b>

## Project Funding

The Company has funding in place for work on the BFS. This includes cash at bank of A\$7.5 million at time of reporting.

Funding for the initial stages of the BFS is expected to be provided by existing working capital. Full budget estimates for the completion of the BFS phase are not yet completed.



## Green Hydrogen Strategy and Offtake MOU with ATCO

See ASX announcement dated 25th November 2020 'Green Hydrogen Offtake MOU with ATCO' and ASX announcement dated 12<sup>th</sup> November 2020 'AVL Launches Green Hydrogen Strategy'

AVL signed an MOU with ATCO Australia for the supply of green hydrogen for AVL's planned processing plant which is to be located near Geraldton. ATCO is one of seven proponents shortlisted by the Australian Renewable Energy Agency (ARENA) under the Renewable Hydrogen Deployment Round to develop a project for the commercial scale production of hydrogen gas in Australia.

The MOU provides a basis for negotiations to establish a binding offtake agreement, with the intention for ATCO to supply 10% of the total gas requirements with green hydrogen.



**Figure 5 ATCO's Clean Energy Innovation Hub in Jandakot, WA**

AVL's strategy to incorporate green hydrogen into the Project includes the following areas:

- Introducing a percentage of green hydrogen into the natural gas feed for the processing plant. The purpose of this is to reduce carbon emissions. This will be analysed fully in the Company's Bankable Feasibility Study.
- Offtake of ammonia from green hydrogen production for use in the final vanadium precipitation step of processing. The CSIRO is working on an ARENA-funded project, (the Australian Government's Australian Renewable Energy Agency), to develop a production process that does not contribute to greenhouse gas emissions.
- Powering minesite or haulage vehicles to move material from the minesite to the processing plant with green hydrogen. Hydrogen generation could be undertaken at the minesite and at the processing plant for refuelling. This is a new area of development for Australia and will need to be fully assessed for its financial implications. AVL is keen to work with the Federal and State Governments and haulage companies who have a forward plan for this technology.

- The use of green hydrogen for steel production in the ore reduction step. AVL is seeking partnerships with companies interested in this area as it would be a noble and efficient use for the FeTi coproduct that the Company plans to produce.
- Through AVL's 100% owned subsidiary, VSUN Energy, integrating hydrogen electrolyzers in plant design, combined with energy storage utilising vanadium redox flow battery (VRFB) technology.

To support the Government of Western Australia's plans for a green hydrogen economy, AVL has submitted a formal response to the request for expressions of interest for the Oakajee Strategic Industrial Area Renewable Energy Strategy. Having a Project located in the Mid-West region, with a variety of ways for AVL to incorporate green hydrogen means that the Company is well-positioned to leverage the emerging hydrogen economy and its financial and environmental benefits.

### **The Australian Vanadium Project to Produce High Purity Vanadium Pentoxide**

*See ASX announcement dated 2<sup>nd</sup> November 2020 'The Australian Vanadium Project to Produce High Purity Vanadium Pentoxide'*

High purity 99.4% vanadium pentoxide ( $V_2O_5$ ) has been produced from representative leach liquor. The vanadium flake product from the Project is expected to be of outstanding quality, comparable to high purity products from existing global producers. Testing has included APV and AMV production routes, allowing optionality in the BFS to simplify the refinery circuit and potentially lower both capital and operating costs. Testwork has demonstrated the ability to produce high purity  $V_2O_5$  at scale.

All vanadium purification tests reported in the announcement were performed on leach solution derived from roasted material produced in pilot scale testwork at Metso Outotec's Dansville pyrometallurgical facility in the USA. The concentrates provided to Metso were in turn generated from pilot scale crushing, milling, and beneficiation testwork at ALS laboratories in Balcatta, WA. Feed materials to the pilot program at ALS were made up from a blend of drill core designed to represent the average first five years and life of mine process feed.

There are currently only three primary vanadium mines known to be operating outside China, producing  $V_2O_5$  from titanomagnetites similar in nature and grade to AVL's Project. The recent testwork summarised in this report indicates the ability for AVL to produce similar vanadium product specifications to existing producers. A direct comparison and links to publicly available information\* is shown in Table 3 below.

**Table 3 Comparison of AVL's V<sub>2</sub>O<sub>5</sub> testwork results versus producer product specifications**

	V <sub>2</sub> O <sub>5</sub>	Al <sub>2</sub> O <sub>3</sub>	Ca	Cr	Fe	MgO	K <sub>2</sub> O + Na <sub>2</sub> O	P	S	Si
	%	%	%	%	%	%	%	%	%	%
<b>AVL V<sub>2</sub>O<sub>5</sub> - APV Precipitation</b>	99.43	0.019	0.005	0.054	0.02	0.008	0.07	0.034	0.004	0.02
<b>AVL V<sub>2</sub>O<sub>5</sub> - AMV Precipitation</b>	99.43	0.038	0.05	0.08	0.01	0.033	0.2	0.02	0	0.21
<b>Industry Standard Grade V<sub>2</sub>O<sub>5</sub></b>	>98				<0.3		<1.5	0.05	<0.03	<0.25
<b>Largo Resources Vpure™ V<sub>2</sub>O<sub>5</sub> Flakes</b>	98.5-99.0	<0.1	<0.06		<0.25		<0.5	<0.02		<0.3
<b>Largo Resources Vpure+™ V<sub>2</sub>O<sub>5</sub> Flakes</b>	99.0-99.5	<0.1	<0.05	<0.02	<0.1		<0.5	<0.01	<0.02	<0.12
<b>US Vanadium High Purity V<sub>2</sub>O<sub>5</sub></b>	99.6				0.02		0.025	0.01		0.01

**\*Table References:**

Fastmarkets (subscription): <https://www.metalbulletin.com/Article/3957059/PRICING-NOTICE-Amendment-to-Chinese-vanadium-fob-price-assessments.html>

Largo Resources Vpure™ V<sub>2</sub>O<sub>5</sub> Flakes:

[https://largovpure.com/wp-content/uploads/2020/01/VPURE\\_Technical\\_StandardFlake\\_v2.pdf](https://largovpure.com/wp-content/uploads/2020/01/VPURE_Technical_StandardFlake_v2.pdf)

Largo Resources Vpure+™ V<sub>2</sub>O<sub>5</sub> Flakes:

<https://largovpure.com/wp-content/uploads/2019/11/VPURE-Flakes-Technical-Data-Sheet-1.pdf>

US Vanadium High Purity V<sub>2</sub>O<sub>5</sub>:

<https://img1.wsimg.com/blobby/go/3f18bace-1ccb-47d4-bc97-b5972e76e9c6/downloads/Product%20Spec%20MC5%20Rev%209%20HPG%20Vanadium%20Pentoxide.pdf?ver=1565476335252>

**MOU with U.S. Vanadium LLC for Vanadium Offtake**

*See ASX announcement dated 2<sup>nd</sup> December 2020 'AVL Signs Strategic Offtake MOU with U.S. Vanadium LLC'*

AVL signed a non-binding Memorandum of Understanding (MOU) with U.S. Vanadium LLC (USV) in relation to offtake from the Project. USV produces and sells a range of specialty vanadium chemicals, including the world's highest-purity vanadium pentoxide (V<sub>2</sub>O<sub>5</sub>) at 99.6%, which is produced at its Hot Springs, Arkansas facility. The MOU sets a framework for progression to a possible formal and binding agreement.

One of AVL's unique attributes is its strong relationships throughout the vanadium market. AVL's Technical Director Daniel Harris, who is also a director of USV and a US national residing in the United States, has deep vanadium experience within the USA and internationally. Working with the highly experienced team at USV will give AVL the ability to negotiate at the highest level within the vanadium market and leverage the critical mineral narrative with end users.

There is an increased emphasis on security and provenance of supply chains globally. The relationship with USV also validates AVL's strong technical capability and the Company's considered approach to its feasibility studies.

The MOU outlines an offtake proposal for USV to acquire 2,000 tonnes of  $V_2O_5$  per annum from AVL. This represents 20% of AVL's planned annual production.



*Figure 6 USV manufacturing facility in Hot Springs, Arkansas, USA*

### **Geraldton Region Vanadium Processing Plant Land Option Extended**

*See ASX announcement dated 21<sup>st</sup> October 2020 'AVL Extends Geraldton Region Vanadium Processing Plant Land Option'*

In October, AVL signed a one-year extension to the land option agreement with the landowner of the proposed location for its vanadium processing plant near Geraldton in Western Australia.



In October 2019<sup>5</sup>, AVL announced that it had signed an option agreement for land to locate the value-adding processing plant for the Project near to the port city of Geraldton in Western Australia. To ensure a low-cost operation, AVL will undertake crushing, milling and beneficiation of vanadium bearing magnetite ore at the minesite location and transport the resulting concentrate to the proposed processing plant outside Geraldton, where final refinement to high-quality, high-value vanadium products will take place.

A unique value proposition resulting from this arrangement is that the Company is able to consider the sale of an Fe-Ti coproduct which will be generated after extraction of high purity vanadium products. The potential for sale of this product is one of the globally unique opportunities provided by the coastal location of the plant.

In 2019, AVL identified the value of locating the vanadium processing plant components near to Geraldton. The Company secured a suitable plant location west of Mullewa, near Geraldton. Evaluation over the past year has confirmed that this location is ideal for the Company. The extension of the option over the relevant land is another step forward towards production.

The physical and infrastructure benefits of the processing plant's location include:

- Access to cheaper and more competitive natural gas and the associated capital cost reduction of not needing to build a gas pipeline to the minesite.
- The opportunity for power at the minesite to have a large component of renewable energy, including a VRFB.
- Significantly reduced minesite water requirements by approximately one third of total water used.
- A reduced minesite camp, due to reduced numbers of personnel required onsite and workers at the Geraldton location living locally, preferably at their homes.
- Reduced construction costs for the processing plant and cheaper transportation costs of reagents.
- Location enables production and sale of Fe-Ti coproduct which would not be feasible from minesite based production.
- Enables consideration of downstream processing opportunities of vanadium or Fe-Ti products onshore near Geraldton.

The extension agreement provides a one-year extension of the original option agreement signed on 21<sup>st</sup> October 2019. The option payment for the second term is 1% of the Purchase Price, with half payable in cash and half in AVL shares. The number of shares issued was based on the volume weighted average share price over the previous five trading days prior to the payment of the option

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<sup>5</sup> See ASX announcement dated 29<sup>th</sup> October 2019 '*Option Agreement to Locate Vanadium Processing Plant near Geraldton, WA*'

fee. The land size is calculated at 1,334 acres, with the purchase price of \$2,100 per acre. All terms in the original option agreement remain valid.



**Figure 7 AVL Project locations diagram**

### **MOU signed with UK company GSA Environmental for collaboration on vanadium products**

*See ASX announcement dated 22<sup>nd</sup> October 2020 'AVL to Collaborate with UK Company GSA Environmental on Vanadium Products'*

AVL signed an MOU for commercial and technical collaboration with a leading-edge UK based engineering and metals recovery/extraction consultancy for the purposes of evaluating value-adding feedstocks to the Australian Vanadium Project.

UK based GSA Environmental Limited (GSAe), is an engineering consultancy with front end engineering design, project management and process safety consultancy capabilities. GSAe has multi-disciplined and extensive expertise across a range of industry sectors including oil and gas processing and refining, petrochemicals and renewables. GSAe has specific intellectual property relating to the extraction of vanadium from traditionally hard-to-process by-product material such as petrochemical wastes and slags.

GSAe and AVL will collaborate principally to evaluate feedstocks that have the capability to further improve the economics of the Project and its planned processing facility near the port city of Geraldton in Western Australia.



AVL has made significant progress through its PFS and highly detailed pilot studies, enabling the Company to reliably target lowest quartile cost production of primary vanadium<sup>6</sup>.

With a number of petrochemical industry by-products containing vanadium, such as fly ash, slags and petcoke slags, AVL's world class vanadium team in conjunction with staff from GSAe will collaborate and partner to investigate the commercial opportunities and possible economies offered by incorporating vanadium units into the processing plant. Vanadium and other metals, such as nickel, are contained in a variety of wastes including fly ash which is generated from crude oil. This material is currently disposed of in landfill sites around the world. Extracting the saleable material from this waste will therefore have a positive economic and environmental impact.

The MOU is for a two-year initial term with an option to extend by mutual agreement. The MOU can be terminated by either party if an offtake agreement with a supplier is not concluded by the end of the term. The agreement provides the basis for the two companies to enter into a commercial agreement for use of GSAe's proprietary technology and technologies developed between AVL and GSAe.

### **MOU signed with Singaporean VRFB manufacturer, V-Flow**

*See ASX announcement dated 1<sup>st</sup> December 2020 'Vanadium Offtake, Electrolyte Supply and Battery Sales MOU'*

At the beginning of December AVL signed an MOU with Singaporean VRFB manufacturer V-Flow Tech. The MOU provides a basis for opportunities relating to VRFBs, including:

- Vanadium products ( $V_2O_5$ ) offtake to V-Flow in Singapore to support global battery sales.
- Vanadium electrolyte manufacture and supply in Australia for V-Flow VRFBs.
- Sales agreement with AVL's 100% owned subsidiary VSUN Energy for VRFB sales in Australia.
- VRFB service and maintenance.

For more information, please see the Vanadium in Energy Storage section below.

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<sup>6</sup> See AVL's 2020 Annual Report

## Geotech Drilling Completed

See ASX announcement dated 24<sup>th</sup> November 2020 'Geotech Drilling at the Australian Vanadium Project'

In November a diamond drilling program was undertaken on the Project's southern Resource blocks 50 and 60. The drilling was designed to gather data for metallurgical and geotechnical purposes which are required for the BFS.

The drill core collected for metallurgical testwork will be used in further variability work and will quantify any potential differences in the massive magnetite horizon between the northern and southern Resource blocks. Diamond holes completed in 2009 and 2015 indicated that the weathering of material in block 60 is shallower than northern blocks 20 and 30. This drilling is designed to confirm the observations and is required for the BFS.

Diamond holes were also drilled for geotechnical data to determine important pit slope information. The intention is to include the southern Indicated Resources in the BFS mining schedule on granted Mining Lease M51/878.

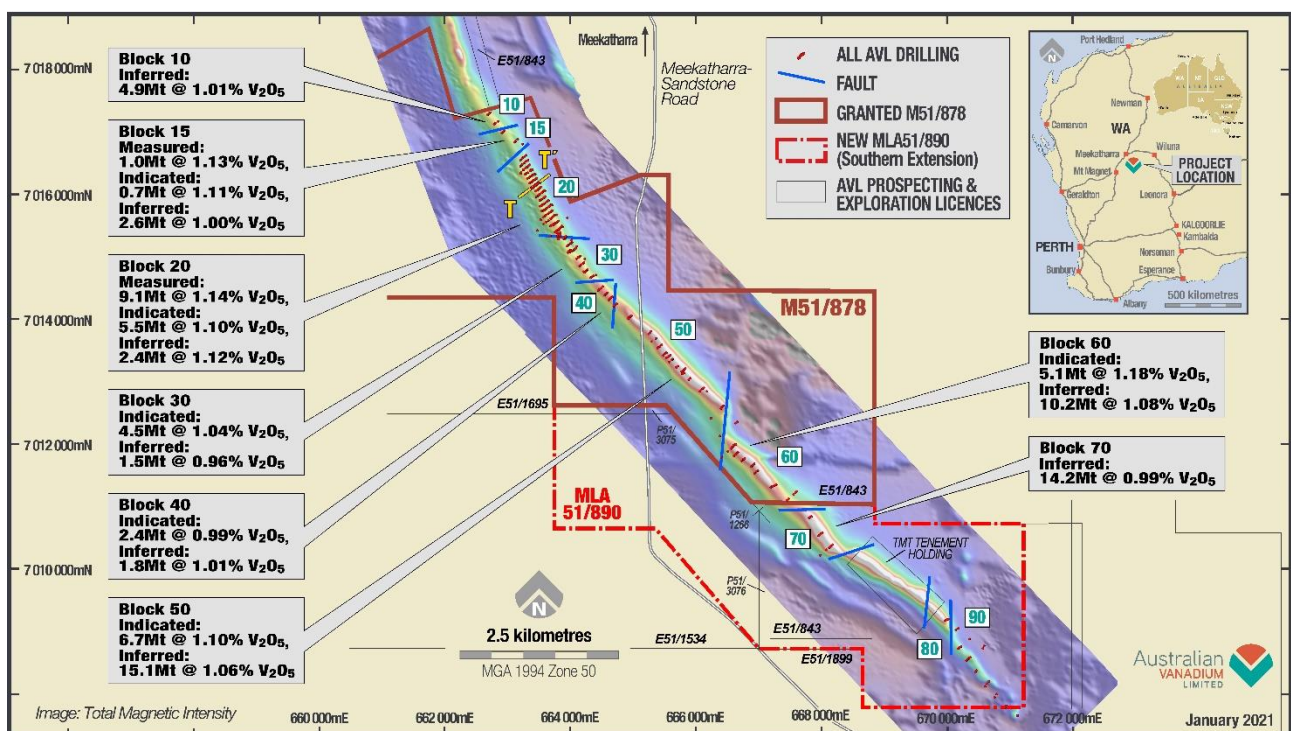


Figure 8 Mineral Resources for Shown Fault Blocks over TMI

## VANADIUM IN ENERGY STORAGE

### MOU signed with Singaporean VRFB manufacturer, V-Flow

See ASX announcement dated 1<sup>st</sup> December 2020 'Vanadium Offtake, Electrolyte Supply and Battery Sales MOU'

AVL's MOU with V-Flow incorporates vanadium electrolyte manufacture and supply and a battery sales, installation, service and maintenance agreement for VSUN Energy in Australia. VSUN Energy has already sold two 5kW/30kWh V-Flow VRFB systems, one to a residential customer in Hyden, WA and one to the Shire of Beverley for the Beverley Caravan Park.



**Figure 9 A 10kW/100kWh V-Flow VRFB**

The V-Flow product is suited to rural residential customers and commercial sites. It can be installed as a grid-connected or off-grid system and is available for purchase and installation now.

### Residential VRFB Developments

See ASX announcement dated 6<sup>th</sup> January 2021 'VSUN Energy Residential VRFB Development'

In addition to work underway with V-Flow, VSUN Energy has received delivery of a grid-connect ready 5kW/30kWh residential VRFB from CEC in China. Local Western Australian design and consultancy group CADDs Group has been appointed to undertake work on the residential VRFB design and prototyping. Testing of the battery is underway at a facility in Bibra Lake, WA with

assistance from local electrical company CDI Electrics and an engineering student from Curtin University.

Initial concept designs have been received and the project is progressing well. See Figure 10 for one example of the proposed designs.



**Figure 10 Concept design for the 5kW/30kWh residential VRFB**

VSUN Energy continues to offer a range of solutions, from 5kW/30kWh through to multi-megawatt sized systems.

#### VRFB Market

The VRFB market is seeing accelerated growth, with the following projects all being awarded or commissioned during the quarter.

California has awarded a \$5m grant for hybrid energy storage which includes VRFBs from Invinity Energy Systems. Invinity has also won projects this quarter for a 200kW/800kWh VRFB for a wastewater treatment plant in Scotland; a 50kW/500kWh VRFB for the Soboba Band of Luiseño Indian lands in California; a 450kW/1.8MWh VRFB for the European Marine Energy Centre (EMEC) for a



tidal and hydrogen project on the Isle of Eday in the Orkney Islands off the coast of Scotland; a 60kW/300kWh battery in the Czech Republic;

Canadian company VanadiumCorp is working with a Dutch naval architect and a German shipowner alongside the German-Australian Alliance for Electrochemical Technologies for Storage of Renewable Energy (CENELEST) on the use of VRFB in shipping.

China continues to install large VRFBs, with the latest being a 7.5MWh grid-connected VRFB in Aksu Prefecture, Xinjiang. Our partner CEC VRFB has installed a 1MW/1MWh VRFB alongside PV in South China and a 1MW/5MWh VRFB paired with wind generation in the Qinghai province. Shanghai Electric has opened a 200MW/1GWh battery Gigafactory in Anhui Province. Weilide Energy Group has started construction of its 100MW per annum VRFB factory in Aksu, Xinjiang.

The Indian market for VRFBs is starting to grow, with one manufacturer located in the country and installations such as the recent charging station for mobile electronics at the Indian Institute of Technology in Delhi.

Meanwhile, in Spain E22 has installed a 250kW/750kWh VRFB for a Spanish gas and power supplier.

In Australia, mining giant Rio Tinto appears to have quietly installed a VRFB to replace a diesel generator at one of their sites. It will be interesting to see how this develops.

The Australian renewable energy funding division ARENA has announced support for a 2MW/8MWh VRFB project in South Australia, utilising the Invinity VRFB.

The Future Battery Industries Co-operative Research Centre now has a battery research facility with a VRFB installed to test.

One of the world's three primary vanadium producers, Largo Resources, announced the launch of their equivalent to AVL's VSUN Energy. Largo Clean Energy has taken over the products and staff from VRFB manufacturer Vionx Energy, with its pipeline of existing and upcoming projects.

Bushveld Energy, subsidiary of one of the other primary vanadium producers, announced that Abengoa would be installing at 1MW/4MWh VRFB at Vametco Alloys mine, owned by Bushveld Minerals, in the North West province of South Africa.

VSUN Energy's active social media platforms provide a good source of information for the VRFB market.

## CORPORATE

### Cliff Lawrenson appointed to the Board

*See ASX announcement dated 12th October 2020 'AVL Renews Board Structure'*

AVL announced the appointment of a new Non-Executive Director Cliff Lawrenson on 12<sup>th</sup> October. At the Company's AGM in November 2020, Non-Executive Chair Brenton Lewis retired and Cliff was appointed as his replacement.

Mr Lawrenson's appointment forms part of the Company's ongoing board renewal process. Cliff is a highly regarded and experienced industry professional and he is currently Non-Executive Chair of Paladin Energy Limited (ASX:PDN), Caspin Resources Limited (ASX:CPN) and Canyon Resources Limited (ASX:CAY). Mr Lawrenson is also Non-Executive Chair of privately owned Pacific Energy Limited and Onsite Rental Group.

Mr Lawrenson was Managing Director of Atlas Iron Ltd from 2017 and led the company to its acquisition by Hancock Prospecting Pty Ltd. Prior to Atlas Iron, Mr Lawrenson was Managing Director of a number of ASX listed companies in the mining and mining services sectors. Mr Lawrenson was a senior executive of CMS Energy Corporation in the United States of America and Singapore and this was preceded by an investment banking career.

### Appendix 5B – Quarterly Cash Flow Report

The cash position of AVL as at 31<sup>st</sup> December 2020 was \$7.15 million.

The aggregate amount of payments to related parties and their associates included in the current quarter cash flows from operating activities were \$246k, comprising Directors' fees, salaries and superannuation.

During the quarter \$7,000 was expensed for exploration and evaluation which related to tenement rents and rates. Of the \$1,053,000 exploration and evaluation expenditure capitalised, \$349,000 was spent on activities related to the Cooperative Research Centre Project. A further \$704,000 was spent on the BFS update including engineering work (\$299,000), environmental/hydrology work (\$172,000), mining studies (\$58,000), drilling (\$69,000), testwork (\$32,000) with the balance comprising of other consultants and labour, and tenement expenses.

No production and development activities were undertaken during the quarter.

### ESG

The Environmental Impact Assessment application will be lodged during Q1 of 2021. The submission focuses on the mine site and concentration plant (CMB) only, which are to be located on the Gabanintha mine site. A separate industrial assessment will be lodged for the planned processing plant at Tenindewa.



AVL has a strong ESG focus and will be further developing its strategies throughout 2021. The introduction of a green hydrogen strategy and the use of renewable energy for mining operations contribute to the environmental strategies of the Company. AVL continues to support the Stephen Michael Foundation in its endeavours to provide opportunities for the children of Meekatharra. The Company is also engaged with the Meekatharra Community Resource Centre and wider Meekatharra community. In the Geraldton region our Community Relations Advisor is building relationships and establishing the ways that AVL can make a difference for the community as we move towards construction and production.

## Marketing

The Company attended a number of online conferences and conducted interviews to promote the company during the quarter, including;

### *Mining Journal*

In November Vincent Algar took part in a series of online meetings for the Mining Journal conference. Meetings were booked on a one-to-one basis and were targeted at financiers for the Project.

During the March quarter AVL will attend;

- RIU Explorers Conference in Fremantle
- Mining Journal Select Virtual Conference
- APAC 121 Mining Investor Virtual Forum
- Geraldton Economic Summit

The Company maintains a strong presence on social media platforms, summarising Company and vanadium related news and developments. The Company is promoted under Australian Vanadium, AVL and VSUN Energy brand names.

For further information, please contact:

**Vincent Algar, Managing Director** +61 8 9321 5594

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*This announcement has been approved in accordance with the Company's published continuous disclosure policy and has been approved by the Board.*

## MINERAL RESOURCE

**Table 4 - The Australian Vanadium Project Mineral Resource Estimate at February 2020 by Domain and Resource Classification<sup>7</sup>**

Zone	Classification	MT	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%
HG 10	Measured	10.1	1.14	43.9	13.0	9.2	7.5	3.7
	Indicated	25.1	1.10	45.4	12.5	8.5	6.5	2.9
	Inferred	52.7	1.04	44.6	11.9	9.4	6.9	3.3
	<b>Subtotal</b>	<b>87.9</b>	<b>1.06</b>	<b>44.7</b>	<b>12.2</b>	<b>9.2</b>	<b>6.8</b>	<b>3.2</b>
LG 2-5	Measured	-	-	-	-	-	-	-
	Indicated	44.5	0.51	25.0	6.8	27.4	17.0	7.9
	Inferred	60.3	0.48	25.2	6.5	28.5	15.3	6.7
	<b>Subtotal</b>	<b>104.8</b>	<b>0.49</b>	<b>25.1</b>	<b>6.6</b>	<b>28.0</b>	<b>16.1</b>	<b>7.2</b>
Transported 6-8	Measured	-	-	-	-	-	-	-
	Indicated	-	-	-	-	-	-	-
	Inferred	15.6	0.65	28.4	7.7	24.9	15.4	7.9
	<b>Subtotal</b>	<b>15.6</b>	<b>0.65</b>	<b>28.4</b>	<b>7.7</b>	<b>24.9</b>	<b>15.4</b>	<b>7.9</b>
Total	Measured	10.1	1.14	43.9	13.0	9.2	7.5	3.7
	Indicated	69.6	0.72	32.4	8.9	20.6	13.2	6.1
	Inferred	128.5	0.73	33.5	8.8	20.2	11.9	5.4
	<b>Total</b>	<b>208.2</b>	<b>0.74</b>	<b>33.6</b>	<b>9.0</b>	<b>19.8</b>	<b>12.1</b>	<b>5.6</b>

**Table 5 Ore Reserve Statement as at December 2020, at a cut-off grade of 0.7% V<sub>2</sub>O<sub>5</sub>**

Ore Reserve	Mt	V <sub>2</sub> O <sub>5</sub> %	Fe <sub>2</sub> O <sub>3</sub> %	TiO <sub>2</sub> %	SiO <sub>2</sub> %	LOI%	V <sub>2</sub> O <sub>5</sub> production kt	Ore Reserve	Mt
Proved	9.8	1.08	59.9	12.4	8.7	3.5	63.2	Waste	244.5
Probable	22.4	1.04	61.7	11.8	8.3	2.8	158.9	Total Material	276.7
<b>Total Ore</b>	<b>32.1</b>	<b>1.05</b>	<b>61.2</b>	<b>12.0</b>	<b>8.4</b>	<b>3.0</b>	<b>222.1</b>	Strip Ratio	7.6

<sup>7</sup> 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).

**Table 6 - Tenement Schedule**

Tenement information as required by Listing Rule 5.3.3 for the quarter ended 30 September 2020.

Project	Location	Tenements	Economic Interest	Notes	Change in Quarter %
Western Australia	The Australian Vanadium Project	E51/843	100% Granted <sup>1</sup>		Nil
		E51/1534	100% Granted <sup>1</sup>		Nil
		E51/1685	100% Granted <sup>1</sup>		Nil
		E51/1694	100% Granted <sup>1</sup>		Nil
		E51/1695	100% Granted <sup>1</sup>		Nil
		E51/1899	100% Granted <sup>1</sup>		Nil
		E51/1943	100% Granted <sup>1</sup>		Nil
		E51/1944	100% Granted <sup>1</sup>		Nil
		P51/3073	100% Granted		Nil
		P51/3074	100% Granted		Nil
		P51/3075	100% Granted		Nil
		P51/3076	100% Granted		Nil
		M51/878	100% Granted		Nil
		MLA51/888	100% Granted <sup>1</sup>		100%
		MLA51/890		100% <sup>1</sup> on Application	Nil
Western Australia	Nowthanna	M51/771	100% Granted		Nil
Western Australia	Peak Hill	E52/3349	0.75% NSR Production Royalty		Nil
Western Australia	Coates	E70-4924-I	100% Granted		Nil
		ELA70/5588		100% <sup>1</sup> on Application	Nil
		ELA70/5589		100% <sup>1</sup> on Application	Nil
South Africa	Blesberg	(NC) 940 PR	10%		Nil

*Note 1: Australian Vanadium Limited retains 100% rights in V/U/Co/Cr/Ti/Li/Ta/Mn & iron ore on The Australian Vanadium Project. Bryah Resources Limited holds the Mineral Rights for all minerals except V/U/Co/Cr/Ti/Li/Ta/Mn & iron ore only.*

## FORWARD LOOKING STATEMENTS

Some of the statements contained in this report are forward looking statements. Forward looking statements include, but are not limited to, statements concerning estimates of tonnages, expected costs, statements relating to the continued advancement of Australian Vanadium Limited's projects and other statements that are not historical facts. When used in this report, and on other published information of Australian Vanadium Limited, the words such as 'aim', 'could', 'estimate', 'expect', 'intend', 'may', 'potential', 'should' and similar expressions are forward looking statements.

Although Australian Vanadium Limited believes that the expectations reflected in the forward-looking statements are reasonable, such statements involve risks and uncertainties and no assurance can be given that the actual results will be consistent with these forward-looking statements. Various factors could cause actual results to differ from these forward-looking statements including the potential that Australian Vanadium Limited's project may experience technical, geological, metallurgical and mechanical problems, changes in vanadium price and other risks not anticipated by Australian Vanadium Limited.

Australian Vanadium Limited is pleased to report this information in a fair and balanced way and believes that it has a reasonable basis for making the forward-looking statements in this report, including with respect to any mining of mineralised material, modifying factors, production targets and operating cost estimates.

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 have not been materially modified from the original market announcement.

## COMPETENT PERSON STATEMENT – EXPLORATION RESULTS AND TARGETS

The information in this report that relates to Exploration Results and Exploration Targets is based on and fairly represents information and supporting documentation prepared by Mr Brian Davis (Consultant with Geologica Pty Ltd). Mr Davis is a member of the Australasian Institute of Mining and Metallurgy and has 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 Davis consents to the inclusion in this report of the matters based on his information in the form and context in which they appear.

## COMPETENT PERSON STATEMENT — MINERAL RESOURCE ESTIMATION

The information in this announcement 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 Barnes and Mr Davis are members of the Australasian Institute of Mining and Metallurgy (AusIMM) and Mr Davis is a member of the Australian Institute of Geoscientists, 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 announcement of the matters based on their information in the form and context in which they appear.

## COMPETENT PERSON STATEMENT – METALLURGICAL RESULTS

The information in this announcement 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 AusIMM. Brian 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 JORC 2012 Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Mr McNab consents to the inclusion in the announcement of the matters based on the information made available to him, in the form and context in which it appears.

## COMPETENT PERSON STATEMENT – ORE RESERVES

The technical information in this announcement that relates to the Ore Reserve estimate for the Project is based on information compiled by Mr Ross Cheyne, an independent consultant to AVL. Mr Cheyne is a Fellow of the Australasian Institute of Mining and Metallurgy. He is an employee and Director of Orelogy Mine Consulting Pty Ltd. Mr Cheyne 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 Cheyne consents to the inclusion in the announcement of the matters related to the Ore Reserve estimate in the form and context in which it appears.