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Vanadium in Energy Storage

March 2018



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COMMENT

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COMPETENT PERSON REFERENCES

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The information is extracted from the report entitled “Substantial high-grade vanadium resource highlights Gabanintha’s world-class potential” released to ASX on 10 November 2015 and is available on the company website at 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 Resource 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 announcement 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 Companies 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.



Gabanintha on pathway to vanadium production

Company

- ASX listed company since 2008.

Vanadium Markets

- Vanadium price on long term uptrend as traditional steel markets actively seek new sources of long term supply.
- Focus offers leverage to rising vanadium prices and new applications in energy storage.
- Energy storage market will require increased global vanadium supply.

Project

- Globally significant project with large, high-grade Measured, Indicated and Inferred resources.
- Metallurgical recovery and concentrate grade comparable to other global operating mines.
- Process design and PFS underway as Company prepares to fast-track project development.





Corporate Snapshot

Key Statistics (as at 13-3-18)

Ordinary shares on issue	1,526m
Listed Options (ex at 2c exp Dec 2018) AVLO	393.46m
Share price	AUD \$0.057
Market capitalisation (undiluted)	A\$86m (Cash ~A\$3m)
Shareholders	5,660

Substantial Shareholders

% holding

J P Morgan Nominees	3.52 %
Management	7 %

AVL Share Price History



Board of Directors

Title

Vincent Algar Bsc (Hons) Geol, MAusImm	Managing Director
Leslie Ingraham	Executive Director
Brenton Lewis MBSc, BBS (Hons)	Non Executive Chairman
Daniel Harris BSc Chem Eng	Non Executive Director



Management

At Australian Vanadium Ltd 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 knowledge.

Within a reliable Australian mining jurisdiction, we believe we have the right team to develop the world's next high grade vanadium mine.



Directors Vincent Algar (left) and Daniel Harris (right)

Vincent Algar

Managing Director

Mr Vincent Algar BSC (Hons) Geology, MAusIMM, is a geologist by profession with over 25 years' experience in the mining industry spanning underground and open cut mining operations, greenfields exploration, project development and mining services in Western Australia and Southern Africa. He has significant experience in the management of publicly listed companies, which includes the entire compliance, marketing and management process and encompasses the development of internal geological and administrative systems, exploration planning and execution, plus project acquisition and deal completion.

Leslie Ingraham

Executive Director

Mr Leslie Ingraham has been in private business for over 26 years, he has worked successfully as a consultant for private companies and public companies listed on the Australian Securities Exchange.

Core competencies are in Corporate advisory, Investor relations, Capital raising, prospecting and exploration in Australia, building long lasting relationships with high end investors in Australia and overseas.

Daniel Harris

Non-Executive Director

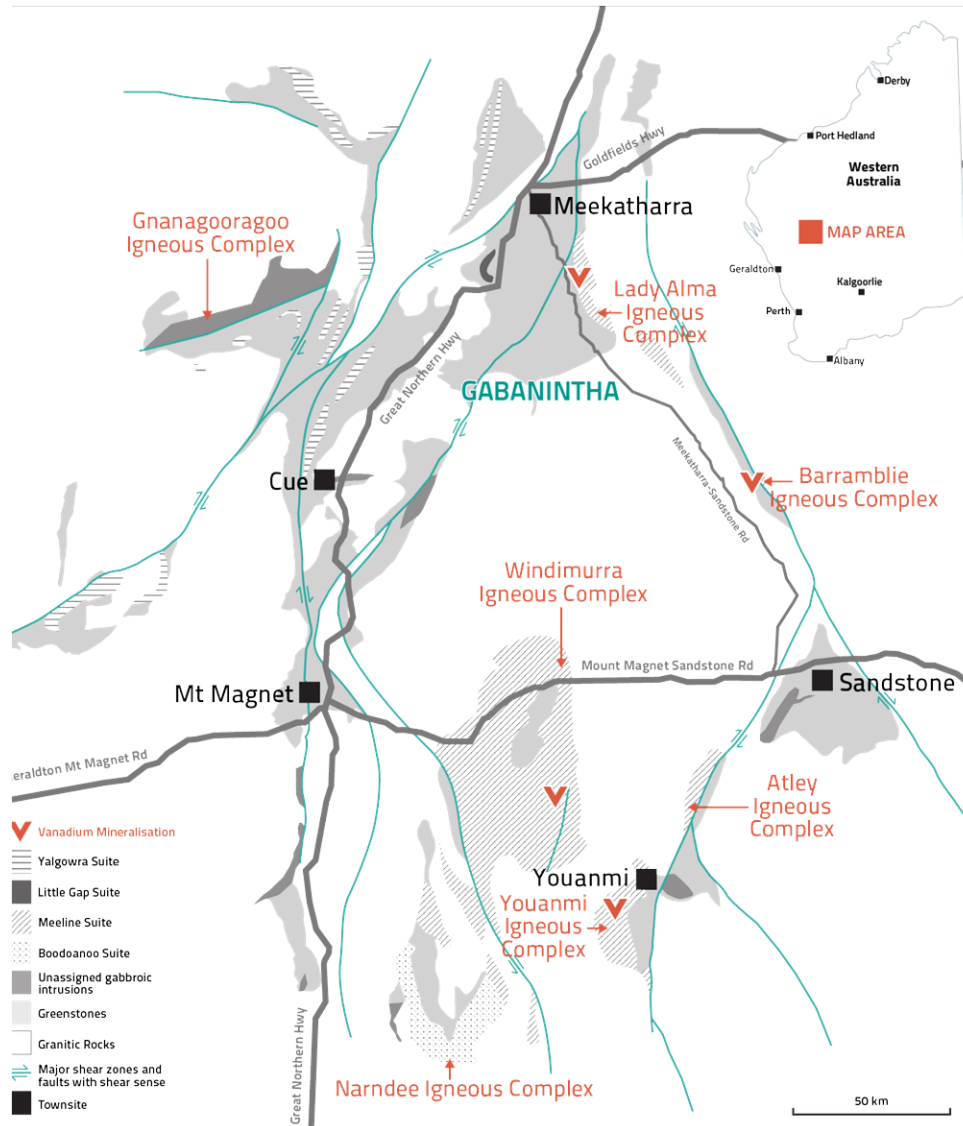
Mr. Daniel Harris has a vast amount of expertise in the vanadium industry and an understanding of the resource sector from both a technical and financial perspective. Recent roles include interim CEO and Managing Director at Atlas Iron; Chief Executive & Operating Officer at Atlantic; Vice President & Head of Vanadium Assets at Evraz Group; Managing Director at Vametco Alloys; General Manager of Vanadium Operations at Strategic Minerals Corp, and acting as an independent technical and executive consultant to GSA Environmental Limited in the United Kingdom.

Brenton Lewis

Non-Executive Chairman

Mr. Brenton Lewis BBSC (Hons) MBSC was a Senior Academic having spent the past 20 years in the tertiary education sector. He has held management positions including Head of Department and Head of Post Graduate Studies and chaired Boards of Management in both academia and community organisations. He has taught, published and researched in areas including Ethics and Psychopathology.

Project location in well developed mining region



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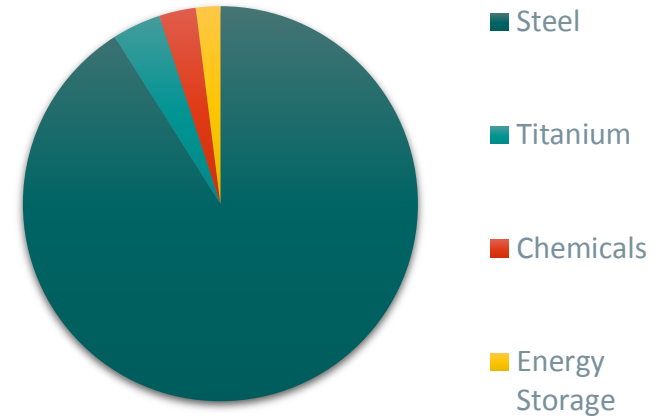
Vanadium Markets



Vanadium Markets - Steel

Despite reduced rate of steel production, demand for vanadium continues to grow. Steel remains a price driver for vanadium.

- Steel is the primary market (92% of vanadium consumption)
- Addition of 0.2% vanadium increases steel strength up to 100% and reduces weight up to 30%
- Demand for use in rebar continues to increase at 6% annually (TTP Squared)
- New standards for Chinese rebar require increased vanadium use, doubling to rest-of-world standards
- New markets in steel will increase demand such as:
 - Materials for automotive, aviation and aerospace
 - Power lines and power pylons
 - High-strength steel structures



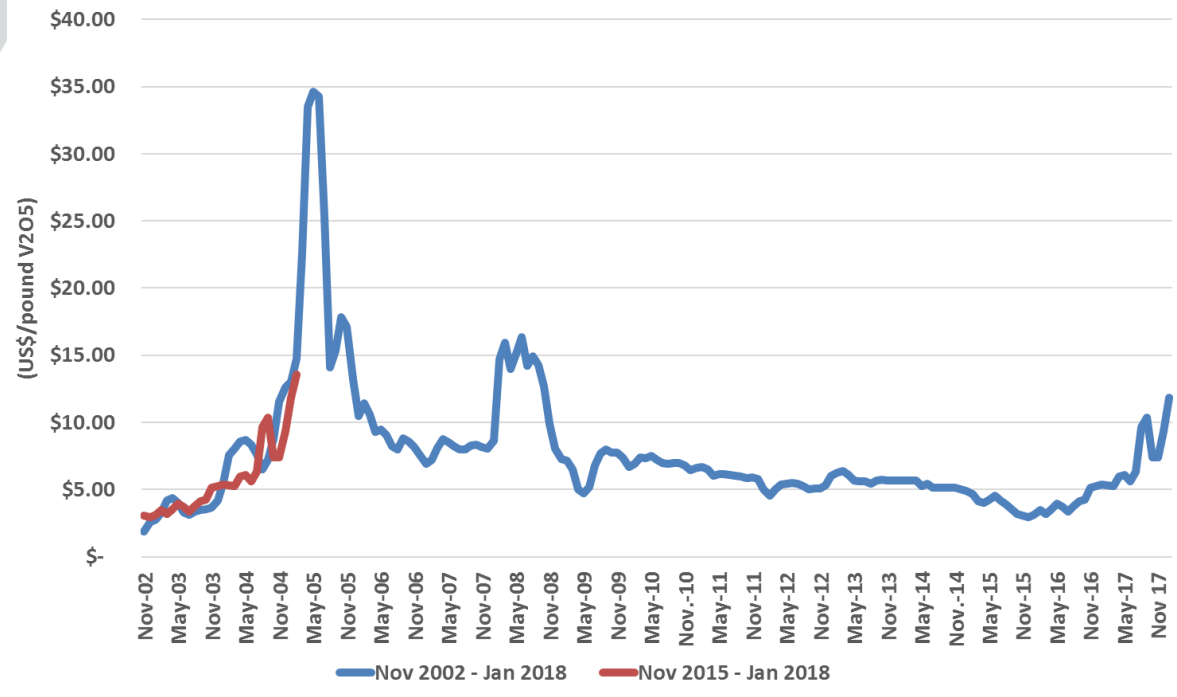


Vanadium Markets - Steel

Global inventory levels are decreasing as evidenced by rising prices over the past three years.

- Ferrovandium prices in China have risen to about \$62 per kilogram
- Vanadium pentoxide prices have risen to \$14/lb*
- Vanadium prices close to six times higher than 2016*
- Supply remains under pressure globally
- Vanadium electrolyte demand increasing
- New Rebar standard in place
- Environmental shutdowns of slag plants ongoing
- Slag imports to China banned from Jan 1 2018
- New Battery demand

Metal Bulletin V2O5 Monthly Midpoint Average Price
inflated to Nov 2017 US\$



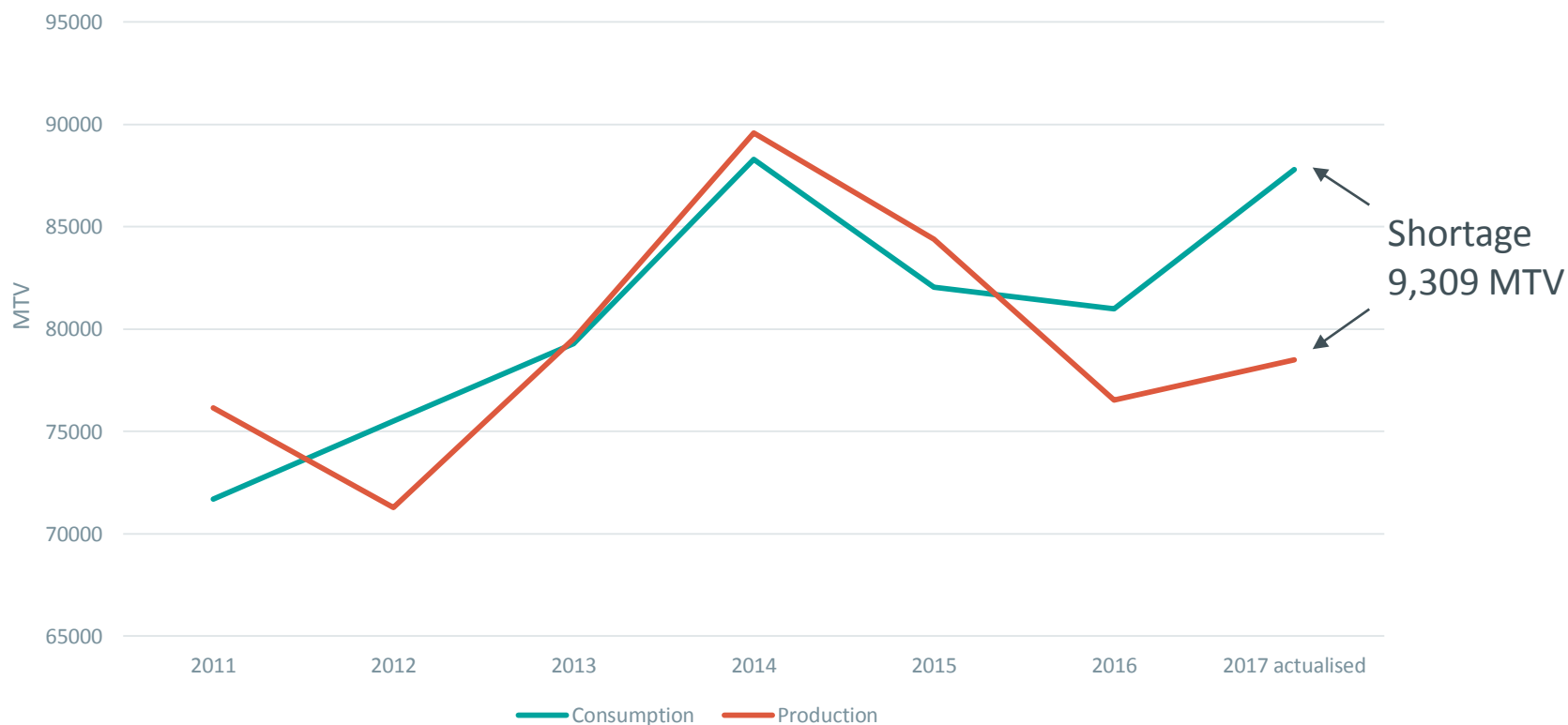
* Source Roskill and Metal Bulletin



Vanadium Markets - Overview

In 2017 (based on three quarter actual results annualized) vanadium consumption exceeded production by more than 9,000 MTV, or over 10% of the market.

Global Vanadium Production vs Consumption



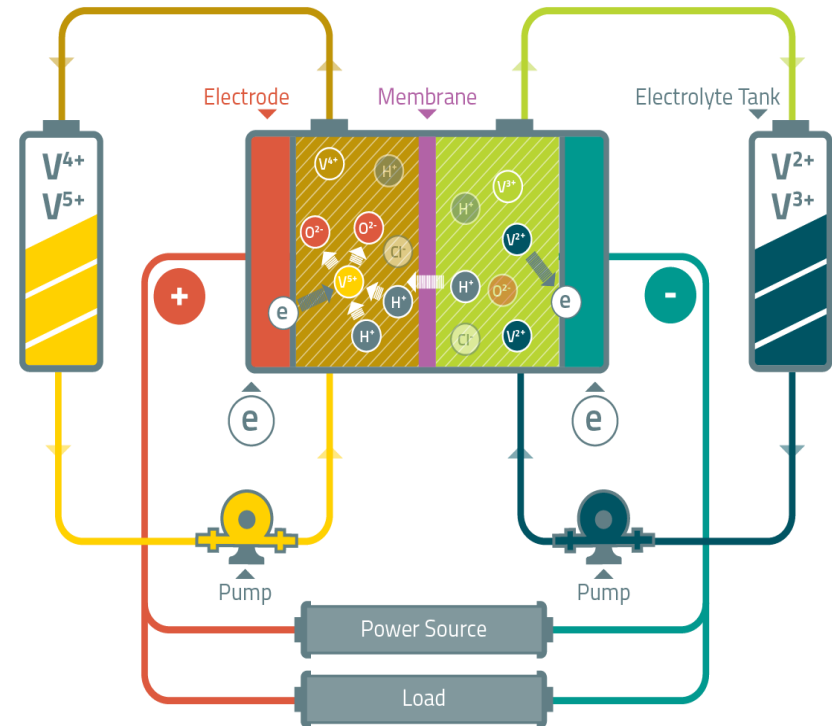
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Vanadium Markets – Energy Storage

Unique characteristics of Vanadium Redox Flow Batteries (VRFBs)

- Flow battery technology is well established and at commercial deployment status
- 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
 - Excellent charge retention (up to 1 year)
 - Suitable for grid connection
 - Can discharge 100% with no damage
 - Improved safety and low replacement rate compared to Li-ion (lower lifetime LCOE)

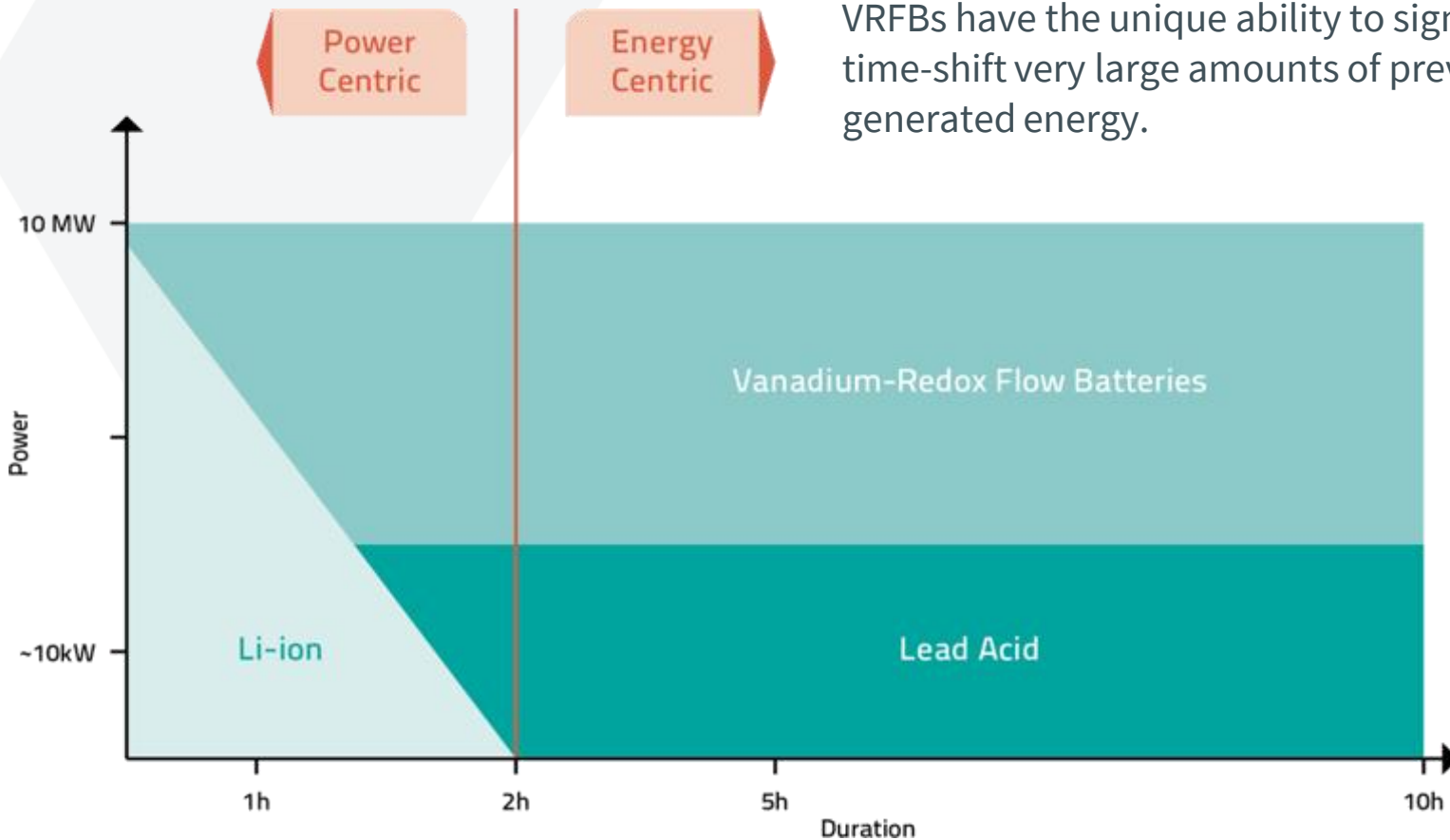




Vanadium Markets – Energy Storage

Defining the space for flow battery technology

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VRFBs have the unique ability to significantly time-shift very large amounts of previously generated energy.

Source: GILDEMEISTER Energy Storage



Energy Storage Market Beckons in Australia

Can VRFBs be the ultimate grid energy storage solution for Australia?

- Rising power costs: VRFBs can reduce power bills by peak/off-peak shifting and demand management
- Australia has world's most extended networks - many fringe-of-grid and off-grid opportunities exist
- Battery storage strongly on political agenda: efforts to reduce power price rises and carbon dependency
- VRFB rollout can assist with Australian networks' primary goal – capital cost deferment
- Australian storage market expected to grow to 3000MWh by 2030 (CEC Report 2012).
- VSUN Energy actively identifying multiple residential and commercial storage opportunities, ranging from 5kW of power with 15kWh of energy storage to 40MW of power with 160MWh of energy storage.



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Flow Battery Installation Completed

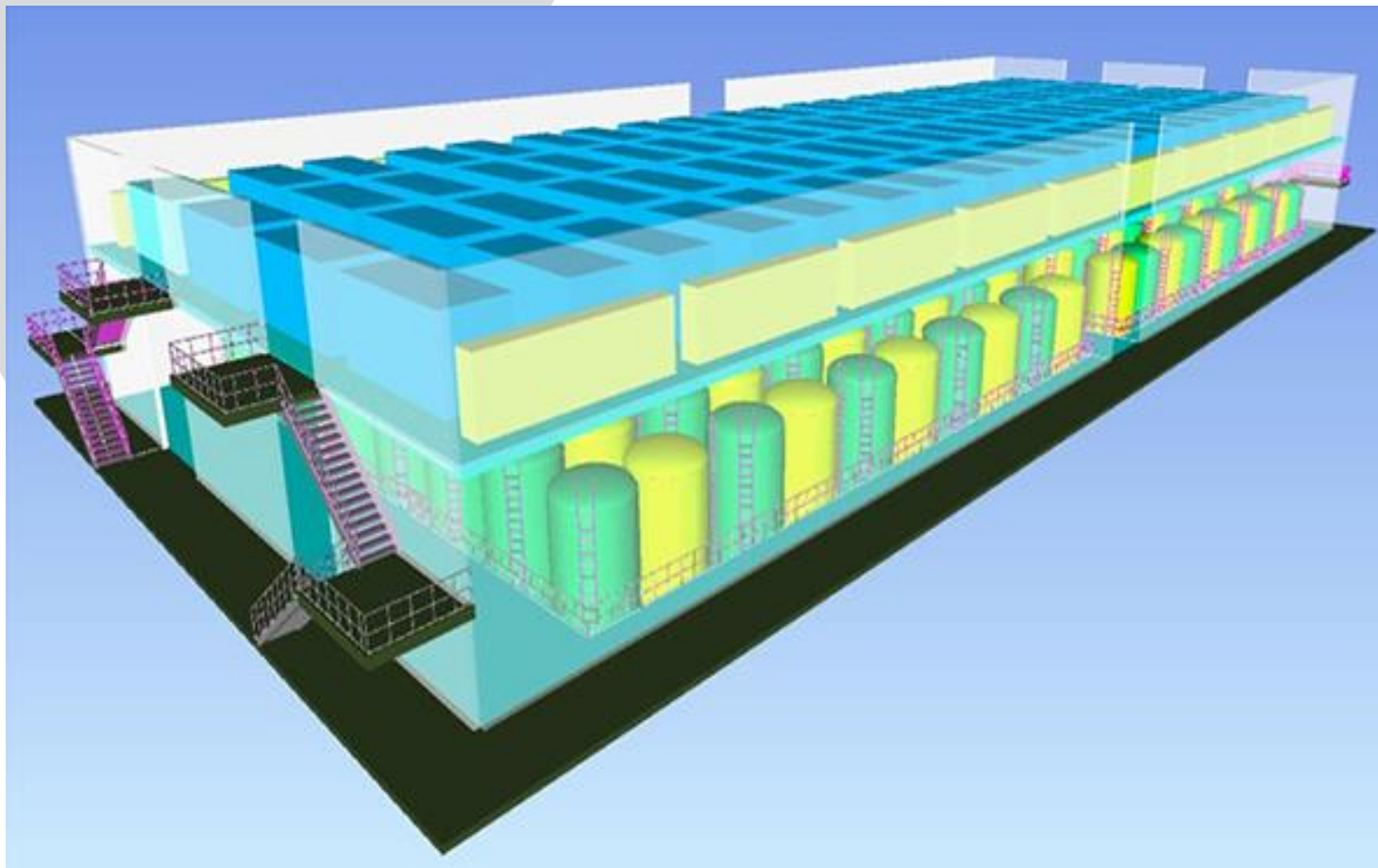
Rural site benefitting from Solar PV plus CellCube VRFB to shift to 100% renewable energy self consumption. First opening into large Australian market.

Largest battery under construction in the world

200MW / 800MWh VRFB in Dalian, China



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Value Addition in V-electrolyte

Vanadium electrolyte production at the source de-risks and adds options

- Vanadium electrolyte is battery “fuel”
- Mild acid solution of V_2O_5 with all oxidation states available for electron transfer
- Can be produced in stand-alone plant or as part of mine process
- Offers unique opportunity to value-add at source location for low cost
- Local production leads to all-important reduction of battery TCO
- Benefits target market by having local “supply” for imported battery units
- High recycle potential for vanadium units
- Pilot plant located in a lab at the University of Western Australia in Perth, commissioned in November 2016



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Vanadium in electrolyte – Market implications



V_2O_5 in H_2SO_4 at 1.6 molar

145g/l

Amount of V_2O_5 used in 1MWh

9.89t

Projected global annual energy storage per year

11GWh

Estimated VRFB installs @ 10%

1GWh

V_2O_5 per year needed to supply VRFB demand

10kt

Current annual global production of V_2O_5 equivalent

140kt



Vanadium in energy storage can have a significant effect on the market



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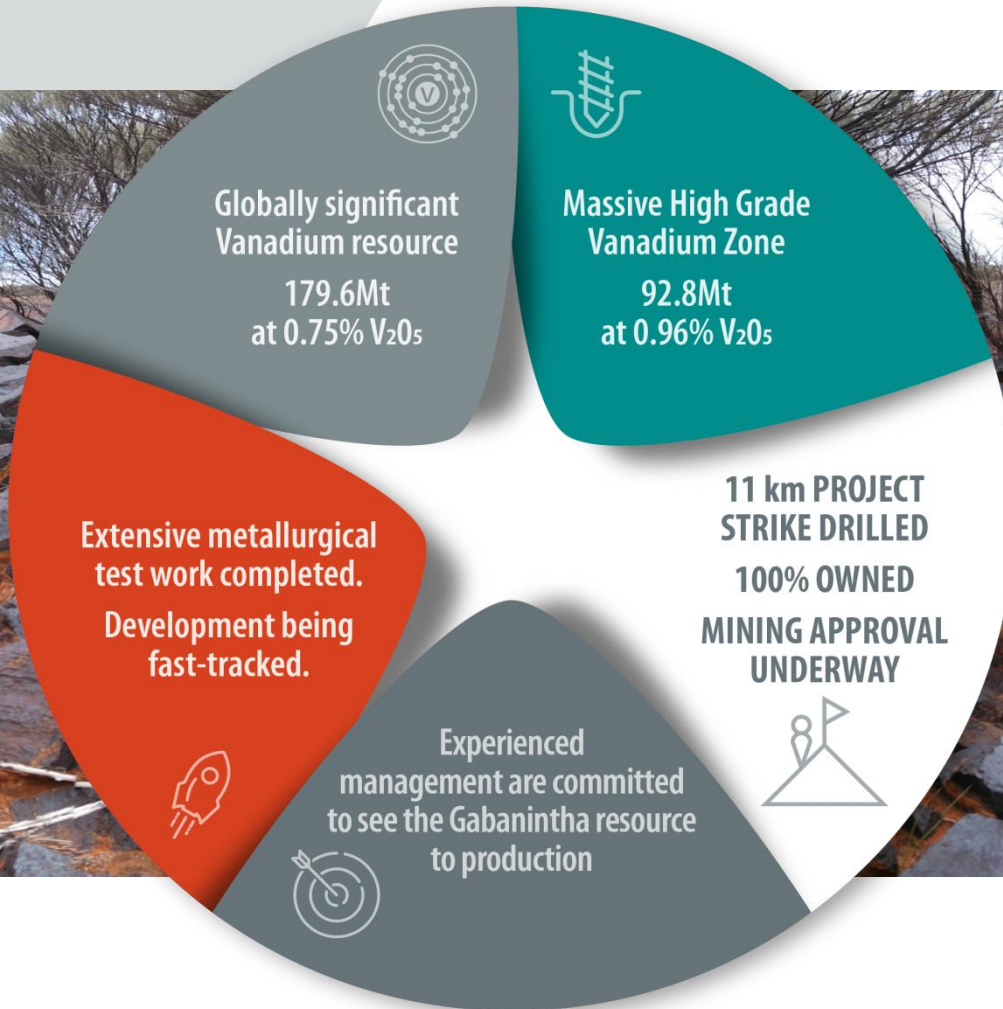
Globally Significant Project

Gabanintha Vanadium Project in Western Australia

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Project Highlights Gabanintha

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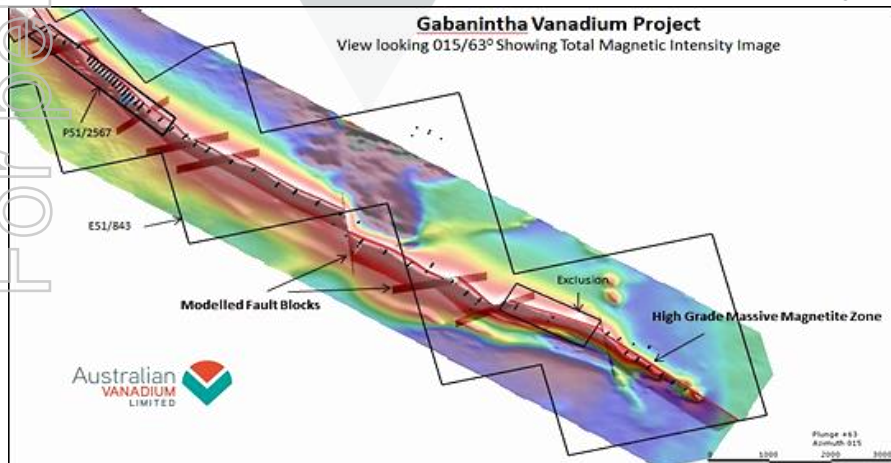


Gabanintha Vanadium Project

High grade resource in favourable mining jurisdiction - Murchison, Western Australia

One of the highest-grade vanadium deposits being advanced globally

- The Mineral Resource includes a distinct massive magnetite high-grade zone of 92.8 Mt at 0.96% V_2O_5 consisting of:
 - Measured Mineral Resource of 10.2Mt at 1.06% V_2O_5 ,
 - Indicated Mineral Resource of 4.8Mt at 1.04% V_2O_5 , and
 - Inferred Mineral Resource of 77.8Mt at 0.94% V_2O_5 .
- Deposit is at surface suitable for open pit operation and open at depth
- High-grade ore feed defined for 15 years @ 1Mt per year
- Total Mineral Resource 179.6Mt at 0.75% vanadium pentoxide (V_2O_5) consisting of:
 - Measured Mineral Resource of 10.2Mt at 1.06% V_2O_5 ,
 - Indicated Mineral Resource of 25.4Mt at 0.62% V_2O_5 , and
 - Inferred Mineral Resource of 144.1Mt at 0.75% V_2O_5 .

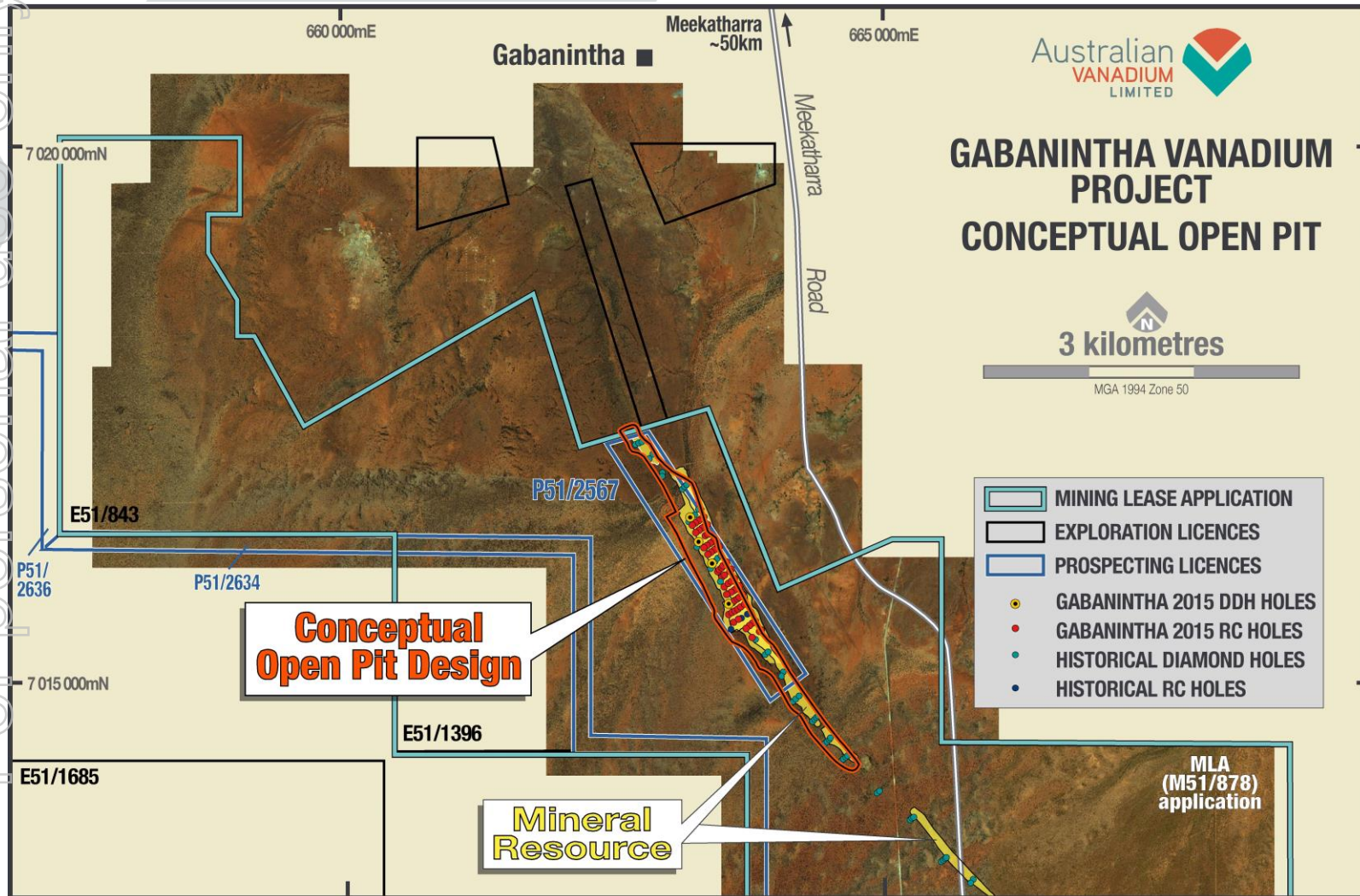


Gabanintha Vanadium Project

Deposit identified over 11km drilled strike length. Good access to infrastructure.



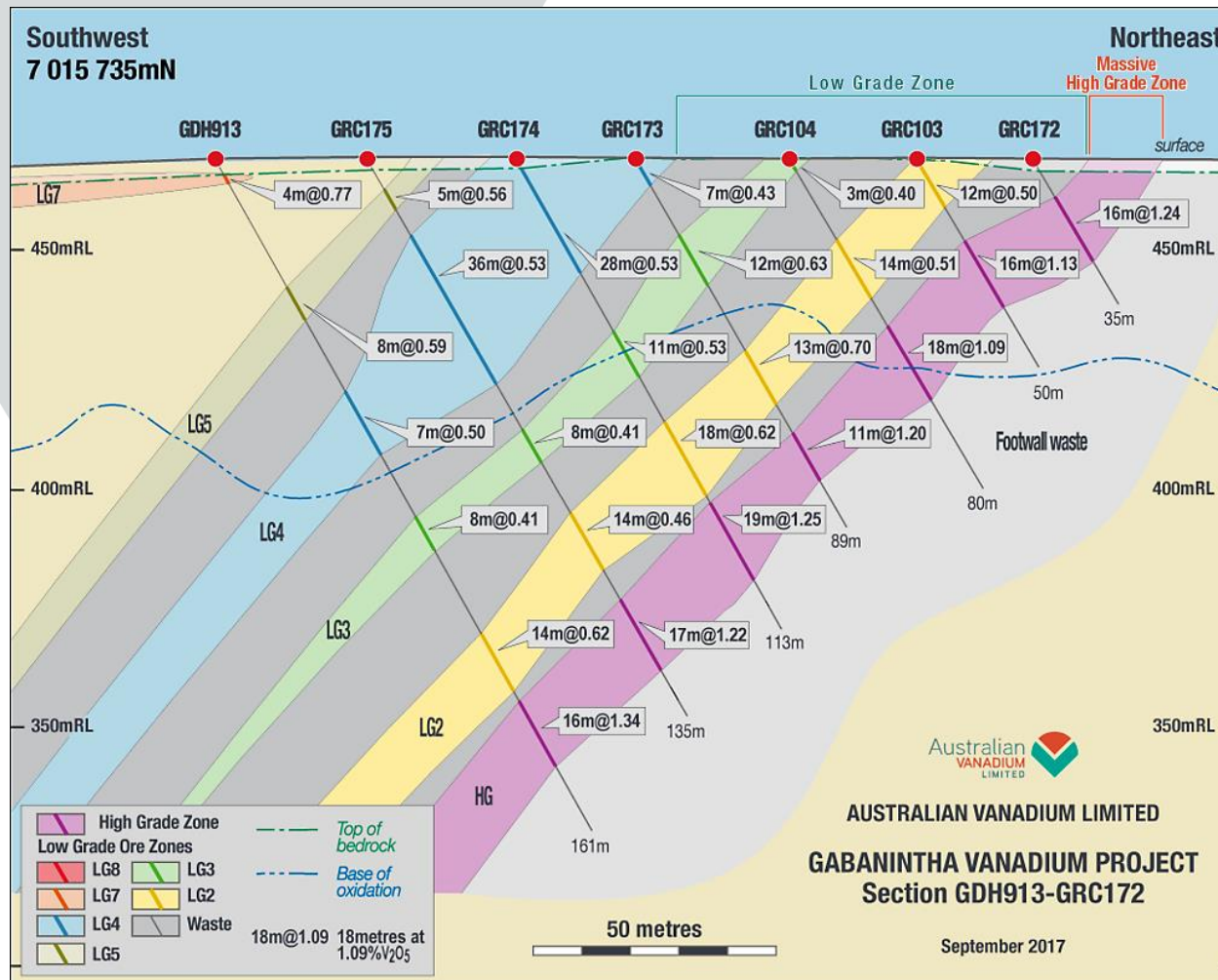
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Gabanintha Vanadium Project

Discrete high-grade zone, simple geometry, suitable for open pit mining



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Vanadium Resource

Resource Table



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Material	JORC Resource Class	Million Tonnes	V ₂ O ₅ %	Fe%	TiO ₂ %	SiO ₂ %	Al ₂ O ₃ %	LOI%
High grade	Measured	10.2	1.06	41.6	12	11.6	8.6	4.2
	Indicated	4.8	1.04	41.9	11.5	12	8	3.6
	Inferred	77.8	0.94	41.2	10.7	12.7	7.9	3.3
Subtotal High Grade		92.8	0.96	41.3	10.9	12.6	8	3.4
Low grade	Indicated	20.5	0.52	24.3	7.1	27.9	17.6	8.4
	Inferred	61.8	0.52	26.2	7	26.9	16.1	7.2
Subtotal Low grade		82.4	0.51	25.7	7	27.2	16.5	7.5
Subtotal Measured	Measured	10.2	1.06	41.6	12	11.6	8.6	4.2
Subtotal Indicated	Indicated	25.4	0.62	27.7	7.9	24.9	15.8	7.5
Subtotal Inferred	Inferred	144.1	0.75	34.4	9	19.2	11.7	5.2
TOTAL		179.6	0.75	33.8	9	19.6	12.1	5.4

Note: Mineral Resource estimate by domain and resource classification using a nominal 0.4% V₂O₅ wireframed cutoff for low grade and nominal 0.7% V₂O₅ wireframed cut-off for high grade (total numbers may not add up due to rounding)

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Metallurgical Test Work

- New test work delivering excellent early results – work ongoing
- Metallurgy and economics focused on opportunities presented by exceptional high grade ore horizon (92Mt at 0.96% V_2O_5 , 15Mt at 1.05% V_2O_5 Measured and Indicated Resources)
- Fresh material high mass recovery (73%), extracting 92.3% of vanadium in a low silica (0.55%) magnetic concentrate grading 1.42% V_2O_5
- Transitional material high mass recovery (73%), extracting 90% of vanadium in a good silica (2.44%) magnetic concentrate grading 1.40% V_2O_5
- Concentrate grades up to 1.72% and 1.66 % achieved, indicating significant upside available from the ongoing test work optimization.
- Results achieved using low mass bench scale DTR and REMS methods.
- Strong recoveries achieved from coarse grind sizes of 100micron, scope to maintain low operating costs.
- Low silica results (below 1% SiO_2) in concentrate offers significant downstream operating cost benefits.
- Focus on conventional vanadium roast-leach technology for processing as used in all world operating Fe-V-Ti projects (Rhovan, Vametco, Largo)

Refer ASX Announcement 20 February 2018: Vanadium Metallurgical Test Work Update



Gabaintha Vanadium Concentrate on pilot scale Low Intensity Magnetic Separation Drum.

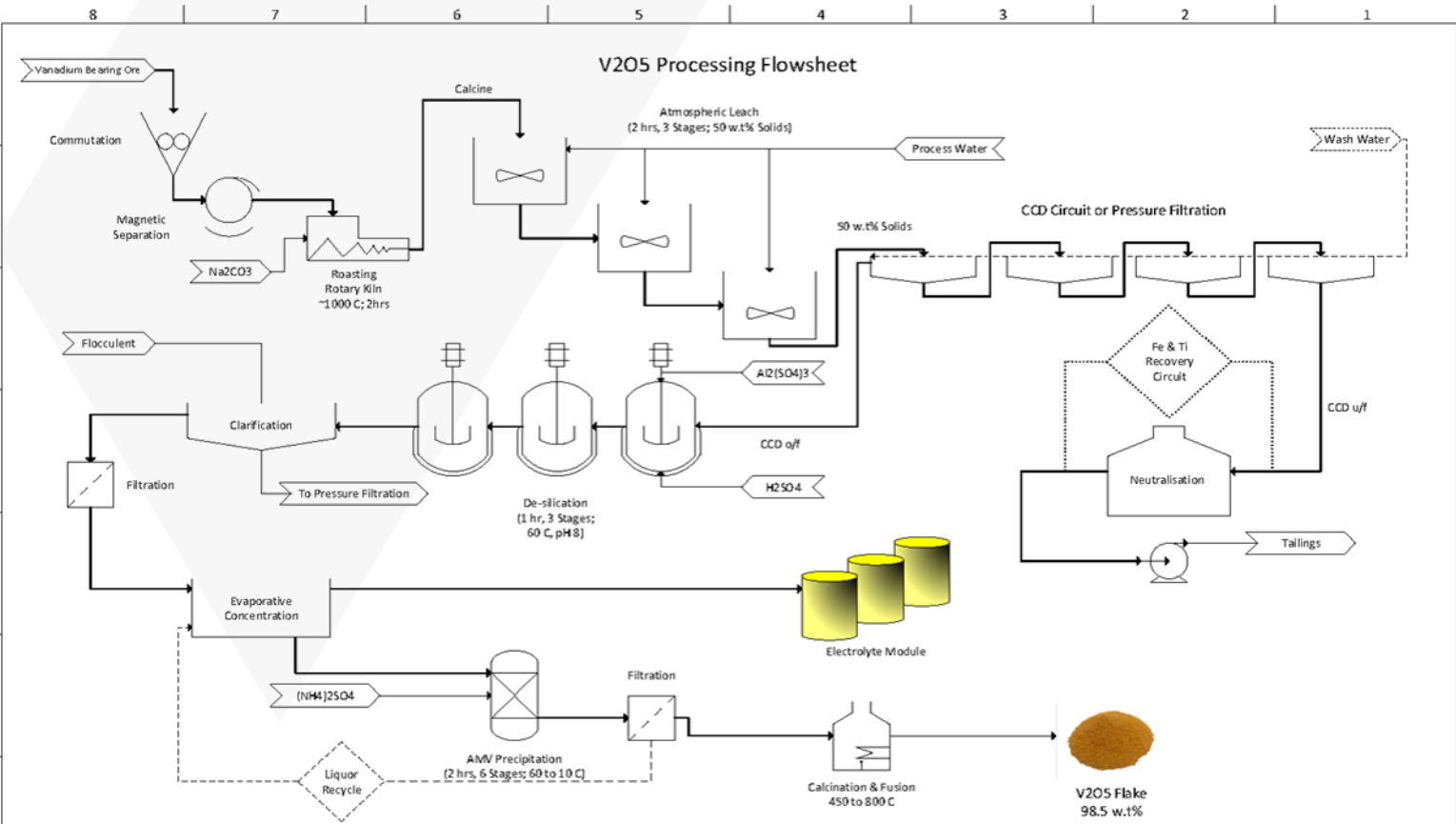
Gabanintha Vanadium Project

Conventional Salt Roast – Aqueous Leach - Proposed Process Flowsheet



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Notes:		Title: GABANINTHA PROJECT-Process Flowsheet		Client: Australian Vanadium Limited				
Last edited: 16/07/2016		Checked by:		1	Issue to Client			MUS
Drawing Number: A01				0	Pre-submission checking			MUS
				8	2 nd Draft			MUS
				A	1 st Draft			MUS
				Revision	Description	Author		



Gabanintha Forward Plan

- Appointment of vanadium industry expert Daniel Harris to the Board of AVL brings key expertise and relationships to execute project.
- Appointment of globally recognised consultants Wood Group to manage test programmes and circuit design.
- Detailed metallurgical test work nearing completion, followed by processing circuit design. Excellent early results indicate robust outcome.
- Mining optimisation and scheduling study to follow metallurgical test results. Preliminary work underway.
- Preliminary Financial Modelling underway.
- Pre-Feasibility Study (PFS) on concentration plant to follow metallurgical work.
- AVL considering all paths to lower time and capital cost to achieve production from Gabanintha.

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