# AVL: unlocking Australia's vanadium advantage

Future Facing Commodities Conference
Singapore, April 2025

ASX:**AVL**

# Compliance & Cautionary Forward-looking Statements

The views expressed in this Presentation contain information derived from publicly available sources that have not been independently verified. No representation or warranty is made as to the accuracy, completeness or reliability of the information.

## Forward Looking Statements

This Presentation may contain certain forward-looking statements with respect to matters including but not limited to the financial condition, results of operations and business of AVL and certain of the plans and objectives of AVL with respect to these items. These forward-looking statements are not historical facts but rather are based on AVL's current expectations, estimates and projections about the industry in which AVL operates and its beliefs and assumptions.

Words such as "anticipates," "considers," "expects," "intends," "plans," "believes," "seeks," "estimates", "guidance" and similar expressions are intended to identify forward looking statements and should be considered an at-risk statement. Such statements are subject to certain risks and uncertainties, particularly those risks or uncertainties inherent in the industry in which AVL operates.

These statements are not guarantees of future performance and are subject to known and unknown risks, uncertainties, and other factors, some of which are beyond the control of AVL, are difficult to predict and could cause actual results to differ materially from those expressed or forecasted in the 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.

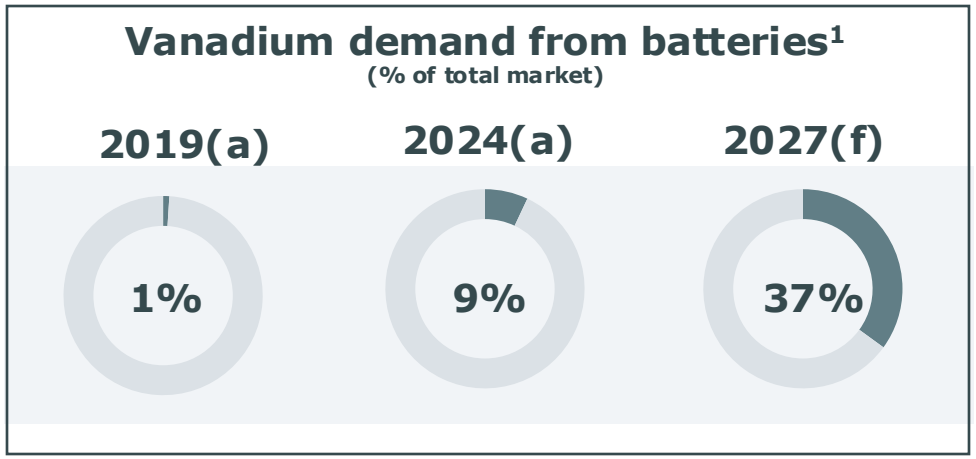
AVL cautions shareholders and prospective shareholders not to place undue reliance on these forward-looking statements, which relate only to events as of the date on which the statements are made.

***ASX Listing Rule 5.23*** The information in this announcement relating to mineral resource estimates for the Australian Vanadium Project is extracted from the announcement entitled '39% Increase in High Grade Measured and Indicated Mineral Resource' released to the ASX on 7 May 2024. The relevant announcement is available on the Company's website www.avl.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 announcements, and that all material assumptions and technical parameters underpinning the estimates in the original 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 announcements.

# Vanadium 101

## Demand

Vanadium market demand is currently dominated by use in the steel industry, although its exposure to the energy transition through vanadium flow batteries (VFBs) could provide a sizeable diversification from steel.

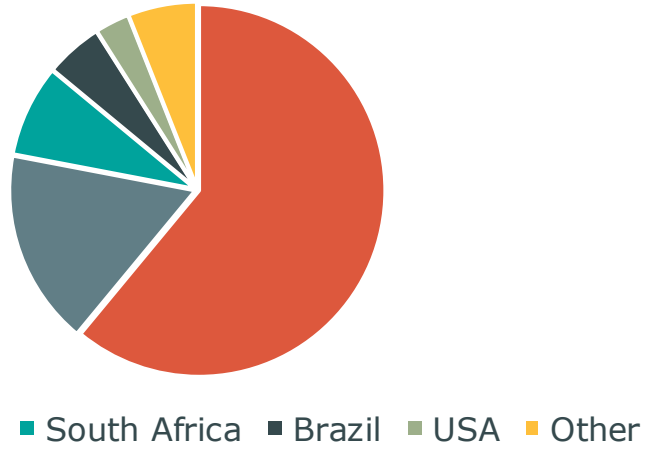



(a) actual (f) forecast

## Supply

Global vanadium market of 133,000 MTV* in 2024. Over 75% of global vanadium supply currently sourced from China, Russia and South Africa.

**Global Vanadium Supply[1]**




* MTV is metric tonne unit of vanadium

1. US based vanadium market specialist, TTP Squared, Inc

# AVL is vertically integrated to generate value across the supply chain

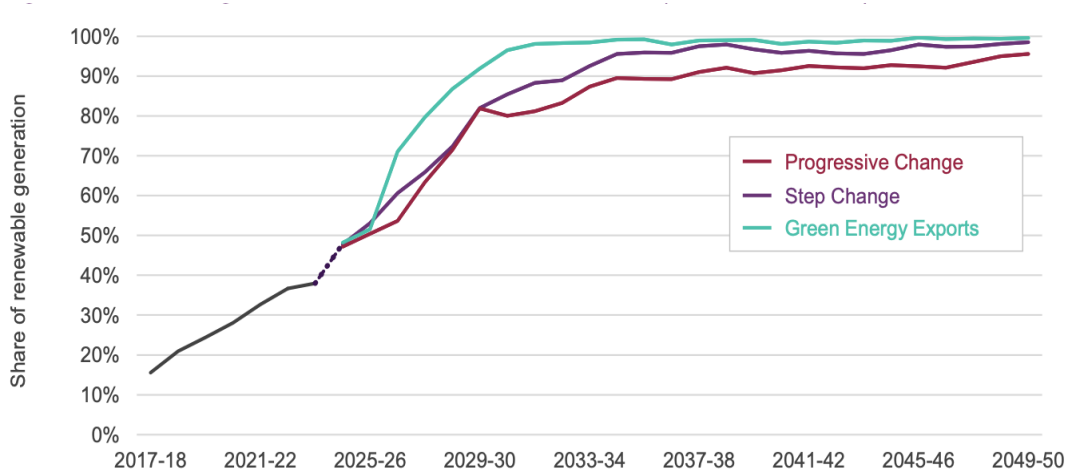
| | Upstream | Midstream | Downstream |
|---|---|---|---|
| |  **Vanadium mining and processing** |  **Vanadium electrolyte manufacture** |  **Utility scale vanadium flow batteries** |
| **AVL Asset** | Australian Vanadium Project | Electrolyte manufacturing facility | VSUN Energy |
| **AVL competitive advantage** | High-grade project in Tier-1 jurisdiction capable of potentially delivering future oxide production for VFB BESS electrolyte[1] | Operational facility.[2] Electrolyte being qualified for utilisation with leading VFB OEMs | Commercial VFB BESS projects and the development of Project Lumina positions VSUN Energy as a leader in VFB BESS deployment in Australia[3] |

1. See ASX announcement dated 7 May 2024, '*39% increase in HG Measured and Indicated Mineral Resource*'
2. See ASX announcement dated 16 September 2024, '*Electrolyte Successfully Deployed in VFB for Horizon Power*'
3. See ASX announcement dated 6 November 2024, '*Realising AVL's Utility-Scale Vanadium Flow Battery Strategy*'

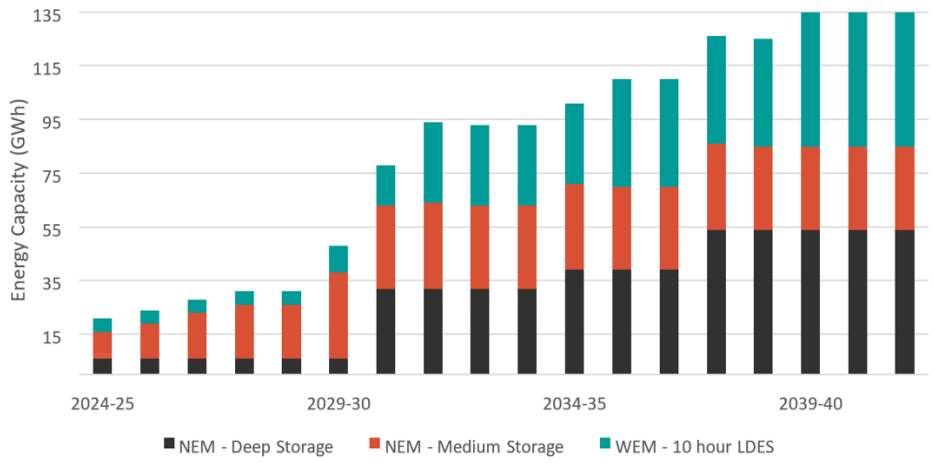
# An Australian VFB industry unlocks demand for vanadium

# Transitioning Australia's NEM[1] will not happen without rapid growth in longer duration energy storage

## Generation from renewable sources – NEM (%)




## Deep/medium energy storage (ex pumped hydro)




Renewable energy generation is set to rapidly increase …

… driving the need for long duration storage to stabilise the grid

## Australia's addressable market for VFB BESS

**120 GWh by 2040**
(excluding pumped hydro)

**Annual growth of 7 GWh over ~25 years**

**Implied average duration 11 hours**
(excluding pumped hydro)

1. AEMO – Australian Energy Market Operator, NEM – National Electricity Market (the electricity market of the eastern and southeastern states of Australia), WEM – Wholesale Electricity Market (the electricity market of Western Australia's South-West Interconnected System – SWIS)

Source: AEMO, 2024 Integrated System Plan for the National Electricity Market

# Why VFB BESS[1] is best positioned to meet demand for long duration storage

**Zero**

Thermal event risk – VFB is a non-flammable technology

**>99%**

VFB commercial end-of-life reuse and recyclability[3]

**Proven**

Nearly 20-year history of grid-connected VFB BESS

**Cost**

VFB BESS competitive on a LCOS basis to lithium-ion BESS[2]

**30+**

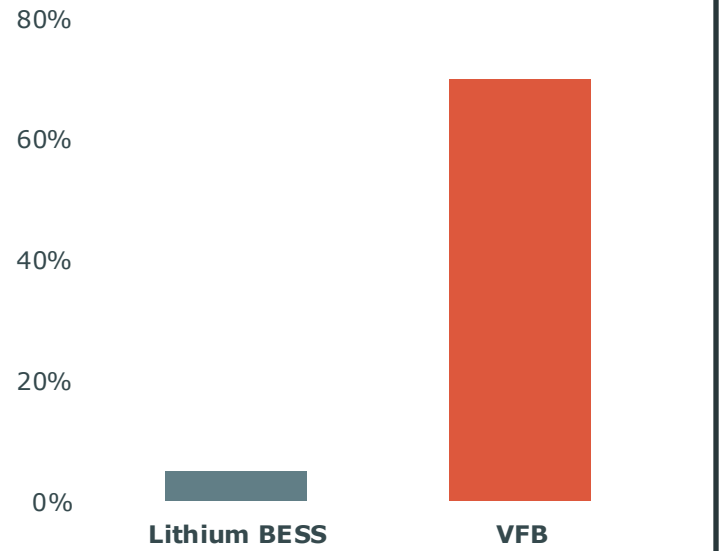
Years

VFB BESS asset life

**Australian**

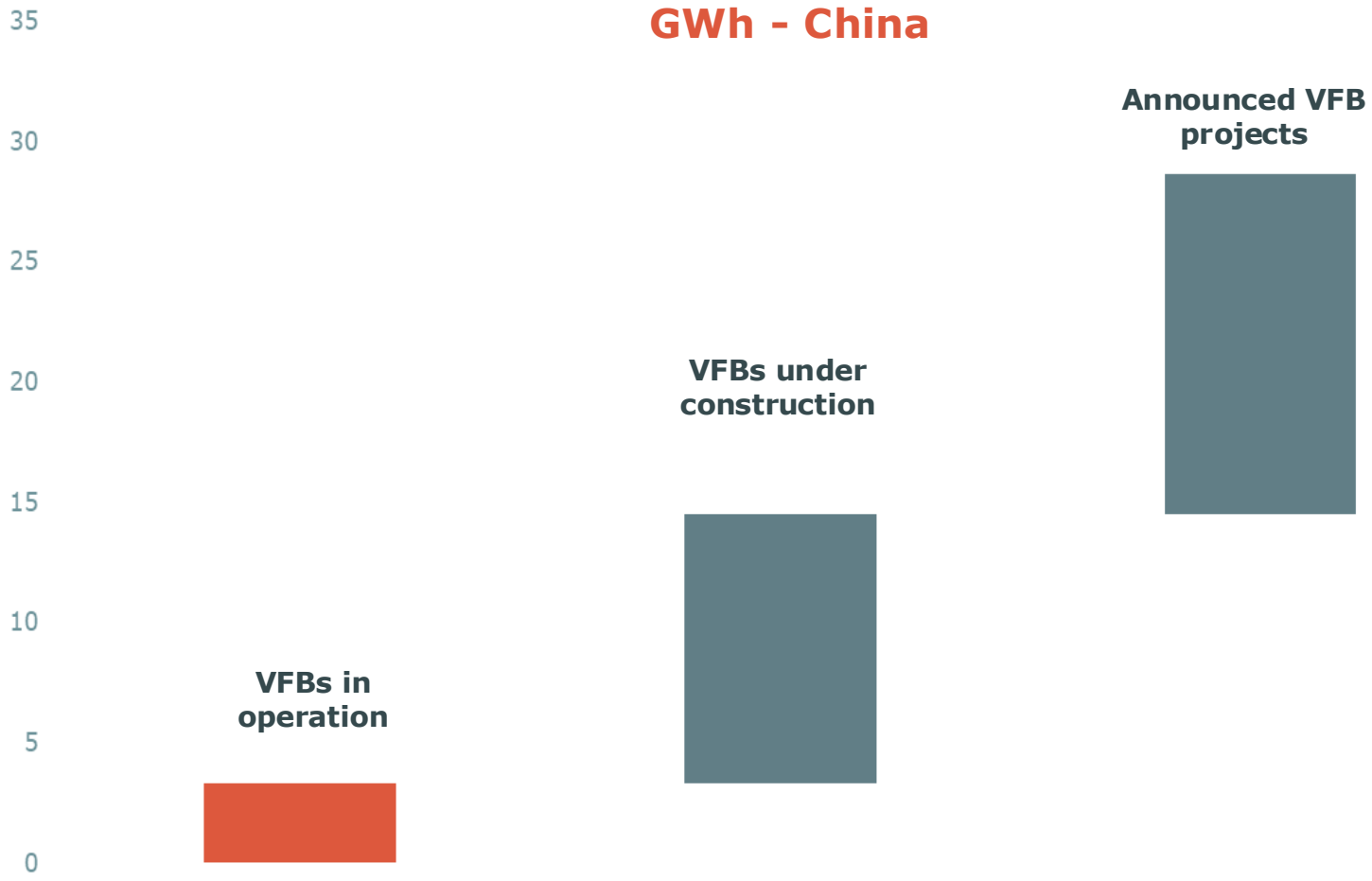
VFB technology designed by UNSW and CSIRO in 1970s

## AVL targeting a high level of local content to VFB deployment




1. VFB BESS: A battery energy storage system based on vanadium flow batteries
2. LCOS: Levelised Cost of Storage. See dated ASX announcement dated 6 November 2024 '*Realising AVL's utility scale vanadium flow battery strategy*'
3. Sumitomo Electric – sumitomoelectric.com/products/flow-batteries/features

# VFB adoption in China is already at GWh scale
# Australia has all the right ingredients to be a fast follower




Source: https://vanitec.org/vanadium/map and China Iron & Steel Research Institute Group (CISRI) VTC Workshop 23 October 2024

# Vanadium flow batteries are now proven at scale globally, gigafactory manufacturing capacity continues to expand

400MWh

700MWh

400MWh

400MWh

400MWh


RKP fully automated gigafactory – 1GWh

## Announced Gigafactories

| Date Gigafactory Announced | Capacity (per year) |
|---|---|
| January 2023 | 1GWh |
| February 2023 | 4GWh |
| March 2023 | 1GWh |
| April 2023 | 4GWh |
| September 2023 | 2GWh |
| November 2023 | 1GWh |
| December 2024 | 1GWh |
| March 2024 | 2GWh |
| May 2024 | 1GWh |
| June 2024 | 4GWh |
| October 2024 | 3GWh |
| December 2024 | 2.5GWh |
| December 2024 | 2GWh |
| December 2024 | 0.5GWh |
| January 2025 | 2GWh |
| January 2025 | 4GWh |
| **Total** | **35GWh** |

Source: Vanitec – www.vanitec.org/latest-from-vanitec/category/news/

# VSUN Energy – Advancing opportunities across five states
## Growing government support for LDES[1] across Australia

### Western Australia – $150M funding for 50MW/500MWh 10-hour VFB BESS

Roger Cook & WA Labor

**DOING WHAT'S RIGHT FOR WA**

MEDIA RELEASE

Thursday, 30 January 2025

**Australian-first battery project to reinforce Kalgoorlie's energy system**

- Re-elected Cook Labor Government will invest $150 million in WA-made vanadium battery
- Project will further reinforce Kalgoorlie's energy system and create around 150 jobs
- Cook Government has secured additional gas back-up generation for the Goldfields and is well underway with the process to replace West Kalgoorlie Power Station by 2026
- Project to stimulate WA's emerging vanadium industry and create opportunities for local battery manufacturing in Kalgoorlie

### New South Wales – support for storage projects of at least 8 hours

**NSW powers ahead with biggest energy storage tender**

nsw.gov.au/media-releases/nsw-biggest-energy-storage-tender Printed: 31 May 2024

Published: 31 May 2024

Released by: Minister for Energy and Climate Change

NSW has opened the largest energy storage tender in NSW history, seeking new long-duration storage projects to boost electricity reliability and keep the lights on in NSW.

These projects will help ensure a steady and reliable supply of energy around the clock. They will play a significant role in the NSW Government's transition to renewable energy, which will deliver reliable and affordable power to households and businesses at the same time as driving down emissions to meet our net zero targets.

Long-duration storage projects can bid for financial support under the new NSW Electricity Infrastructure Roadmap Tender 5 which is now open. This tender offers support for up to 1 gigawatt of projects, which can each release energy into the NSW grid for at least 8 hours.

### Federal Government support packages target 4-hour projects

Australian Government

**The Capacity Investment Scheme**

The Capacity Investment Scheme (CIS) Tender 3 – National Electricity Market (NEM) – Dispatchable (CIS Tender 3) Stage A has closed, and Project Bids are being assessed.

**About the Tender**

Tender 3 is a competitive process to secure dispatchable capacity in the National Electricity Market (NEM).

The Tender is seeking an indicative target of 4 GW of four-hour equivalent dispatchable capacity, or 16 GWh of dispatchable capacity, that will be operational before 31 December 2029.

1. LDES: Long duration energy storage

# AVL developing a utility scale vanadium flow battery for Australian conditions – Project Lumina[1]

## Project Lumina

- AVL launched a detailed design of a scalable, turnkey, utility-scale VFB BESS designed for Australian conditions.
- Targeting FID by Q3 2025
- Detailed design, engineering, costing and EPCM pathway will be utilised to tender into opportunities like the Kalgoorlie 500MWh VFB BESS

## Developing a deconstructed VFB

A deconstructed VFB removes electrolyte tanks and pumps from containers delivering material benefits including:

- Rapid deployment
- Ease and low capital intensity of duration extension
- Capital cost efficiencies
- Reduced shipping and logistic costs

## Ability to capture downstream value

- Utilise proven cell stack technology
- Leverage readily available components (pumps, pipes, tanks) to reduce costs, elevate local content and increase design flexibility
- Scalable in ~15MW and ~2h duration increments
- Designed for + 30year operational life

## Initial Partners

- Secured key technology provider and early contractor involvement

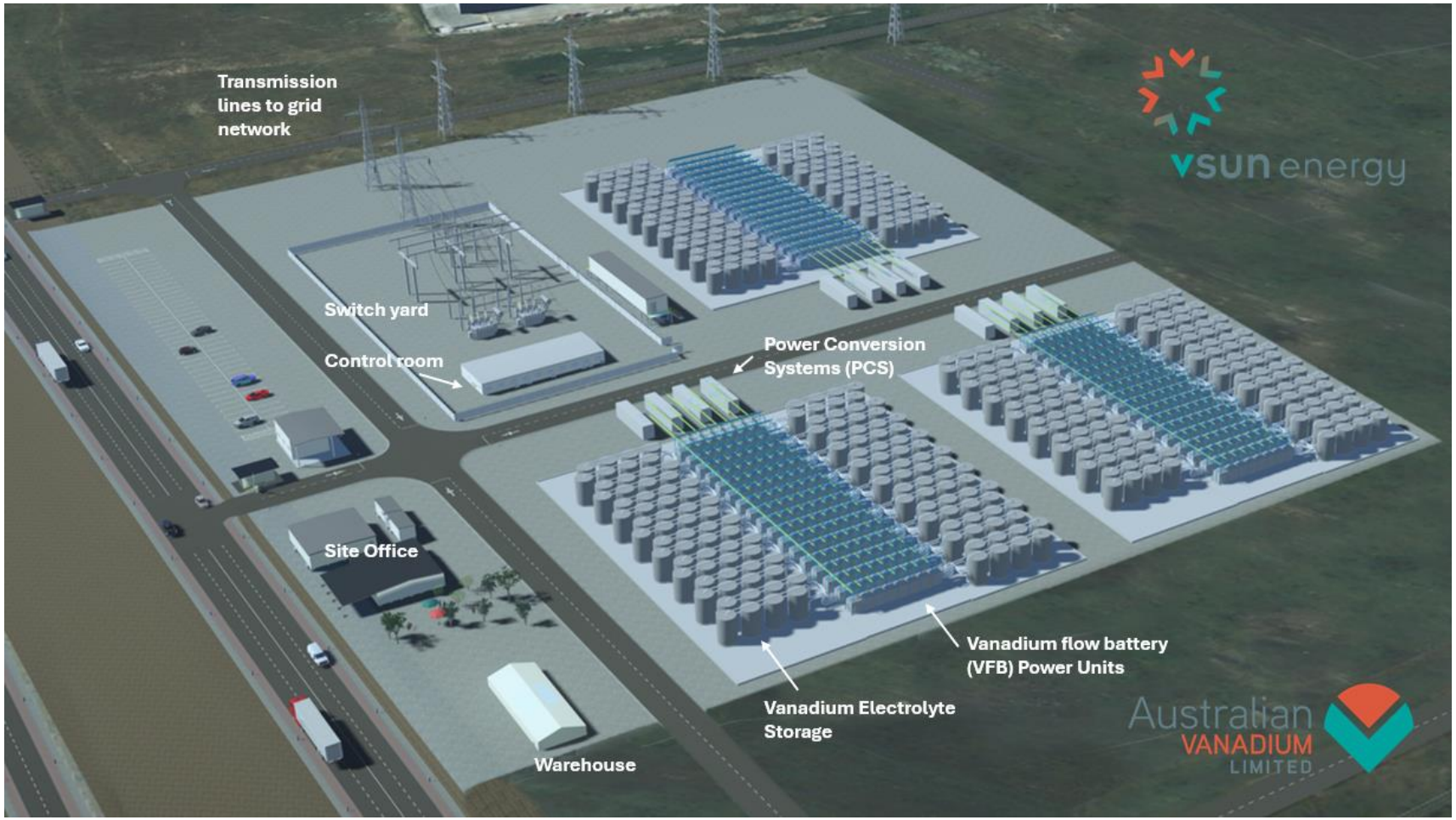
GENUS

SEDGMAN

cellcube

1. See ASX announcement dated 6 November 2024, '*Realising AVL's Utility-Scale Vanadium Flow Battery Strategy*'

# Project Lumina: a turnkey VFB BESS architecture tailored for Australian build-own-operate delivery



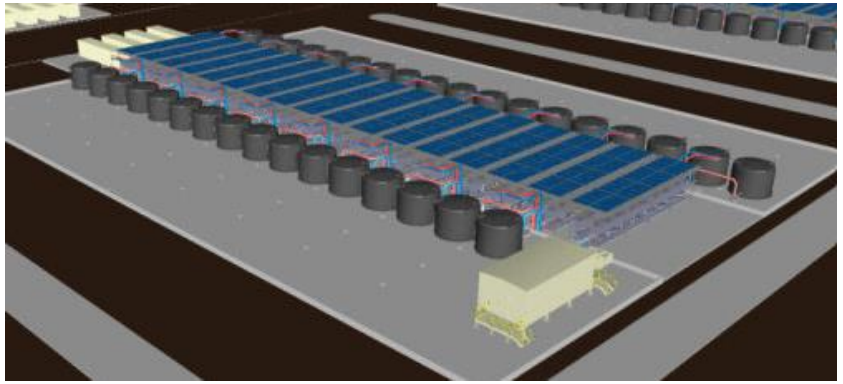

**Example 50MW 10-hour (500MWh) VFB BESS Layout**

- Simple and scalable supply chain: vanadium, tanks, pumps, piping, power stacks
- Configuration optionality to meet specific land requirements
- Utilisation of industry standard inverters allows grid forming/firming, FCAS, black start, etc
- VFB BESS can do what lithium-ion BESS can do and more
- Targeting +70% local content
- Low-cost duration augmentation to match evolving market conditions

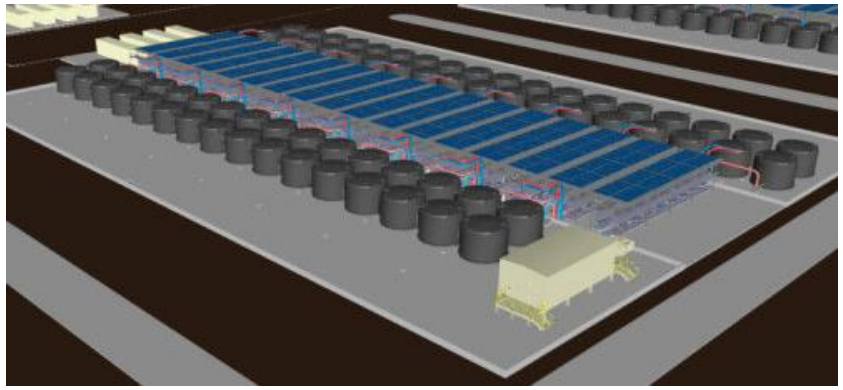
1. See ASX announcement dated 6 November 2024, '*Realising AVL's Utility-Scale Vanadium Flow Battery Strategy*'

# Matching duration to the market:
# Extending duration is as simple as adding tank capacity

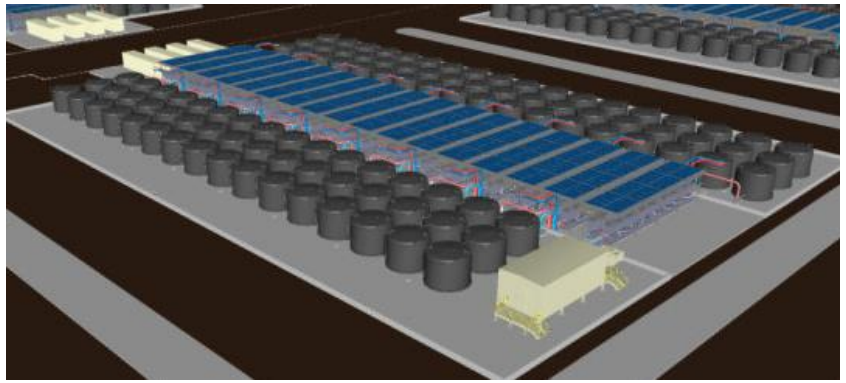
**2 Hour Duration**



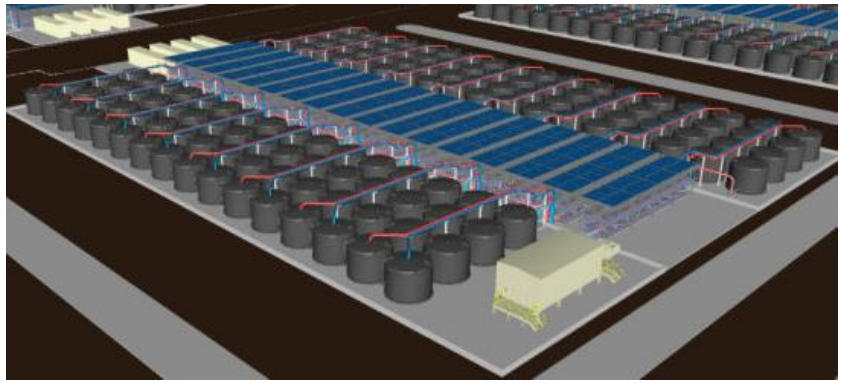
**4 Hour Duration**



**6 Hour Duration**



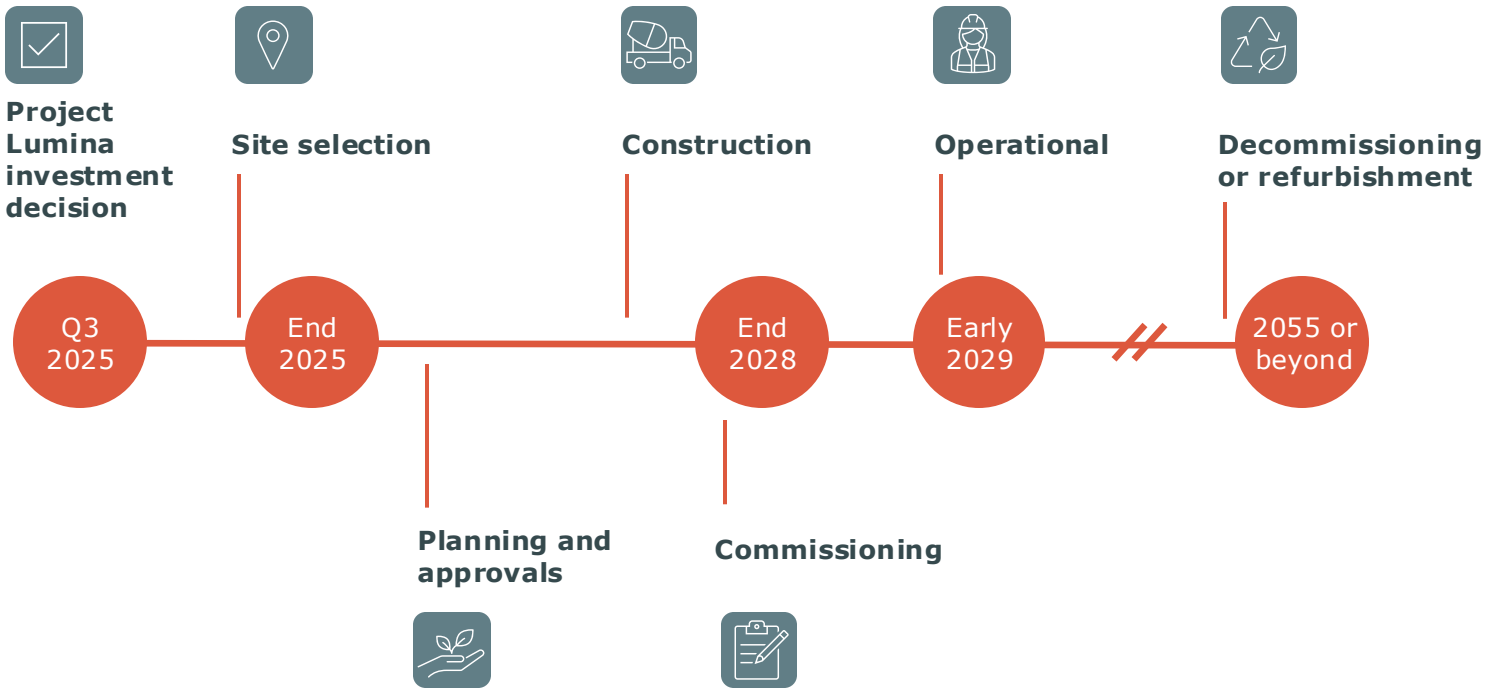
**8 Hour Duration**



- Deconstructed approach to VFB BESS deployment allows for low capital intensity duration expansion
- Future proofs the VFB BESS to allow for capacity additions as market pricing signals mature
- Ability to expand beyond 12 hours

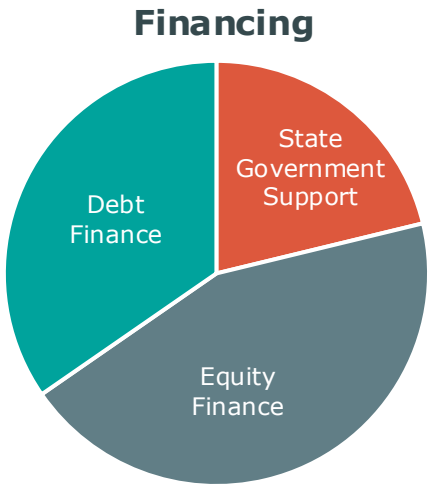
# Funding framework and development timeframe

## Indicative project timeline




## Funding example

The Melbourne Renewable Energy Hub will be one of Australia's largest lithium-ion BESS projects with an initial capacity of 600MW/1600MWh. Project capital is expected to cost $1.2bn, supported by equity financing from the State Electricity Commission of Victoria.




Source: https://infrastructurepipeline.org/project/melbourne-renewable-energy-hub-phase-1

# VFB strategy supported by the Australian Vanadium Project

# A single utility scale VFB BESS unlocks globally significant demand for vanadium

**50MW/ 500MWh**

**VFB BESS**

≈

**4kt**

$V_2O_5$ demand[1]

≈

**c.1.7%**

Of global $V_2O_5$ supply[2]

1. AVL internal, utility scale VFB BESS modelling
2. TTP Squared, Inc – 2024 global vanadium market size 133,000 metric tonnes vanadium (equivalent to 237kt $V_2O_5$)

# The world class Australian Vanadium Project is at the core of our vertical integration strategy

- A world class asset located in Western Australia, a Tier-1 mining jurisdiction
- Simple open pit mining with standard magnetite concentrator process
- Global vanadium MRE of 395.4Mt at 0.77% $V_2O_5$ including 104.5Mt at 1.12% $V_2O_5$ classified as Measured or Indicated[1]
- Optimised Feasibility Study underway, aimed at creating project with superior economics[2]
- Current focus on finalising remaining approvals, while securing offtake and funding


1. See ASX announcement dated 7 May 2024, '*39% increase in HG Measured and Indicated Mineral Resource*'
2. Refer ASX announcement 2 July 2024, '*Completion of First Phase of Optimised Feasibility Study*'

# Optimised Feasibility Study advancing the Australian Vanadium Project

**The first phase of the OFS[1] for the Australian Vanadium Project (Project) delivered key outcomes to unlock further advancement of the project**

### Updated mineral resource estimate

AVL has delivered an updated MRE for the consolidated Project, showing a 39% increase in Measured and Indicated categories for the high vanadium grade domain and increased iron concentrate grades

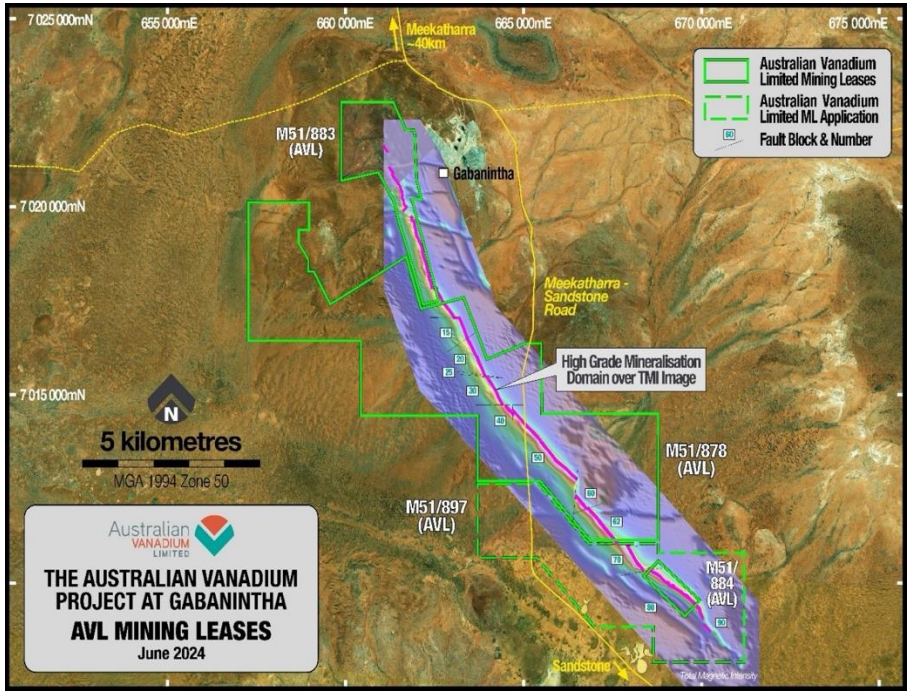
### Initial mining location

Identified the southern blocks of the Project, with higher vanadium and iron concentrate grades and favourable weathering attributes for economic mining

### Processing plant location

Completed a key trade-off study that has determined Tenindewa, near Geraldton in Western Australia, as the preferred location for the downstream processing plant for the Project[2]

### Location and Tenure of The Australian Vanadium Project showing fault block numbering[2]




1. See ASX announcement dated 2 July 2024, '*Completion of First Phase of Optimised Feasibility Study*'
2. See ASX announcement dated 7 May 2024, '*39% Increase in HG Measured and Indicated Mineral Resource*'

# Significant deliverables in advancing the Australian Vanadium Project towards FID

## Delivered

- ☑ Bankable Feasibility Study (pre-merger basis)[1]
- ☑ Mining leases approved[2]
- ☑ Completion of large-scale process plant pilot programs[3]
- ☑ Australian Government grant for up to $49 million[4]
- ☑ Merger to deliver project synergies[5]
- ☑ Combined Mineral Resource Estimate update[6]
- ☑ Significant EPA approval received[7]
- ☑ Green Energy Major Project status to support streamlined approvals outcomes[8]

## Upcoming catalysts

- ☐ Complete integrated OFS[9] targeting Q3 CY2025
- ☐ Progress approvals including full EPA approval and Traditional Owner agreement – targeting Q2 CY2025 for Environmental Review Document submission
- ☐ Permitting of proposed Tenindewa processing site[10]
- ☐ Secure bankable offtake to support project finance
- ☐ Deliver Final Investment Decision

1. See ASX announcement dated 6 April 2022, '*Bankable Feasibility Study for Australian Vanadium Project*'
2. See ASX announcement dated 31 August 2020, '*Mining Lease Granted for Australian Vanadium Project*'
3. See ASX announcement dated 8 June 2021, '*High Vanadium Extractions Confirmed in Pellet Leach Pilot*'
4. See ASX announcement dated 30 May 2023, '*$49 Million Government Grant Agreement Executed*'
5. See ASX announcement dated 1 February 2024, '*Successful Implementation of AVL and TMT Merger*'
6. See ASX announcement dated 7 May 2024, '*39% Increase in HG Measured and Indicated Mineral Resource*'
7. See ASX announcement dated 13 January 2025, '*AVL Secures EPA Approval for Gabanintha Vanadium Project*'
8. See ASX announcement dated 29 January 2025, '*Green Energy Major Project Status Granted*'
9. See ASX announcement dated 2 July 2024, '*Completion of First Phase of Optimised Feasibility Study*'
10. See ASX announcement dated 6 August 2024, '*Council Support for Vanadium Processing Site Near Geraldton*'

# Conclusion and Investment Highlights

# Vanadium: delivering positive economic outcomes for Western Australia



| Benefits for Western Australia | Vanadium |
|---|---|
| 1 Growing or improving industrial capability | ✓ |
| 2 Helping industry pursue value-adding opportunities | ✓ |
| 3 Improving economic diversity | ✓ |
| 4 Crowding-in private finance | ✓ |
| 5 Decarbonisation | ✓ |
| 6 Creating secure jobs and a skilled, adaptable workforce | ✓ |
| 7 Boosting supply chain resilience | ✓ |
| 8 Commercialising Australian innovation and technology | ✓ |
| 9 Sustainability and circular economy principles and solutions | ✓ |
| 10 Regional development | ✓ |

# Investment highlights

## Australia's grid continues to transition to renewables

- Increases the need for medium-to-long duration storage solutions capable of supporting energy grids
- Growing government support for long duration storage in Australia

## VFBs provide a proven, economic solution for utility scale energy storage

- VFB rapid uptake into GWh scale energy storage systems
- Led by China, with over 20GWh of announced VFB projects

## Ability to capture downstream value

- Competitive levelised cost of storage (LCOS) of VFBs as solution for high growth long duration energy storage market
- VFBs display operational advantages vs Li-ion


## Commercial partnerships in place

- De-risked execution of Project Lumina
- AVL is well positioned to deliver investment ready utility scale VFB BESS solutions

## World class Australian Vanadium Project

- Project provided supply chain scalability and security for VFBs
- Advancing toward investment decision – permitting, offtake, financing

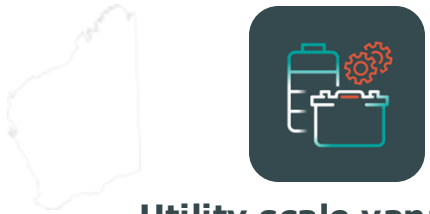
# Appendix

# Upstream
## Grant funding and approvals support

- AVL was awarded a $49 million grant under the Australian Government's Modern Manufacturing Initiative Collaboration Stream (**Grant**)[1]
- The Grant enables AVL to pursue opportunities to minimise project execution risks through enhanced project definition, such as full detailed engineering of key infrastructure and project approvals
- AVL has received an initial two tranches of the Grant totalling $24.5 million[2]
- Continued progression of workstreams at the Australian Vanadium Project has the potential to unlock the remaining funds under the Grant
- AVL will continue to engage with State and Federal Agencies such as NAIF, ARENA, CEFC and National Reconstruction Fund Corporation to maximise utilisation of government and grant funding for the development of critical minerals and clean energy projects
- AVL recently secured EPA approval for the Gabanintha Vanadium Project which forms part of the Australian Vanadium Project[3]
- AVL's Australian Vanadium Project recently secured Green Energy Major Project status from the WA Government[4]
- Recent approval of the Critical Minerals Production Tax Incentive (CMPTI) can materially improve competitiveness of Australian based vanadium projects


1. See ASX announcement dated 30 May 2023, '*$49 Million Government Grant Agreement Executed*'
2. See ASX announcement dated 20 June 2024, '*$14.7 Million Received from Federal Grant*'
3. See ASX announcement dated 13 January 2025, '*AVL Secures EPA Approval for Gabanintha Vanadium Project*'
4. See ASX announcement dated 29 January 2025, '*Green Energy Major Project Status Granted*'

# Government support strongly aligned to AVL's full supply chain solution

| | Upstream | Midstream | Downstream |
|---|---|---|---|
| |  **Vanadium mining and processing** |  **Electrolyte manufacture** |  **Utility scale vanadium flow batteries** |
| **Election Commitment** | ✓ Royalty of 2.5% on vanadium products excluding electrolyte[1] | ✓ Net zero royalty on vanadium electrolyte product[1] | ✓ **Pledged $150m to support development of 50MW 10-hour (500MWh)** vanadium flow battery in Kalgoorlie[2] |
| **Why AVL** | ✓ Australian Vanadium Project[5] is a large high-grade deposit located in WA<br>✓ Granted Major Project Status by WA Government<br>✓ Significant EPA approval received | ✓ AVL has the only commercial electrolyte facility in WA and its locally produced electrolyte is installed in VFB for Horizon Power[4] | ✓ With AVL's vertically integrated vanadium strategy and the work being done on Project Lumina,[5] the Company is well-positioned to pursue opportunities like this proposed Kalgoorlie battery |

1. www.amec.org.au/wp-content/uploads/2025/01/04.-An-important-step-forward-for-Western-Australias-emerging-Vanadium-Industry.pdf
2. www.rogercook.com.au/media/australian-first-battery-project-to-reinforce-kalgoorlie-s-energy-system
5. See ASX announcement dated 31 January 2025, '*Quarterly Activities*
4. See ASX announcement dated 16 September 2024, '*Electrolyte Successfully Deployed in VFB for Horizon Power'*
5. See ASX announcement dated 6 November 2024, '*Realising AVL's Utility-Scale Vanadium Flow Battery Strategy*'

# Midstream
## Proven vanadium electrolyte manufacturing capacity

### AVL built, owns and operates a manufacturing facility in Perth, Western Australia, producing vanadium electrolyte[1]

- 33MWh per annum energy storage equivalent of vanadium electrolyte production, with first production completed in 2024[2]
- First use of AVL's vanadium electrolyte in an Invinity Energy Systems battery for WA utility Horizon Power[3]
- Qualification of electrolyte well advanced with multiple VFB industry leaders
- Ability to scale and replicate facility to meet growing demand
- Ability to process third party vanadium oxides to supply high quality electrolyte prior to AVL oxide production

CEO Graham Arvidson and The Hon Anthony Albanese MP, Prime Minister of Australia, and The Hon Roger Cook MLA, Premier of Western Australia at AVL's electrolyte facility[4]

1. See ASX announcement dated 15 December 2023, '*Vanadium Electrolyte Facility Construction Complete*'
2. See ASX announcement dated 19 March 2024, '*Battery Ready Vanadium Electrolyte Produced*'
3. See ASX announcement dated 16 September 2024, '*Electrolyte Successfully Deployed in VFB for Horizon Power*'
4. See ASX announcement dated 31 January 2025, '*Quarterly Activities Report*'

# Downstream
## VSUN Energy – engaging with mining and utility customers

### IGO Limited

**Nova Nickel Operation (Western Australia)**

Installation of a VFB to provide storage capacity to assist carbon free electricity to be used at the Nova Nickel operation, reducing their $CO_2$ emissions as part of IGO's broader net-zero strategy.

**Status**: Battery operational, standalone power system under final stages of commissioning

### Horizon Power

**Kununurra (Western Australia)**

Horizon Power, a utility owned by the Western Australia government, purchased a VFB installed at Kununurra as part of a long-duration energy storage pilot project. First battery to utilise AVL produced vanadium electrolyte.

**Status**: Commissioned and operational

# Mineral Resource Estimate

| Zone | Category | Mt | $V_2O_5$ % | Fe % | $TiO_2$ % | $SiO_2$ % | $Al_2O_3$ % |
|---|---|---|---|---|---|---|---|
| HG | Measured | 30.6 | 1.14 | 46.3 | 12.9 | 7.4 | 6.2 |
| | Indicated | 74.8 | 1.11 | 47.5 | 12.6 | 7.0 | 5.7 |
| | Inferred | 67.9 | 1.06 | 45.3 | 12.1 | 9.0 | 6.6 |
| | **Subtotal** | **173.2** | **1.09** | **46.5** | **12.5** | **7.8** | **6.1** |
| LG | Indicated | 61.8 | 0.55 | 26.1 | 7.1 | 26.6 | 16.3 |
| | Inferred | 142.5 | 0.48 | 24.9 | 6.6 | 28.9 | 15.2 |
| | **Subtotal** | **204.3** | **0.50** | **25.3** | **6.8** | **28.2** | **15.5** |
| Transported | Inferred | 17.9 | 0.65 | 31.0 | 7.3 | 24.1 | 14.4 |
| | **Subtotal** | **17.9** | **0.65** | **31.0** | **7.3** | **24.1** | **14.4** |
| Total | Measured | 30.6 | 1.13 | 46.3 | 12.9 | 7.4 | 6.2 |
| | Indicated | 136.6 | 0.85 | 37.8 | 10.1 | 15.8 | 10.5 |
| | Inferred | 228.2 | 0.66 | 31.4 | 8.3 | 22.6 | 12.6 |
| | **Subtotal** | **395.4** | **0.77** | **34.8** | **9.3** | **19.1** | **11.4** |

*Note: Totals may not add up due to rounding*

Australian VANADIUM LIMITED

+61 (08) 9321 5594

info@avl.au

www.avl.au

Level 2, 50 Kings Park Road, West Perth,
Western Australia 6005