AVL - the solution to Australia's energy storage needs

Diggers and Dealers Mining Forum

August 2024

ASX:**AVL**

Compliance & Cautionary Forward-looking Statements

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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.

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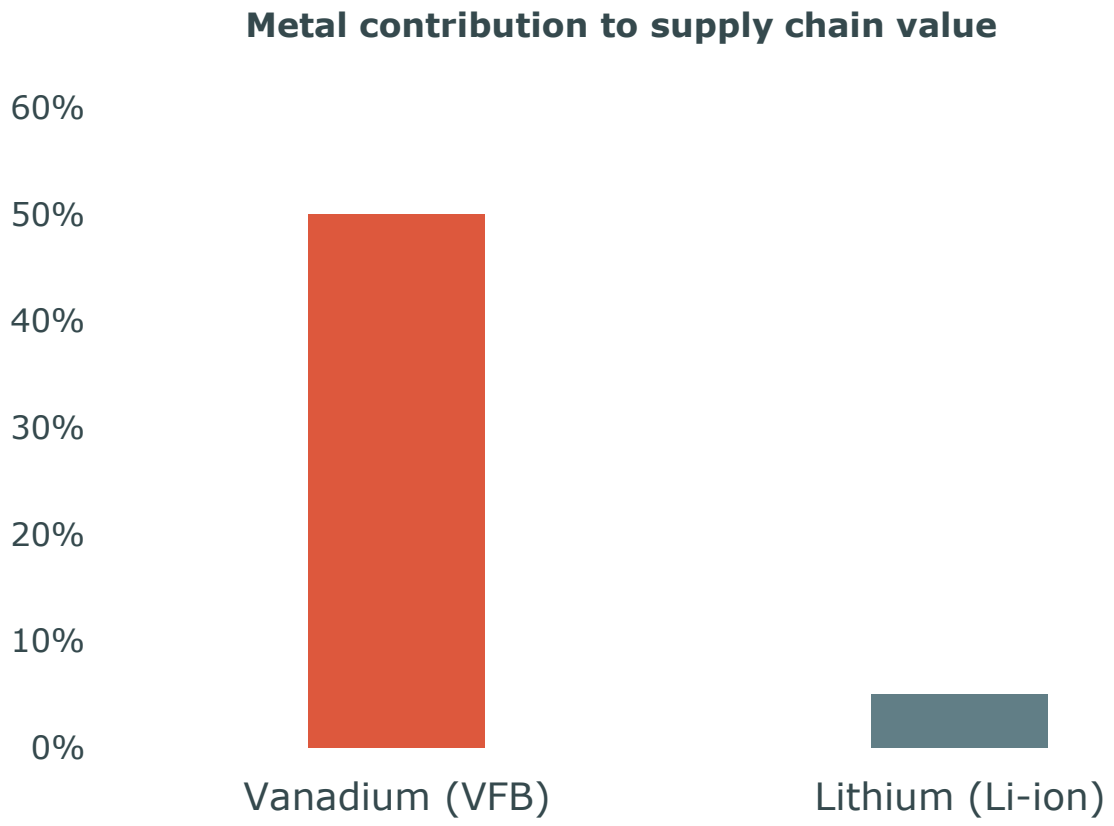
AVL cautions shareholders and prospective shareholders not to place undue reliance on these forward-looking statements, which relate only to events as of the date on which the statements are made.

A renewables-based energy transition requires both electricity generation AND matched energy storage

- There is enormous effort and spend on electricity generation – **too little on energy storage**
- Vanadium flow batteries provide a **proven, economic solution** for utility scale energy storage
- The value of vanadium in a flow battery provides AVL with an **unparalleled opportunity for value creation** from global energy decarbonisation through the Australian Vanadium Project and VSUN Energy battery strategy

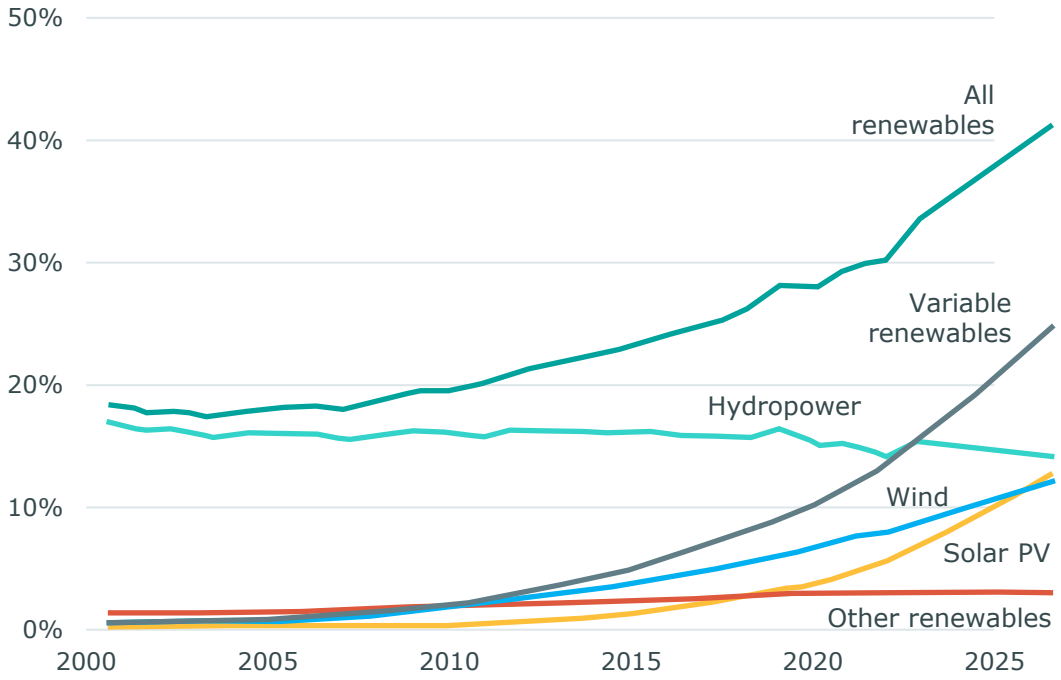


Indicative only. Based on installed capex of total battery deployment
Source: FBICRC Li-ion battery cathode manufacturing in Australia: A Scene Setting Project and AVL analysis

Growing global need for battery storage

Renewable energy is forecast to account for over 40% of global energy generation by 2028…

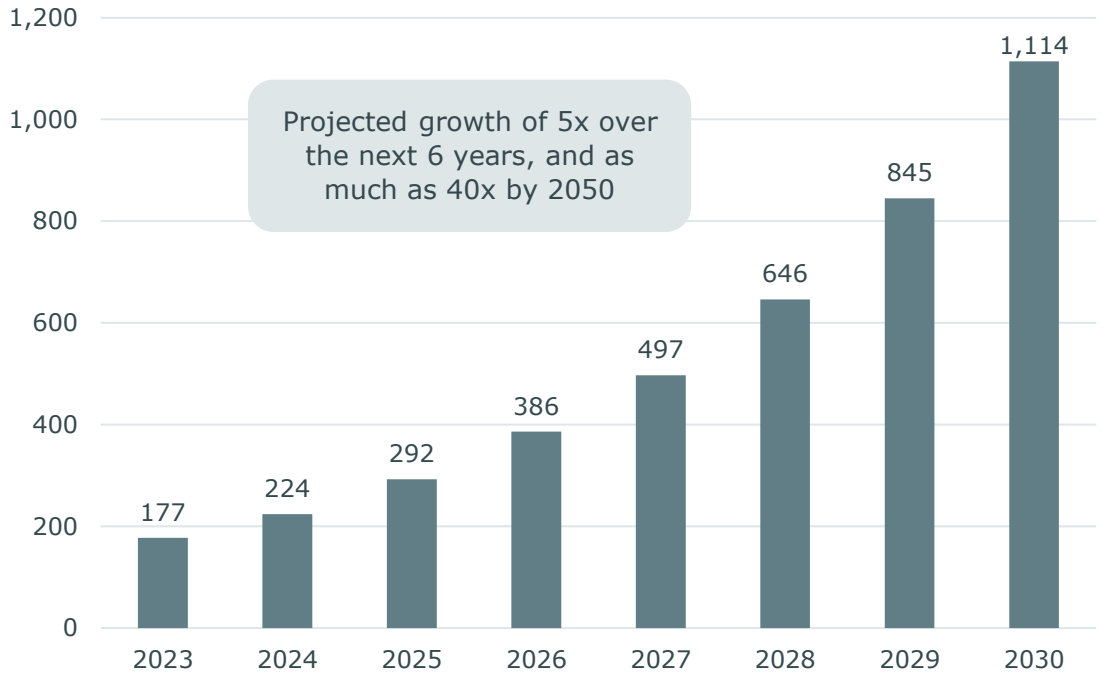
Share of global renewable electricity generation by technology, 2000–2028



Source: IEA
'Variable renewables' combines wind and solar PV

…increasing the need for global stationary energy storage

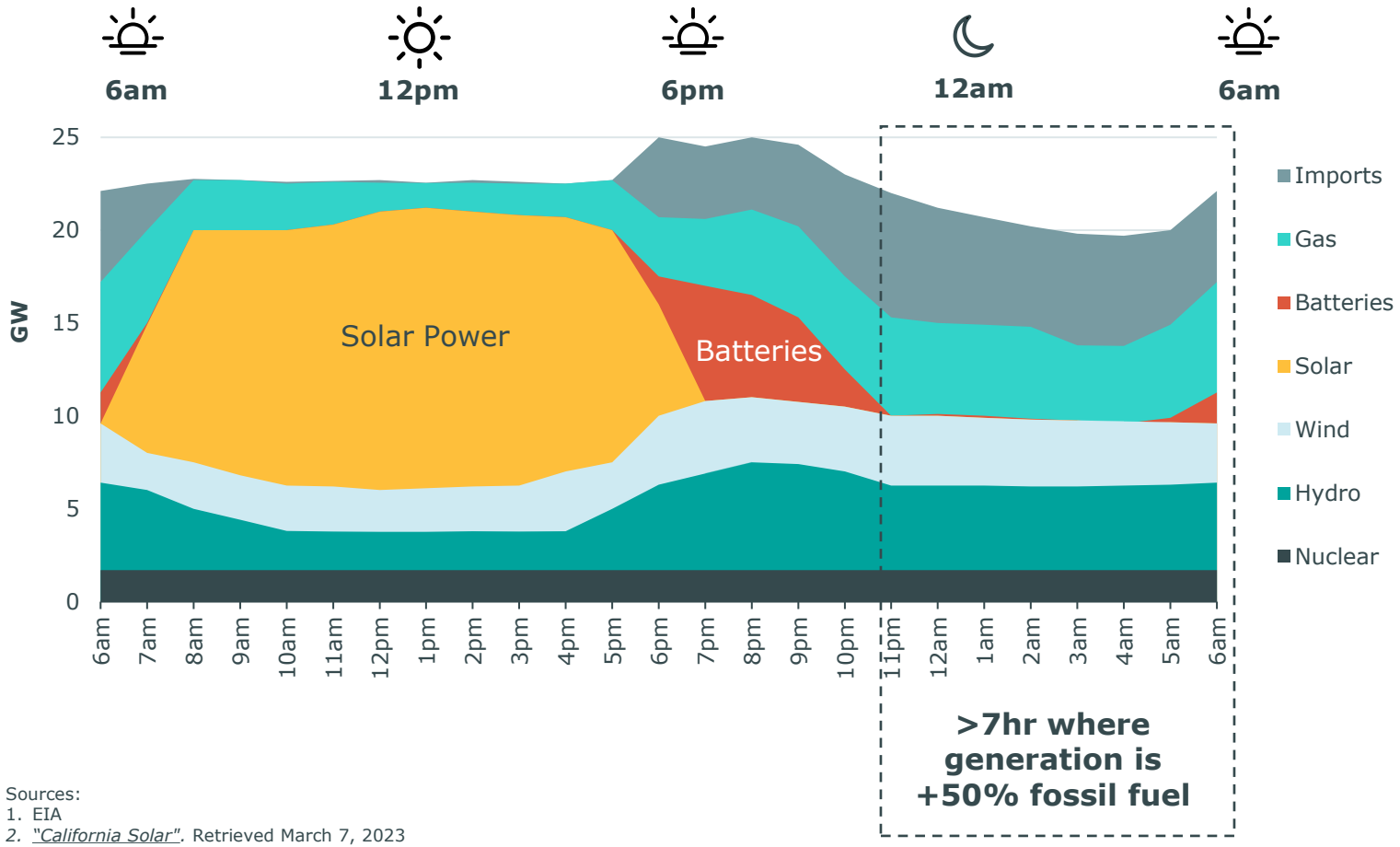
Global demand in GWh



Sources: IEA. Sources: Vanadium Battery Storage Report; Circular Business Model For Vanadium Use In Energy Storage 2023; World Bank Group, Project Blue

The need for long duration storage – Californian case study

California's Average Daily Operational Demand (April 2024)[1]



Sources:
1. EIA
2. *"California Solar"*. Retrieved March 7, 2023
3. S&P Global Market Intelligence
4. nbcnews.com

'Imports' relates to energy imported from neighbouring states

California has 46GW of installed solar capacity[2] and over 10GW of battery storage capacity[3]

Mismatch in renewable generation versus storage capacity has resulted in over **2.6GWh of renewable energy lost** from January to July 2024[3]

Current installed battery base has less than 4hr of capacity resulting in over 7 hours of generation that is fuelled by +50% fossil fuels

Long duration energy storage (4-10+ hours) can increase capacity of storage and the duration of discharge, resulting in a higher concentration of renewable power generation to the grid

The need for long duration storage – Victorian case study

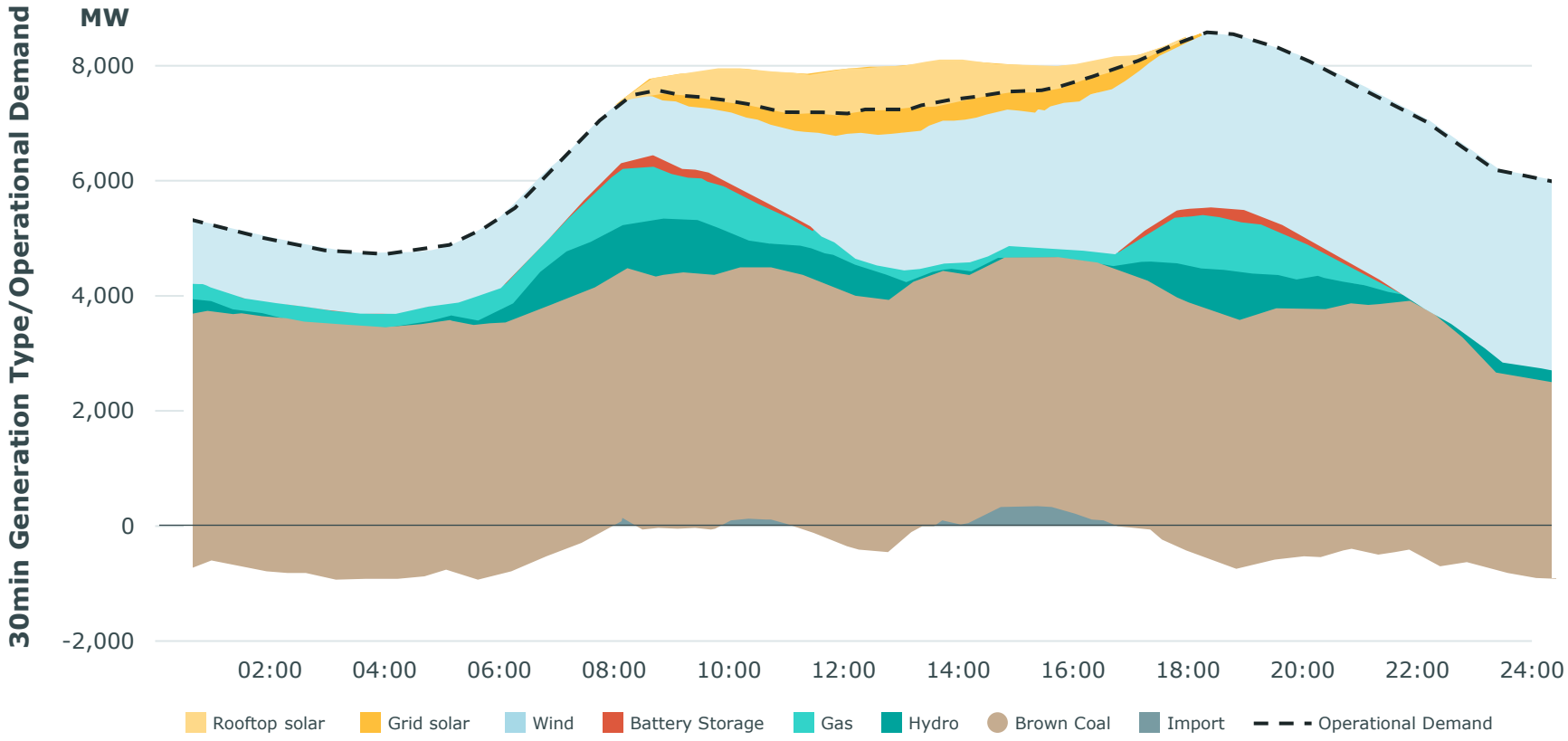
Victoria recently set a new peak power demand record of 8.6GW

Despite Victoria having over 4GW of solar capacity, **solar and battery storage contributed less than 5%** of supply

Brown coal and wind provided the majority of supply capacity

Victoria needs long duration energy storage to **reduce the reliance of the grid on brown coal**

Winter operational demand – Victoria 15 July 2024



Source: AEMO

The benefits of VFBs

Zero

Thermal event risk

4-10+

Hours of storage capacity

30+

Year asset life

>60%

Commercial end-of-life reuse and recyclability

Cost

Competitive on a LCOS basis to lithium-ion batteries

100%

Depth of discharge

Zero

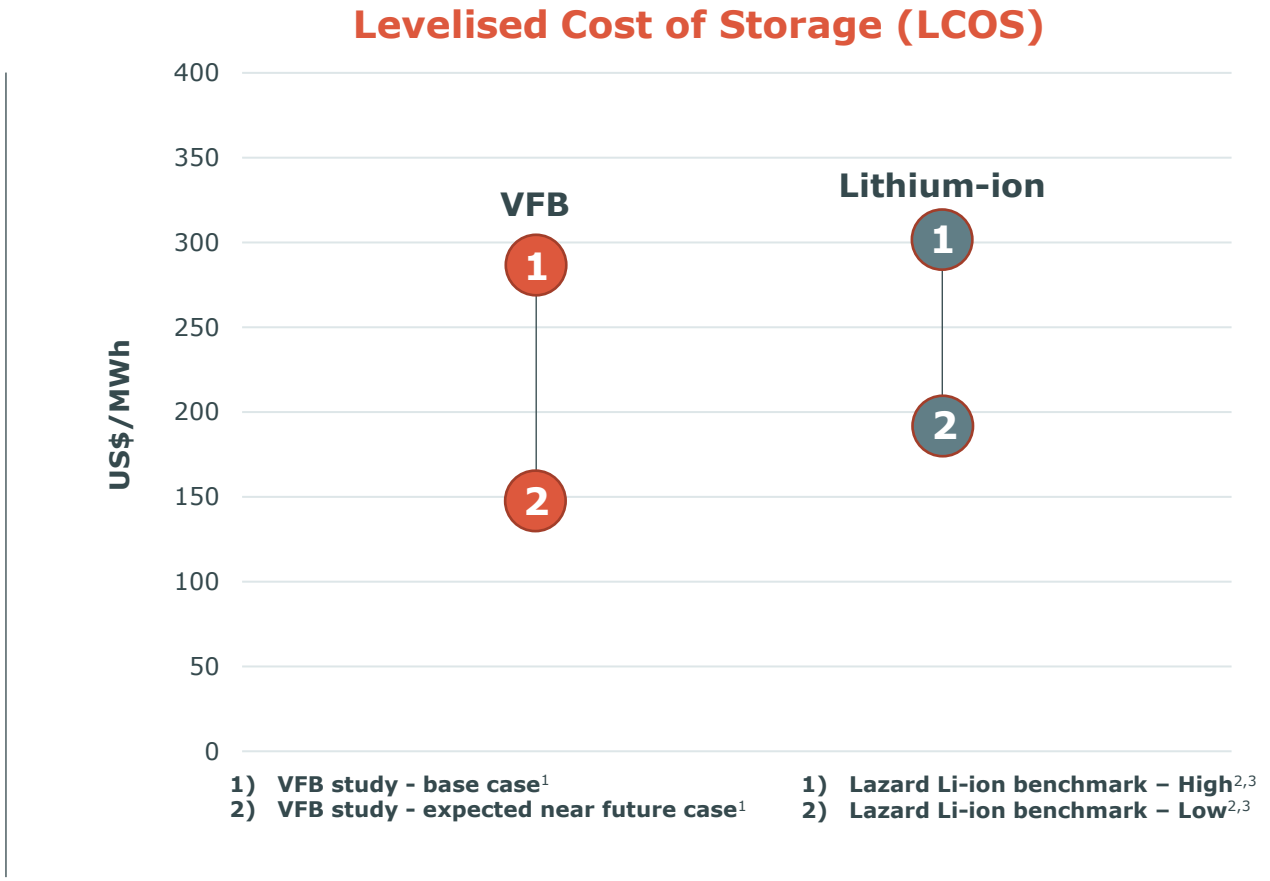
Operational warranty constraints

Proven

Nearly 20 years of grid-connected VFBs

Levelised Cost of Storage

Large scale vanadium flow batteries are projected to have a lower LCOS than the current benchmark utility-scale lithium batteries, driven by their **30+ year life** and residual value (recycle value of the electrolyte).



1. Poli et al. Techno-economic assessment of future vanadium flow batteries based on real device/market parameters, Applied Energy 2024.
2. Lazard. Levelized Cost of Energy, June 2024. Pages 20 and 41-42.
3. Lazard LCOS: 20-year project life; 400MWh; 90% DoD; 90% RTE; One cycle/day; 2.6% battery degradation p.a.; 350 days a year; USD/AUD 0.7, WACC 11.2%

The VFB is a proven and commercialised technology at scale

VFBs are operational across 20+ countries

Japan

Sumitomo Electric Industries

15MW x 4 hour and 17MW x 3 hour VFB in Hokkaido, Japan

First operational since 2015, second since 2022

Services: frequency regulation, renewable generation smoothing

China

Rongke Power

100MW x 4 hour VFB in Dalian, China

Operational since 2022

Services: support grid stability, peak shaving, frequency regulation, renewable integration, black start, auxiliary power supply

USA

Sumitomo Electric Industries

2MW x 4 hour VFB in San Diego, USA

Operational since 2017

Services: microgrid operation, peak shaving, renewable firming, market participation in energy and ancillary services

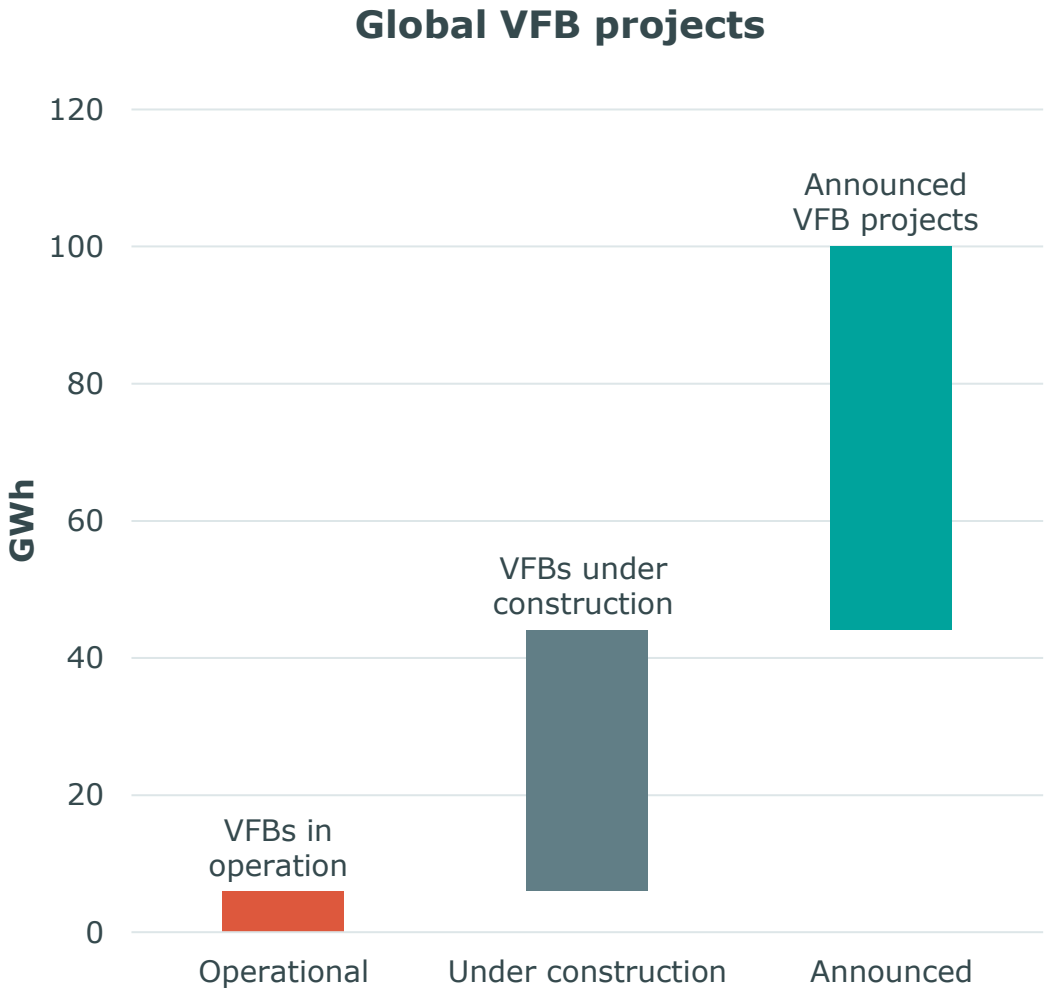
The transition is underway in China - Australia needs to make progress

Recent announcements from China indicate the potential for **180 GWh of VFB** deployment by 2030, requiring **1.4 million tonnes of V_2O_5**

2023 global production of vanadium was equivalent to **225,500 tonnes of V_2O_5**

Potential for deployment of VFBs in China by 2030 equals **6 times** the amount of global production in 2023

AVL can provide a secure supply of vanadium and vanadium electrolyte for Australia's energy storage requirements



Source: Vanitec and FerroAlloyNet

Source: Vanitec

Vertically integrated to generate value across the supply chain

	Upstream	Midstream	Downstream
	 **Vanadium Mining and Processing**	 **Electrolyte Manufacture**	 **Battery Installation and Maintenance**
Asset	Australian Vanadium Project	Electrolyte manufacturing facility	VSUN Energy
AVL advantage	High-grade project in Tier-1 jurisdiction with simple mining and processing	Established Australian manufacturing facility producing battery grade electrolyte	Vertically integrated to deliver cost competitive VFB storage solutions in Australia
Status	Optimised Feasibility Study underway	Producing battery grade electrolyte with capability to process 3rd party product	Establishing key partnerships to accelerate growth

VSUN Energy – engaging with mining and utility customers

IGO Limited

Nova Nickel Operation (Western Australia)

Installation of a VFB to provide storage capacity to allow for carbon free electricity to be used 24/7 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 vanadium flow battery (VFB) to be installed at Kununurra as part of a long-duration energy storage project.

Status: Undergoing factory acceptance testing in Perth, prior to delivery to site

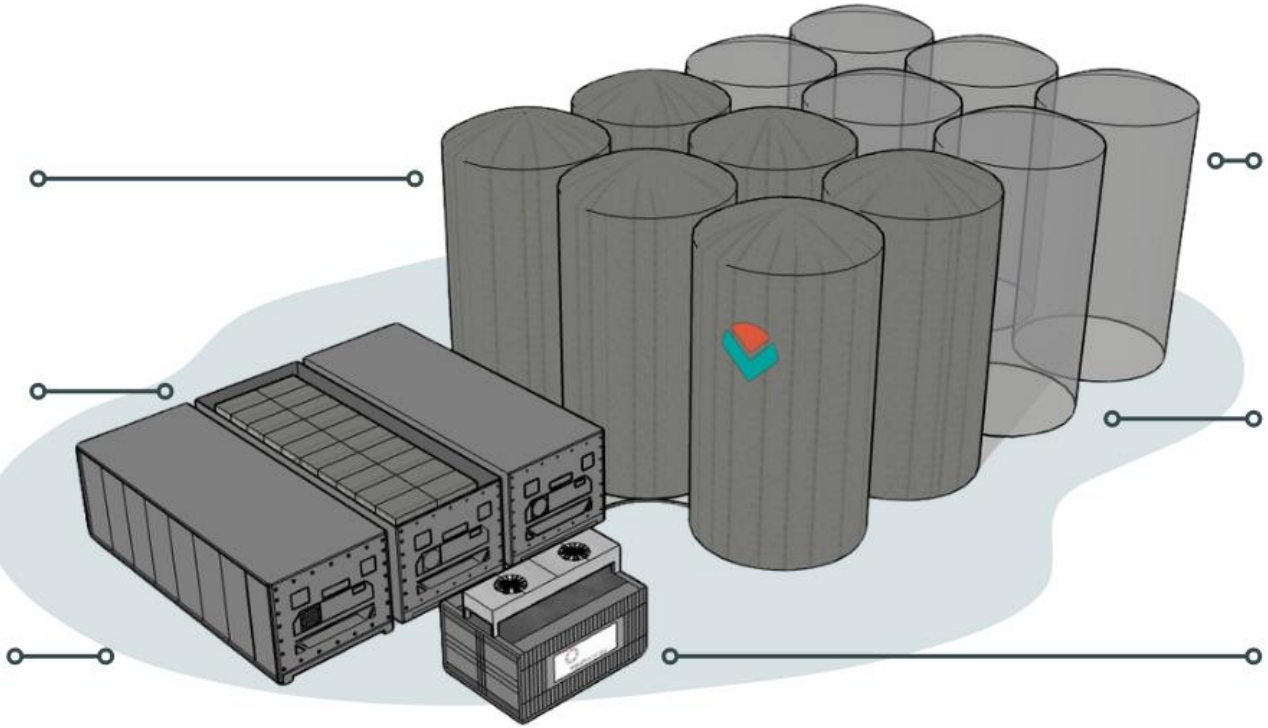
VSUN Energy will utilise key relationships to deliver a total VFB storage solution

Site Infrastructure
Utilise local specialist EPC partners

Electrolyte
Sourced from an AVL electrolyte manufacturing facility

Battery Technology
Utilise proven VFB technology from global suppliers

Project Management
VSUN Energy or third-party provider



Forward Planning
Ensuring additional units can be installed as required

Tanks
Australian-based suppliers

Power Conversion System (PCS)
Proven solutions from established manufacturers

With vanadium electrolyte comprising between 40-60% of the capital cost of a VFB, VSUN Energy has a core competitive advantage for the construction of VFBs in Australia

Leveraging partners to accelerate deployment

Technology and Deployment

- Advanced discussions with VFB technology partners to secure strategic alliances with key manufacturers
- Progressing partnering opportunities with EPC/EPCM contractors to perform installation

VFB Funding

- 30+ year asset life delivers multiple funding opportunities
- Advancing government grant, asset infrastructure and JV partner funding models

Energy Offtake

- Advanced discussions with BESS energy offtake partners
- Ability to utilise brownfield sites with short transmission distances is attractive for energy offtake

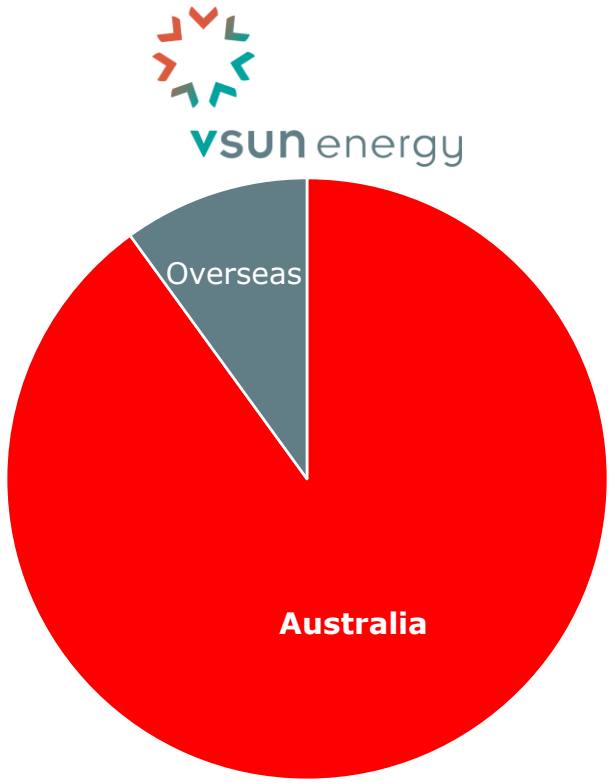
Land Access

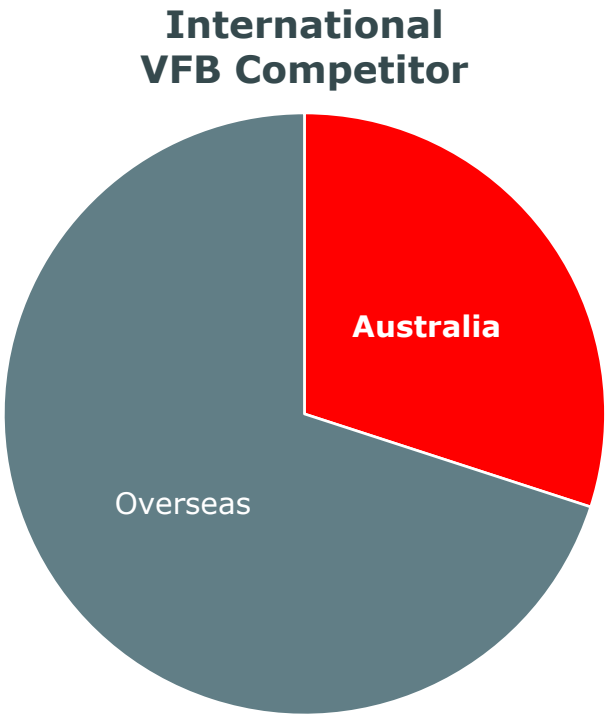
- Advanced discussions to secure land access with partners for long duration energy storage projects
- Competitive advantage in locations unsuitable for other technologies

Clear and focussed strategy will allow for rapid VSUN Energy deployment of VFBs to meet demand

VSUN Energy delivers local content to the Australian market

VSUN Energy's ability to leverage electrolyte supply from AVL delivers a VFB that contains an unrivalled local content component with unparalleled supply chain security





Indicative only. Based on installed battery basis ex land value

Proven vanadium electrolyte manufacturing capacity

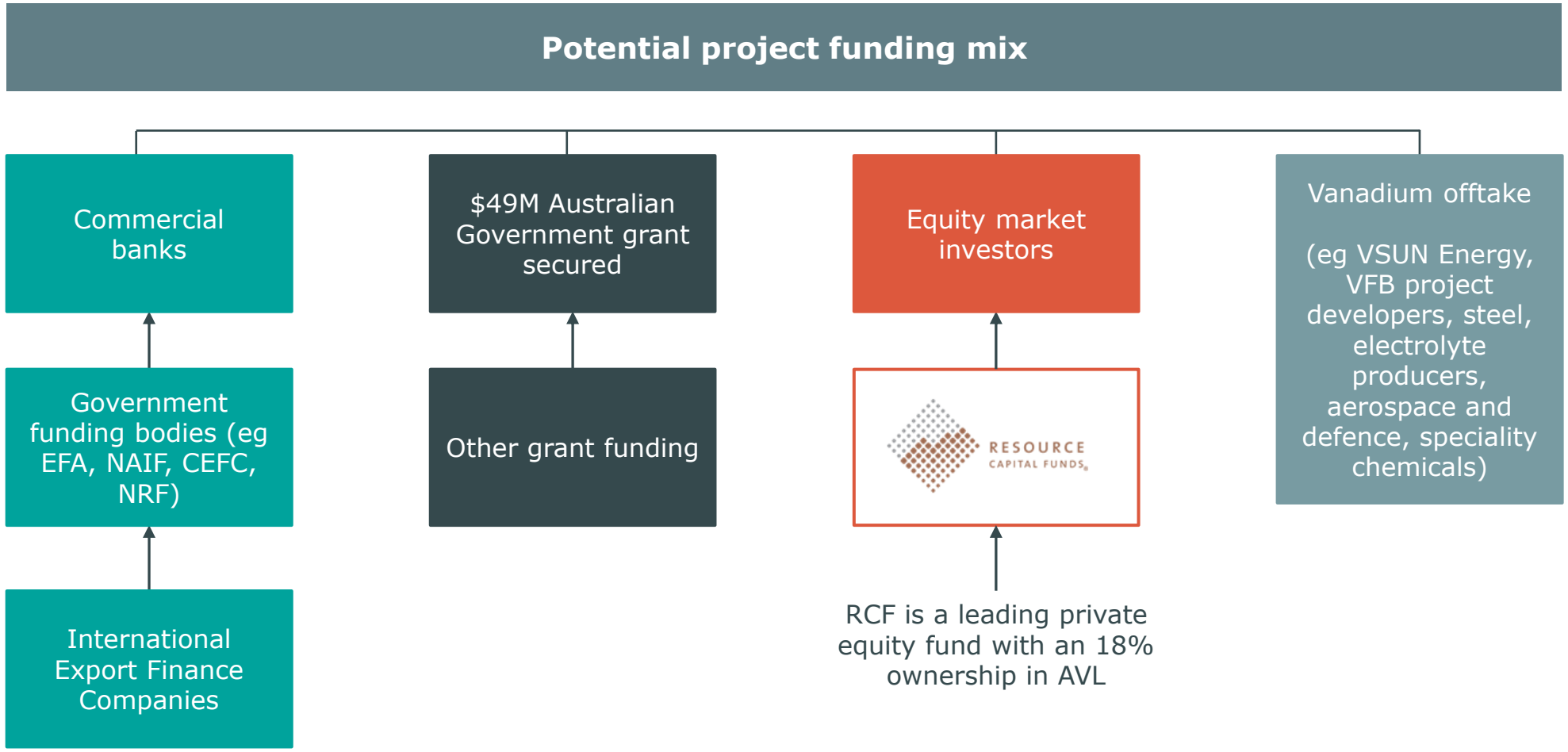
AVL built, owns and operates a manufacturing facility in Perth, Western Australia, capable of commercial vanadium electrolyte production

- 33MWh per annum energy storage equivalent of vanadium electrolyte production
- First production completed in 2024
- Qualification of electrolyte well advanced with seven VFB industry leaders
- Ability to scale and replicate facility to meet growing demand
- Ability to process 3rd party vanadium oxides to supply high quality electrolyte prior to AVL oxide production

The world class Australian Vanadium Project unlocks our strategy

- A world class asset located in Western Australia, a Tier-1 mining jurisdiction
- Simple open pit mining with standard magnetite concentrator process
- Proven processing technology that reduces project risk
- Optimised Feasibility Study (OFS) underway, aimed at creating project with superior economics
- Current focus on finalising remaining approvals, while securing offtake and funding

Improved funding capability



Progressing the project to production

Delivered

- [x] BFS completed (pre-merger basis)
- [x] Mining Leases approved
- [x] Completion of large-scale process plant pilot programs
- [x] Australian Government grant agreement for up to $49 million executed
- [x] Merger to deliver project synergies
- [x] Combined Mineral Resource update
- [x] Project development strategy update
- [x] Electrolyte production brought online

Next steps

AVL Project

- [ ] Publish integrated Optimised Feasibility Study (OFS)
- [ ] Progress approvals including EPA and Traditional Owner agreement
- [ ] Finalise permitting of proposed Tenindewa processing hub site
- [ ] Progress discussions with Government debt and export finance agencies
- [ ] Secure bankable vanadium offtake including option for project finance
- [ ] Deliver final investment decision

Downstream strategy

- [ ] Secure VFB technology partners
- [ ] Secure priority locations for VFB deployment
- [ ] Engage EPC/EPCM partners for battery deployment
- [ ] Progress funding discussions with potential strategic partners for rapid deployment of VSUN Energy strategy
- [ ] Secure energy offtake partners

Investment thesis

Growing vanadium fundamentals

Leveraged to energy market structural changes and increasing demand for long duration energy storage solutions

High metal content of VFBs

Underpinning the importance of upstream operations at the Australian Vanadium Project to secure supply of high-grade product

World-class Australian Vanadium Project

World-class asset located in Tier-1 mining jurisdiction with simple open pit mining and processing method

Ability to capture downstream value

VSUN Energy positioned to capture downstream value with a competitive advantage delivered through vertically integrated business

Delivering local content

Australian Vanadium Project and electrolyte manufacturing capability delivers a VFB that contains an unrivalled local content component

Appendix

Board

Cliff Lawrenson
Chair

Experienced Chair and extensive executive career in resources, energy, infrastructure and investment banking

Daniel Harris
Non-Executive Director

Over 40 years of global vanadium experience, including processing and operation

Miriam Stanborough AM
Non-Executive Director

Over 20 years of experience in the mineral processing industry across a range of commodities

Peter Watson
Non-Executive Director

Chemical engineer, with 40 years of experience in senior technical, project and management roles, in addition to corporate experience running ASX-listed companies

Anna Sudlow
Non-Executive Director

Corporate finance executive with experience in the mining and resources sectors across a range of commodities and jurisdictions

Jo Gaines
Non-Executive Director

Stakeholder engagement and corporate affairs experience across State and Federal Government. Policy development and a focus on People and Culture.

Executive Team

International vanadium expertise – track record in project execution and operations

Graham Arvidson
Chief Executive Officer

18 years of experience in the mineral sector spanning vanadium and lithium project development and operations

Todd Richardson
Chief Operating Officer

Over 20 years of experience in the vanadium sector and an expert in vanadium process design, commissioning and operations

Louis Mostert
Chief Legal and Commercial Officer

20 years of experience in project contracting and finance, corporate advisory, mergers and acquisitions

Tom Plant
Chief Financial Officer

30 years of experience in various corporate and commercial roles. Strong background in debt and equity funding solutions, investment evaluation and corporate transactions

Ross Jennings
Chief Safety and People Officer

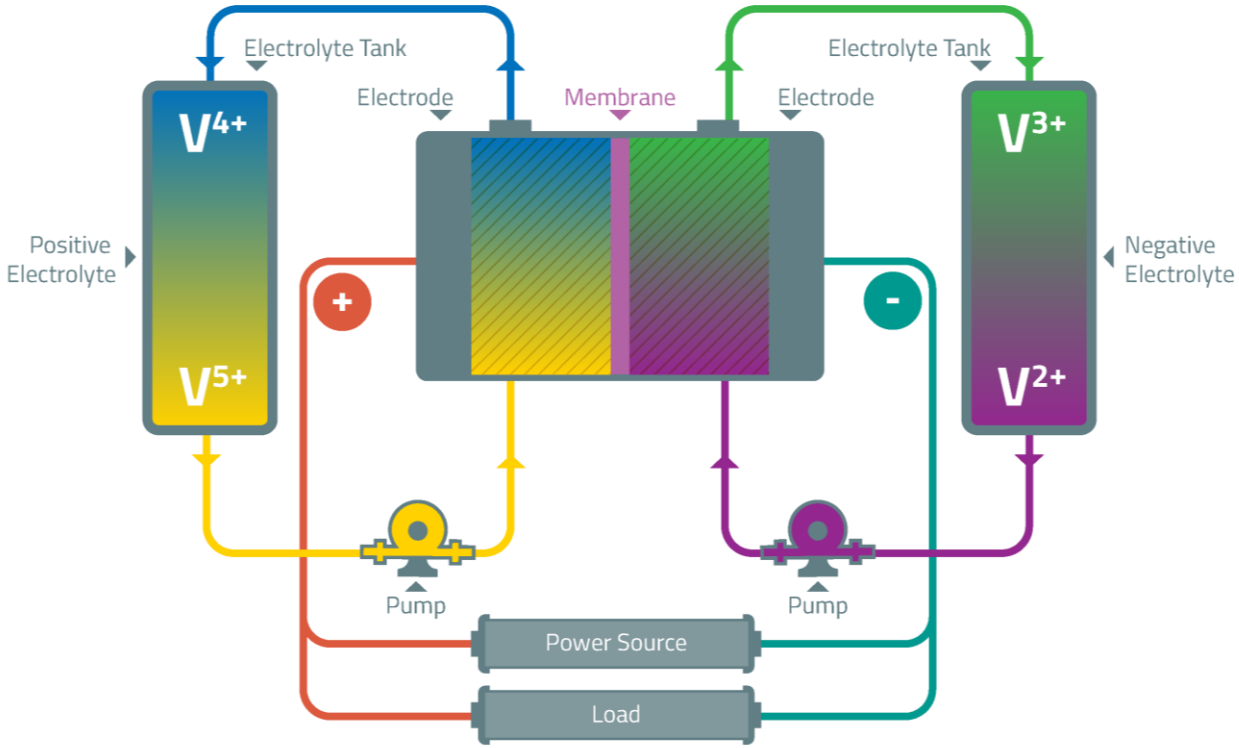
Over 18 years of experience in the mining industry and has worked in leadership roles across operations, health, safety and emergency response

Flormirza Cabalteja
Executive General Manager Project Delivery – Downstream

16 years of experience in operations and design/commissioning in the minerals sector for nickel, cobalt, vanadium and ammonium phosphate-based fertilizers

What is a vanadium flow battery (VFB)?

- A **VFB** is made up of two tanks filled with **vanadium electrolyte** fluid
- The electrolyte acts as cathode and anode, tank size determines capacity
- Vanadium electrolyte contains **145g** of high-purity V_2O_5 per litre
- Invented over 40 years ago and commercialised at very large scale
- Offers compelling cost of energy storage for applications where greater than 4 hours of storage is required



Comparison between VFB and Li-ion Battery Technologies

Vanadium Flow Battery	Lithium (Li-ion)
Energy Battery – Store large amounts of energy for later use	**Power Battery** – ideal for shorter-term high-power application
Energy stored in electrolyte tanks	All energy stored in cell
Stable – non-flammable	Flammable (susceptible to thermal runaway)
Long lifespan (30+ years). No degradation during cycling (30,000+ cycles)	Short lifespan (~15 years) due to irreversible physical changes induced in charge discharge cycle (6000 cycles)
Vanadium electrolyte can be re-used, does not degrade (residual value)	Recycling difficult due to multiple components (minimal residual value)
Scalability – as modules or by introduction of larger tanks – fewer control systems	Multiple small batteries required – complexity of control increases
No warranty constraints in operational modes. Full DoD available for use	Limited to 80% DoD. Significant constraints in operation due to warranty requirements reduces revenue opportunities

ESG in action

Renewable energy strategy

- Ability to produce ethical, low carbon vanadium product, expecting to be 50% lower carbon intensity per unit of vanadium than existing co-production vanadium producers[1]
- Use of solar and/or wind generation
- Use of VFBs for energy storage

Community relationships

- Workforce participation and business opportunities for Yugunga-Nya People Traditional Owners
- Regional Engagement Manager based in Geraldton
- Sponsorship of awards and scholarships at Central Regional TAFE
- Mullewa and Meekatharra community sponsorships

Governance

- Developing ESG reporting structure aligned to the global ISSB framework (incorporating SASB, TCFD and GRI) and the incoming Australian Sustainability Reporting Standards (ASRS)
- Experienced and competent Board of Directors
- Long term engagement with Environmental Protection Agency

1. Source: AVL internal benchmarking, public information from co-producers

Australian commitments driving energy storage

The Australian Federal Government continues to target 82% renewable energy by 2030, introducing the *Capacity Investment Scheme* (CIS) to encourage new investment in renewable capacity (eg wind and solar) and dispatchable capacity (eg battery storage). The CIS aims to help deliver an additional 32GW of capacity by 2030, which includes 9GW of clean dispatchable capacity.

What are some of the individual states doing?

NSW Climate and Energy Action

- *Climate Change (Net Zero Future) Act 2023* commenced, requiring GHG emissions reduction of 50% by 2030, 70% by 2035, and net zero by 2050
- NSW Electrical Infrastructure Roadmap to support delivery of 12GW of new renewable electricity generation and 2GW of long duration energy storage
- As at March 2024, 29 renewable energy projects were in the planning process and another 70 new projects are about to be submitted for departmental approval[1]

Victoria State Government – Energy, Environment and Climate Action

- Ambitious GHG emissions reduction target of 75-80% by 2035 and net zero by 2045
- Victoria's *Renewable Energy (Jobs and Investment) Act 2017* targets 65% renewable energy by 2030 and 95% by 2035
- Legislated energy storage targets are at least 2.6GW of energy storage capacity by 2030, and at least 6.3GW by 2035, which will incorporate short, medium and long duration energy storage systems[2]

Queensland Government – Department of Energy and Climate

- Passed the *Clean Economy Jobs Act 2024* in April 2024, targeting 30% GHG emissions reduction by 2030, 75% by 2035 and net zero by 2050
- Queensland renewable energy generation targets of 50% by 2030, 70% by 2032 and 80% by 2035
- 22GW of new wind and solar, and another 12GW of batteries and pumped hydro, targeted by 2035, part of its $62 billion investment plan[3]
- Queensland Government part funded construction of a vanadium electrolyte manufacturing facility in Townsville

Government of Western Australia

- *Climate Change Bill* introduced in November 2023 that will require state government to set GHG emissions reduction targets
- Long duration battery trials run by Horizon Power including a VFB purchased from AVL's subsidiary VSUN Energy plus additional batteries supported by WA Government and ARENA
- WA's *Future Battery Industry Strategy* aims to support WA's dominant role in battery minerals and enhance downstream value-add processing of battery materials in the state

1. NSW Government, '*Clean energy projects up and running to power 1.5 million homes*', 1 March 2024, https://www.nsw.gov.au/media-releases/clean-energy-projects-up-and-running-to-power-15-million-homes
2. Victorian State Government, '*Victorian renewable energy and storage targets*', 30 April 2024, https://www.energy.vic.gov.au/renewable-energy/victorian-renewable-energy-and-storage-targets
3. Renew Economy, '*Queensland to legislate renewable targets in $62 billion wind, solar and storage plan*', https://reneweconomy.com.au/queensland-to-legislate-renewable-targets-in-62-billion-wind-solar-and-storage-plan/
4. Queensland Government, '*Vanadium battery production gets flowing in Townsville*', https://statements.qld.gov.au/statements/97329