



VSUN Energy

A Renewable Energy Company

Corporate Presentation | November 2019



VSUN Energy

A Renewable Energy Company

- VSUN Energy's parent company, **Australian Vanadium Limited (AVL)** is an emerging vanadium producer with a high-grade deposit near Meekatharra in Western Australia.
- VSUN Energy was launched by AVL in **2016** to grow the vanadium redox flow battery (VRFB) market in Australia and now offers clients VRFBs from a **range of manufacturers**.
- VSUN Energy's **first VRFB installation** was in 2016 at a native tree nursery in Busselton, Western Australia. In October 2019, the nursery's owners celebrated three years of paying nothing for electricity use since the installation.





About Vanadium Redox Flow Batteries

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What is a VRFB?

Redox Flow Batteries

- A **redox flow battery** is made up of two tanks filled with **electrolyte** fluid.
- The electrolyte acts as cathode and anode, tank size determines capacity.



Vanadium Redox Flow Batteries

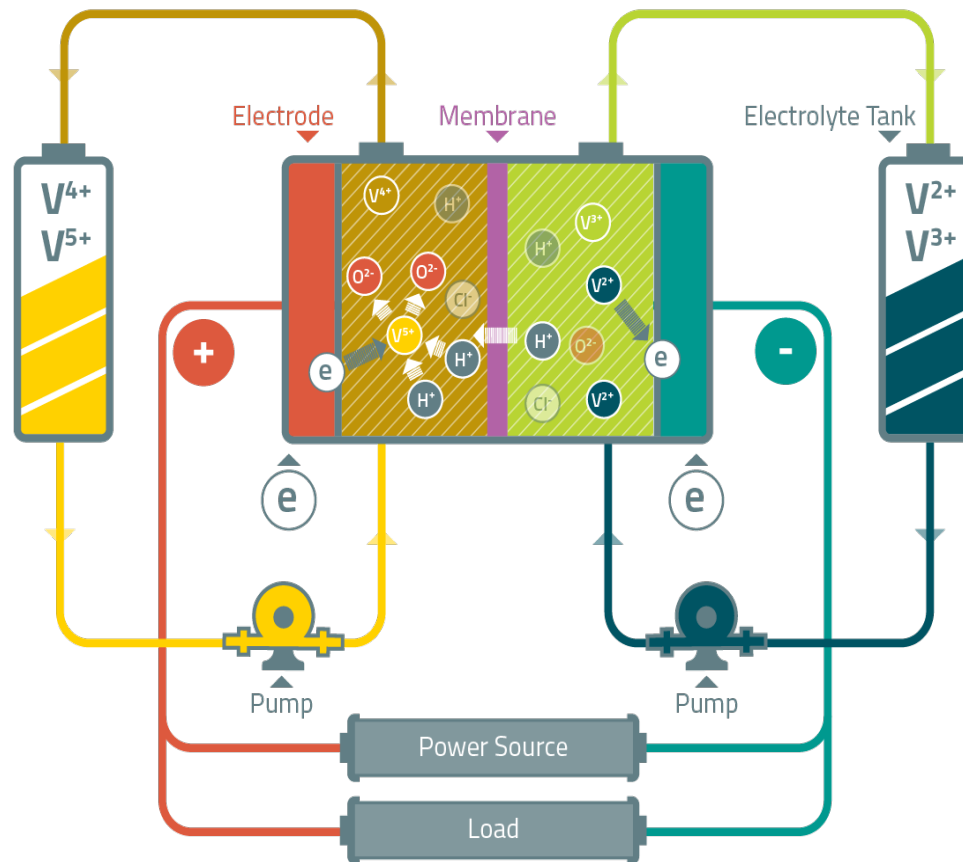
- In a **vanadium** redox flow battery (VRFB) **vanadium electrolyte** is used.
- Vanadium electrolyte contains **145g** of high-purity V_2O_5 per litre.

New Market Entrants

Rising vanadium prices have led to **innovations and new entrants**, for example:

- Welded stack technology;
- Electrolyte leasing;
- Changing power-to-energy ratio;
- Dispatchable energy at solar farms;
- Government incentives;
- **1GWh** of new vanadium energy storage technologies needing around **10,000** tonnes of high-purity V_2O_5 .

How Does a VRFB Work?



VRFB Characteristics

Unique Characteristics and Advantages

An **energy battery**, able to store large amounts of energy for later use



The VRFB is **non-flammable**, making it safer than other batteries on the market

Easy to scale by adding modules or introducing larger electrolyte tanks



Can switch between charge and discharge **instantaneously**, with **100% depth of discharge**

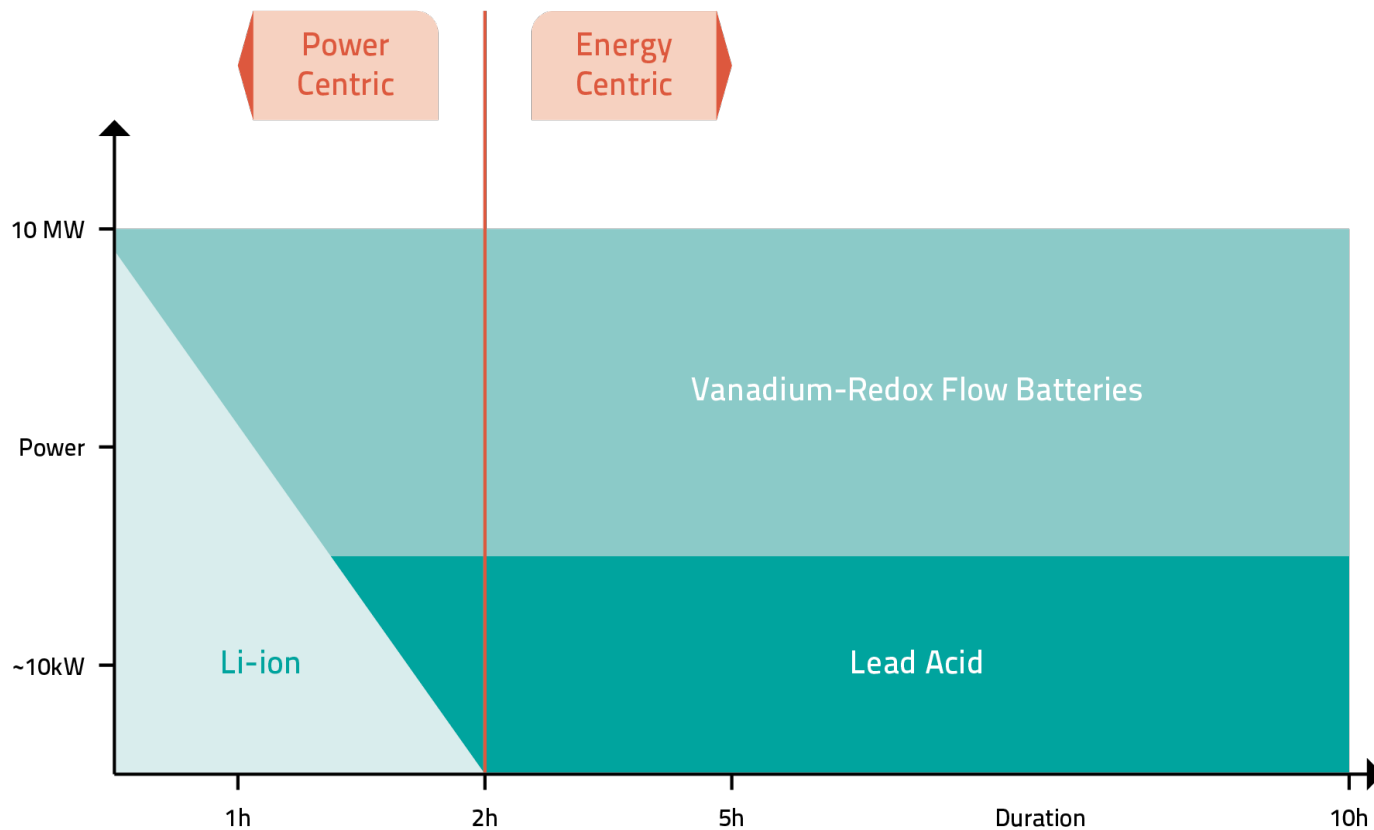
Lifespan of over 20 years with **no degradation in performance** over time



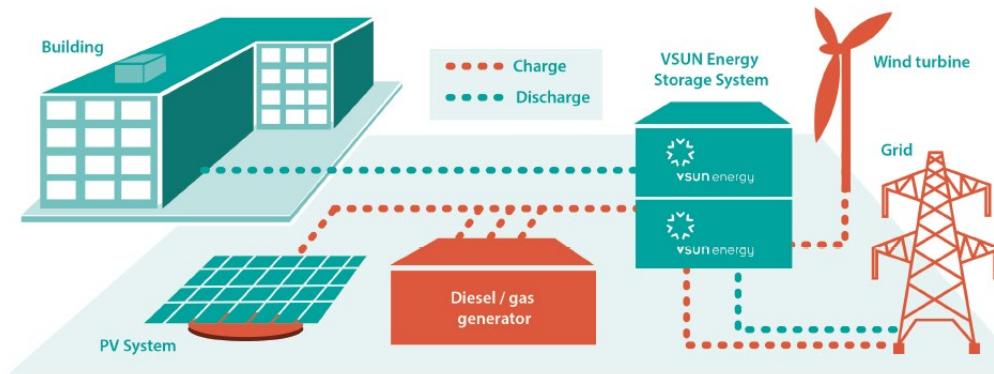
The vanadium electrolyte in a VRFB can be **reused indefinitely**

Power vs Energy Centric

Vanadium Redox Flow Batteries are Energy Storage Devices



VRFB Applications



Utilities	smooth delivery of renewable energy into the grid
Commercial & Industrial	maximize use of renewable energy
Agricultural	reduce diesel power reliance, cost and emissions
Mining	reduce infrastructure & diesel costs with renewable energy
Remote	reduce trucking diesel & secure uninterrupted energy
Electric Vehicle Charging	charge electric vehicles from a renewable energy source
Telecommunications Power	power remote towers anywhere with solar + storage
UPS Battery Back Up	secure the supply of energy if the grid is unavailable
Domestic Renewable Energy	when the sun goes down, use excess energy generated by solar panels during the day

VRFB Manufacturers

The Number of VRFB Manufacturers Continues to Grow





VRFB Installations Around the World

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VRFB Installations in Australia

The number of VRFB installations in Australia is increasing, with universities leading the way.

Year	Size	Location	Customer	Status
2015	30kW/130kWh	Sydney, NSW	University of NSW	Operational
2016	10kW/100kWh	Busselton, WA	Native tree nursery	Operational
2018	180kW/900kWh	Melbourne, VIC	Monash University	Operational
2019	120kW/600kWh	Heron Island, QLD	University of Queensland	Operational
2019	135kW/450kWh	Adelaide, SA	University of Adelaide	Construction
2019	20kW/80kWh	Pakenham, VIC	Priest Bros Orchard	Announced
2019	80kW/320kWh	Meredith, VIC	Meredith Dairy	Announced
2019	40kW/160kWh	Marble Bar, WA	Strelley Community School	Tender

VRFB Installations in China

China's Flow Battery Energy Storage Development Plan



Qinghai: Wind integration (2MW/10MWh)

Jiangsu: Offshore wind integration (200MW/1,000MWh); paired with 5GW TianWan nuclear station (200MW/1,000MWh)

Liaoning: Renewables integration (200MW/ 800MWh)

Hubei: Phase 1 PV integration (10MW/40MWh); phase 2 peak plant (10MW/ 500MWh)

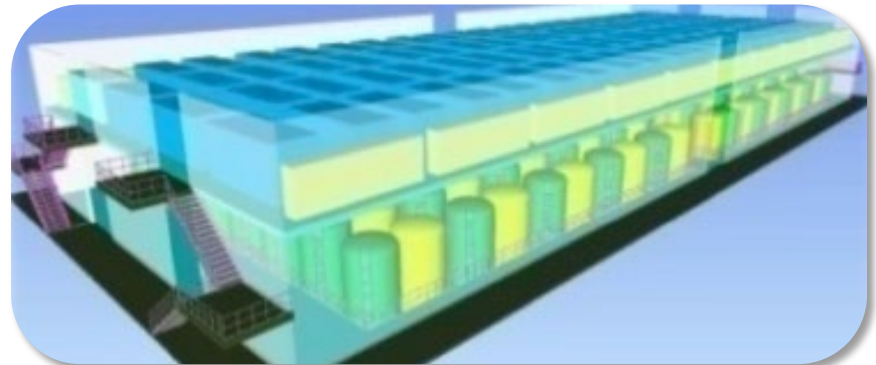
A new **5MW/20MWh vanadium redox flow battery project** was announced at a vanadium and titanium conference attended by AVL in China, September 2019.

China committed to significant new VRFB installations. Map shows equivalent to **4 years production** from The Australian Vanadium Project.

Rongke Power (China)

One of the Largest Batteries in the World

- A **200MW/800MWh** vanadium redox flow battery is the largest battery in the world.
- The battery's purpose is to enhance grid stability and deliver power during peak hours of demand, during black-start conditions and in case of emergency.
- The system is expected to peak-shave about 8% of Dalian's expected load when it comes online in 2020.
- **First floor** – electrolyte tanks.
- **Second floor** – power & control units.
- **Third floor** – PCS and transformer.



Sumitomo (Japan)

104MWh Installed Worldwide

- In December of 2015, Sumitomo's **15MW/ 60MWh** VRFB came online in Hokkaido, Japan. The battery was funded by the Japanese government.
- In March 2017, Sumitomo launched a **2MW/8MWh** pilot VRFB storage project in California. The project studies how energy storage technology **integrates** renewable energy and improves **flexibility**.
- The VRFB developed for the California energy storage project is the **largest of its kind in the US**.



Hokkaido, Japan
15MW/60MWh



California, USA
2MW/8MWh

UET (USA)

Heron Island Research Centre – First UET Battery in Australia

- In 2015, UET installed a **1MW/4MWh** VRFB at the Turner Substation in Pullman, Washington to support Washington State University's **smart campus operations**.
- In December of 2016, Snohomish County Public Utility District installed a **2MW/ 8MWh** VRFB supplied by UET as part of a program aimed at transforming how utilities manage grid operations.
- UET also recently deployed a **150kW/ 600kWh** VRFB on Heron Island in Australia – the standalone microgrid powers the Heron Island Research Station.



Pullman, Washington
1MW/4MWh



Snohomish County, Washington
2MW/8MWh

CellCube (Austria)

University of New South Wales

- The VRFB was invented in Australia at the **University of New South Wales** in the 1980s by Emeritus Professor Maria Skyllas-Kazacos. CellCube installed a **30kW/130kWh** VRFB at the University in 2015.
- The storage system at the University is primarily used for **research** purposes. It also takes up the surplus energy from a **solar PV system**.
- In 2016 CellCube installed a **10kW/100kWh** VRFB at an agricultural property near Busselton. The battery was installed alongside a **15kW** solar PV system. The fully containerized VRFB was the **first of its kind** in Western Australia.



University of New South Wales
30kW/130kWh



Native tree nursery in Busselton, WA
10kW/100kWh

redT energy (UK)

Monash Smart Energy City

- In 2018, redT energy installed a hybrid energy storage system consisting of a **180kW/900kWh** VRFB and a **120kW/120kWh** lithium battery at Monash University in Victoria.
- The system is part of the university's **Smart Energy City**, integrating building management systems, electric vehicle charging stations and energy sharing mechanisms.
- Monash University is the largest university in Australia, and it is the first to commit to a target of **net zero carbon** emissions by 2030.





Leasing Vanadium Electrolyte

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Why Lease Vanadium Electrolyte

A Game Changer for the VRFB Market

Game Changer

- Leasing is a VRFB **game changer** – increased sales, providing a financial instrument and revenue stream – the opportunities are endless

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- Long-term **revenue** streams.
- VSUN Energy can sell the same electrolyte product **multiple** times.
- VSUN Energy **optionality exposure** to yield on vanadium leasing – financial intermediary/facilitator provides pure exposure to vanadium price long and short-term.

The Benefits

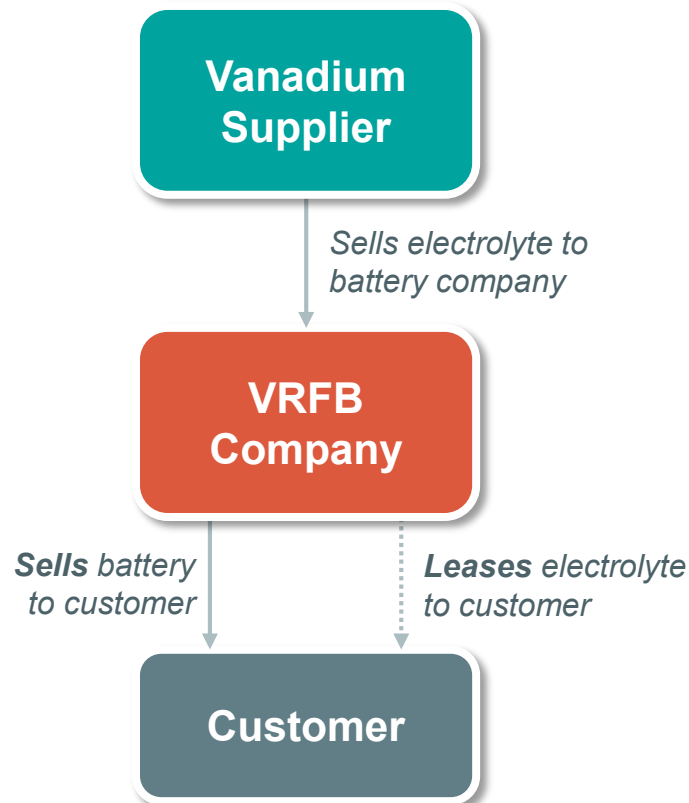
- **Reduces volatility risks** – allocates it to investors in Battery Electrolyte Investment Trust (BEIT).
- Brings benefits of **recyclability and long life** to the decision-making point of VRFB customers vs lithium alternatives.
- Materially **reduces** upfront capex.
- Provides investor with ability to create a **new asset** (lease contract).

The Costs

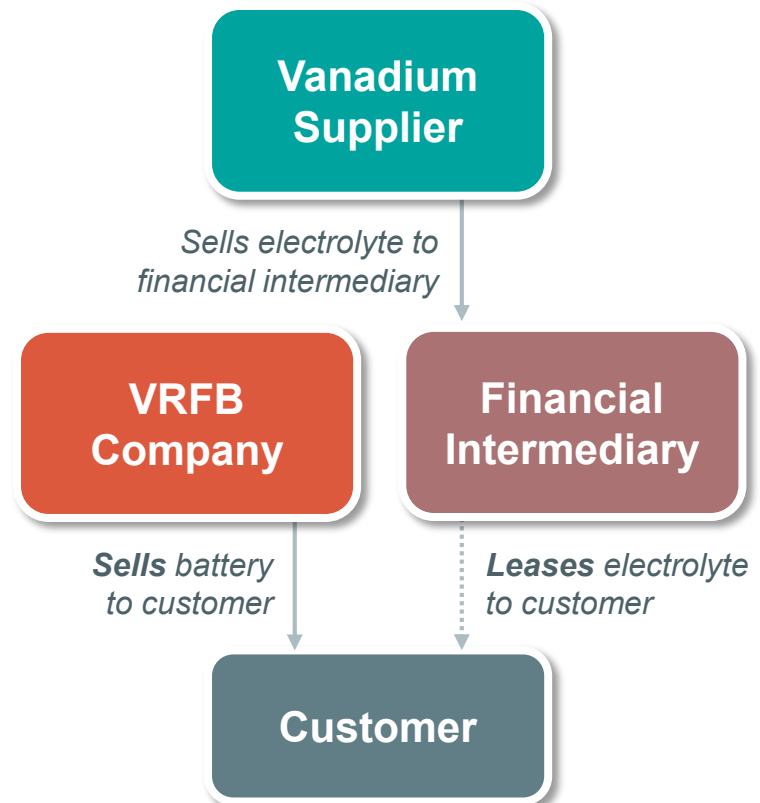
- **Modestly increases** operating costs as the capex reduces (the cost of leasing the electrolyte).

Leasing Models

Direct Leasing Model



Indirect Leasing Model





VSUN Energy Business Update

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Meredith Dairy

80kW/320kWh VRFB

- Solar and VRFB system to be installed at a dairy farm in Meredith, Victoria.
- **450kW solar array** to be combined with an 80kW/320kWh VRFB.
- The system will provide a minimum of **four hours** of renewable energy storage and will allow the client to increase onsite renewable generation and consumption.
- Meredith Dairy's goal is to have a **sustainable operation** with full power being supplied via onsite renewable generation.



Community School

40kW/160kWh VRFB

- VSUN Energy has a Memorandum of Understanding (MOU) with **Nomads Charitable & Educational Foundation** for a period of 12 months.
- VSUN Energy has applied for a grant from the West Australian State Government to fund the installation of a **VRFB and solar PV system** at Strelley Community School in the Pilbara region of WA on behalf of Nomads.
- Strelley Community School is the oldest continually operational Independent Aboriginal Community School in Australia, having commenced operation in 1976.
- The project will include training local people on renewable energy installation, with a view to installing other systems in the region.





Priest Bros.

20kW/80kWh VRFB

- VSUN Energy had secured an order for a **20kW/80kWh VRFB** to be installed at an orchard in Victoria.
- The system will provide a minimum of **four hours** of stored renewable energy and will allow the orchard's owners to significantly increase their onsite renewable energy generation and consumption.
- The agricultural sector is a key market for VRFB energy storage systems - the qualities of being a **long-life, reliable and non-flammable asset** are particularly appealing.



Metrowest

Vanadium Redox Flow Battery MOU

- VSUN Energy has an MOU with **Metrowest Power Systems** to facilitate the installation of VRFB energy storage solutions.
- Metrowest delivers high-end critical Uninterruptible Power Supply (UPS) systems and provides EPC capability.
- The agreement will allow the companies to work together to bring to fruition **larger project opportunities**.

Residential VRFB

A Residential Energy Storage Solution

- The VRFB offers a **large amount of stored energy**, providing a home's real energy requirements during the evening, night and early morning.
- VSUN Energy has been approached by **more than 200 people** seeking a residential VRFB.
- Unique selling point of **non-flammability**, safe for residential settings.
- Many Australian states interested in promoting new manufacturing and other associated jobs.
- Manufacturers such as Volterion and Voltstorage are current potential suppliers.



 **volterion**

 **VOLTSTORAGE**



Contact Us

P +61 (08) 9321 5594

E info@vsun.com.au

www.vsunenergy.com.au

Level 1, 85 Havelock Street West Perth,
Western Australia 6005



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www.vsunenergy.com.au