Market Update: vanadium-based energy storage solutions

Australian Vanadium Limited is pleased to communicate positive signs of growth in vanadium demand as it applies to the energy storage market.

Key factors for growth and vanadium demand include;

- Renewable energy generation in Australia is due to more than double over the next four years as the country seeks to meet a renewable energy target of 23 per cent.
- This increased renewable energy generation drives the need for new ways to store energy. Battery storage is proving to be an attractive answer, with numerous implementations already underway.
- Commercial vanadium redox flow batteries represent a significant new use of vanadium in the form of an electrolyte solution.

Australian Vanadium is well positioned to take advantage of this new application and has recently entered into MOUs[1] for future co-operation in developing the Australian vanadium flow battery technology and installations.

Australian Vanadium is actively advancing its 100% owned vanadium resource at Gabanintha in Western Australia.

Battery storage market driving vanadium demand

The inconsistent nature of renewable energy generation such as solar and wind power is driving demand for energy storage solutions. Vanadium battery solutions are an option for consumers having favourable characteristics such as a long life cycle, high charge retention and scalability.

Australian Vanadium is well positioned to take advantage of this opportunity and has recently entered into key agreements[1] for future co-operation in developing the Australian vanadium flow battery technology and installations.

In Australia the amount of renewable energy generated needs to more than double if the country is to meet the Government's mandated 23 per cent renewable energy target by 2020.(Australian Government, Department of the Environment, RET)

[1] ASX Release 23 February 2016; AVL signs MOU with GILDEMEISTER energy Storage GmbH and ASX Release 25 February 2016; AVL Signs MOU with Sun Connect.

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ASX ANNOUNCEMENT

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It is a worldwide trend; according to the REN21 Renewables 2015 Global Status Report renewables represented approximately 58.5 per cent of net additions to global power capacity in 2014. By early 2015, 164 countries had defined renewable energy targets.

Alongside this growth, energy storage is also set to increase, with capacity reaching 185 Gwh in the next few years (Lux Research; Grid Storage and TTP Squared Inc) with vanadium batteries having potential to account for around 30 per cent of this future capacity growth – equating to capacity of 62 Gwh of storage.

The 62 Gwh capacity growth over the next few years alone equates to new demand of 300,000 tonnes on vanadium – more than three times what is currently produced (TTP Squared Inc).

AVL's CEO Vincent Algar said that this shift will have significant impacts for vanadium producers.

"The effect on vanadium demand will be driven more and more by battery demand. We have identified this opportunity and are working hard to get all our integrated activities in full swing, to take advantage across the whole value chain"

Australian Vanadium's vertical integration strategy.

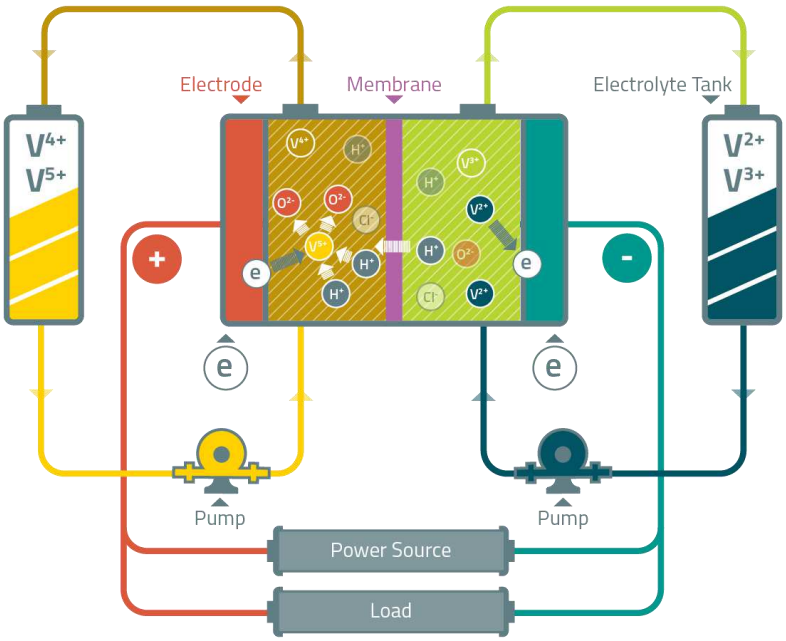
Australian Vanadium has recognised the potential for involvement in the energy storage market and explored the growth of demand for vanadium redox flow batteries ("VRFB" or "VRB"). It is on this basis that the company launched its vertical integration strategy in 2015, alongside its progression of the high-grade Gabanintha Vanadium Project in Western Australia. The strategy involves the establishment of a subsidiary company, VSUN Pty Ltd, which is focused on selling vanadium batteries and assessing the commercial viability of establishing an electrolyte plant in Australia.

The Gabanintha Project will allow Australian Vanadium to supply high-quality vanadium products to electrolyte producers worldwide, as well as its own plant planned for Australia.

The vertical integration strategy offers shareholders exposure to the potential of early cash flows coming from the expected sales of vanadium batteries. These batteries will be imported by Australian Vanadium and its subsidiary, VSUN Pty Ltd.

Australia is reliant on non-renewable resources to sustain its society. The increasing use of renewable energy in everyday lives represents a shift towards more energy efficient behaviour by individuals, businesses, utilities and governments. Storage technologies such as VRFB present Australian Vanadium with an opportunity to participate in this shift, while improving its bottom line. Businesses and networks need storage assets that are long term, able to survive and perform over the lifetime of the project.

Vanadium Batteries



Batteries using vanadium as the primary element are a solution within the energy storage technology market for those seeking high power, multi-hour, very high-cycle solutions. A number of global companies, including GILDEMEISTER energy storage (which has an MOU with AVL), Schmid Energy Solutions, Imergy and Rongke Power have been commercialising the technology since its invention in the 1980s at the University of NSW by Emeritus Professor Skyllas-Kazacos (an AVL consultant).

Vanadium redox flow batteries are preferred over alternatives due to a number of reasons including;

- scalability to high–power, multi-hour commercial and grid scale solutions,
- lifespan of 20 years,
- excellent charge retention (up to one year),
- suitability for grid connection,
- ability to discharge to 100% with no damage,
- multiple cycling (thousands of cycles), and
- use of only one element (V_2O_5 in solution), providing ease of operation and improving safety and failure risks.

VRFBs employ vanadium ions in different oxidation states to store chemical potential energy. Essential to the batteries, is vanadium pentoxide (V_2O_5) processed into an electrolyte (solution). The battery's storage capacity can be expanded by adding more electrolyte storage tanks, which hold the electrical charge for later use. They can also be left completely discharged for long periods with no reduction in performance. The battery can be charged and discharged at the same time, and has the additional ability to cycle often (thousands of times) and deeply (down to 0% and up to 100%), differentiating it from solid state (Li) based batteries.

Fields of Application

VRFB commercial installations are increasing in number around the globe with installations by various producers. Their features make them ideal for a range of storage applications including;

- Peak shifting: to use stored renewable energy at a time when peak electricity prices apply and direct renewable energy is not available, (such as early mornings or late afternoons/nighttime),
- Peak demand reduction: to use stored renewable energy to avoid peak demand charges,
- Backup as grid support: to stabilise low and medium voltage systems, as an energy reserve, or to smooth out output spikes (management of load and production peaks),
- Backup: as an in-line uninterruptible power supply system with frequency and amplitude decoupling,
- Stabilise wind and solar production: storage will buffer and stabilise energy output and fluctuations, leading to higher power contract security by having energy reserves in times of reduced renewable performance,

- Due to their ability to provide high power for many hours as required, VRFBs can ensure constant energy feed after wind and solar are no longer available in off-grid situations,
- VRFB based storage systems lead to an increase in self-consumption of renewable energy generated and reduce the need to substitute power needs with diesel generators, and
- As a temporary store for renewable energy before use in electric vehicles (via charging stations).

Further information

Please visit our website or further information for contact CEO **Vincent Algar; +61 8 9228 3333**