

## Australian Vanadium Purchases Pilot Electrolyte Plant from C-Tech Innovation Ltd

### Highlights:

- **AVL signs contract to purchase a vanadium electrolyte pilot plant from leading UK technology company C-Tech Innovation Limited (“C-Tech”).**
- **The pilot plant, the first of its kind in Australia, is capable of producing vanadium electrolyte via an electrochemical reduction process.**
- **The pilot plant will test and verify various local and international V<sub>2</sub>O<sub>5</sub> source materials for use in Vanadium Redox Flow Batteries (VRB).**
- **The self-contained pilot plant is in construction and will be sent to Australia in July 2016. Operation will commence immediately after arrival.**
- **The pilot plant will allow AVL to develop significant expertise in the preparation of electrolyte, a key component of VRB systems.**
- **C-Tech is an innovative research company who have developed commercial technology for the preparation of vanadium electrolyte for use in VRB.**
- **Direct electrolyte capacity is being considered as part of the Gabanintha Project feasibility studies and plant design. C-Tech will assist optimising metal recovery along with conventional metallurgical methods.**
- **C-Tech will continue to collaborate with AVL (along with other consultants) on planning a commercial-scale electrolyte plant.**

Western Australian based Australian Vanadium Limited (ASX: AVL) is pleased to announce it has purchased a vanadium electrolyte pilot plant from C-Tech Innovation Limited, a research, technology and innovation organisation based in the UK. C-Tech has developed technologies for electrochemical preparation of vanadium electrolyte as well as many other chemical and electrochemical technologies.

This purchase will enable AVL to develop unique vanadium electrolyte production expertise and capability in Australia, through both stand-alone and planned mine-attached facilities. The pilot plant will be used to test and verify the production of vanadium electrolyte products that are suitable and approved for use in third party vanadium redox flow battery products being sold in Australia, New Zealand, the Pacific and Asia.

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### ASX ANNOUNCEMENT

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The equipment purchased from C-Tech is an experimental vanadium electrolyte production system, consisting of an electrochemical cell and complete balance of plant, to facilitate investigations into the commercial production of vanadium electrolyte.

The pilot system will be the first of its kind in Australia. Skid-mounted and self-contained, the unit has all the necessary components, (electrochemical cells, pumps, instrumentation, safety and process control mechanisms), to produce high quality vanadium electrolyte in a single operation, without the need for chemical reductants. The process creates a mixture of  $V^{3+}$  and  $V^{4+}$  ions in solution, used as the “fuel” in VRB systems. The plant is capable of managing the ionic ratio of  $V^{3+}$  to  $V^{4+}$  according to the specific battery requirements. The management of impurities in the feed is also a key indicator of VRB performance, and the system will be used to assess and optimise different raw materials.

VRB use the unique chemical properties of vanadium to hold four oxidation states in acid solution to operate. The batteries require only a single balanced initial solution to operate, making them distinct from other flow battery systems.

AVL will locate the test plant in a laboratory facility in the Perth metropolitan area and, on its arrival and commissioning in July, will commence testing a variety of vanadium source materials in the plant. Vanadium pentoxide ( $V_2O_5$ ) powders will be sourced locally and internationally, allowing AVL to identify suitable material and suppliers for future commercial arrangements. Chemical analysis will be conducted and the results shared with C-Tech and GILDEMEISTER Energy Storage. Preparation of a solution that is suitable for use in GILDEMEISTER CellCube VRB is a priority for AVL and its battery sales subsidiary, VSUN.

Once a suitable supplier of  $V_2O_5$  and consistent electrolyte results are achieved to the satisfaction of GILDEMEISTER, plans for a commercial electrolyte plant will be accelerated and arrangements with the suppliers finalised.

Vincent Algar, AVL’s Managing Director said: “The purchase and commissioning of this pilot plant – along with the sale of our first battery through VSUN, is another concrete step forward for the company – in line with AVL’s vanadium market integration strategy.

“We are extremely pleased with AVL’s positioning as a leader in the roll-out of vanadium-based technologies and applications, and we are very proud to be bringing this industry and its exciting down-stream processing opportunities, to Western Australia.

C-Tech has developed important technology to support the anticipated rapid uptake of commercial vanadium redox flow batteries across the world, as energy storage becomes a key part of renewable energy penetration.

Raw materials such as vanadium require processing in order to prepare them for battery use. This relationship with C-Tech, leveraging its existing technologies and exciting new ideas, provides AVL with further opportunities to grow, as its vanadium integration strategy takes shape.

For AVL, developing the expertise now prepares us for future commercial production of electrolyte. This has the potential to be a high volume, high margin business unit for us, providing benefit to shareholders and simultaneously lowering the price of VRB in the Australian market. This also enables the increased uptake of VRB systems to occur in the many niches offered in the Australian energy market.”

Shipping of the plant will commence within the next few weeks on completion of the unit in the UK.

C-Tech Managing Director Ged Barlow was hugely impressed by the speed at which AVL’s plans were moving. “C-Tech is proud that its technology is being recognised on a global stage, and is delighted to be at the forefront of AVL’s continuing plans, both now and into the future.

The VRB market is set to become a very exciting one, and AVL’s confidence in C-Tech’s development work on a direct electrochemical route to clean, cost-effective electrolyte, puts the company in a strong position for the future.”

## About C-Tech Innovation Limited

C-Tech Innovation Ltd delivers innovative products and processes for electrochemical and advanced thermal applications. This includes unique electrochemical processes for use in energy and environmental applications, such as metal recovery, water treatment, chemical synthesis, fuel cells and batteries. C-Tech's work with flow batteries, and in particular, their product solutions for the electrochemical production of vanadium electrolyte, are a strong attraction for AVL as part of the company's integrated vanadium strategy for Vanadium Redox Flow Batteries.

C-Tech has developed a proprietary electrochemical process for the production of vanadium electrolyte suitable for use in vanadium redox flow batteries. Approximately 20% to 30% of the total cost of a VRB is due to the vanadium electrolyte, which can be used to store electrical energy from grid or renewable generation sources. This stored energy is then able to be used later when the battery is discharged, for example, when demand is higher than supply from renewable sources, or to export back to the grid to maintain grid stability.

VRB are unique commercial energy storage devices particularly suited to commercial on-grid and off-grid applications implementation due to their scalability, long asset lives and deep and very high cycling capability. Their low-risk operation makes them particularly suitable for commercial operations where safety is of paramount importance.



*Figure 1. C-Tech Electrochemical Pilot Plant*

Earlier in the year, AVL signed a MoU with C-Tech. The key objectives of the agreement include;

- The contract supply and installation of a pilot-scale electrolyte plant. The plant to be set up to allow testing of various vanadium sources with the aim of producing vanadium electrolyte of a suitable standard for use in commercial VFB units;
- Assistance with a full-scale electrolyte plant design and costing;
- Collaboration with other AVL consultants on design and specification of a mine-attached electrolyte purification and production facility as part of the Gabanintha feasibility study.
- AVL to act as an exclusive agent for C-Tech vanadium electrolyte cell technology in Australia, New Zealand and South East Asia regions.

## Australian Vanadium Limited

AVL is a diversified resource company with an integrated strategy with respect to Vanadium, seeking to offer investors a unique exposure to all aspects of the vanadium value chain – from resource through to steel and energy storage opportunities.

AVL is advancing the development of its 100%-owned, world-class Gabanintha Vanadium project. Gabanintha is currently one of the highest-grade Vanadium projects being advanced globally with Measured, Indicated and Inferred Resources of 91.4Mt, grading 0.82% V<sub>2</sub>O<sub>5</sub> and containing a discrete high-grade zone of 56.8Mt, grading 1.0% V<sub>2</sub>O<sub>5</sub> reported in compliance with the JORC Code 2012 (ASX Announcement 10 November 2015). AVL also aims to develop a local production capacity for high-purity vanadium electrolyte, which forms a key component of redox flow batteries.

AVL, through its 100%-owned subsidiary VSUN Pty Ltd, is actively marketing vanadium redox flow batteries in Australia through a distribution agreement with world-leading flow battery manufacturer, GILDEMEISTER Energy Storage GmbH (ASX Announcement 11 April 2016).

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