

27 September 2024

## Vanadium Technology Pathway Review

- Tivan has completed a technology review of the dual pathways under consideration for the development of the Speewah Vanadium Titanomagnetite Project in Western Australia - the TIVAN+ processing technology with CSIRO and a conventional salt roast technology.
- Tivan previously announced testwork outcomes for both TIVAN+ and salt roast technologies had delivered excellent results confirming the amenability of processing Speewah concentrate for both pathways at bench-scale.
- The vanadium technology review supports completion of salt roast testwork aiming to produce vanadium electrolyte to achieve specification for Vanadium Redox Flow Batteries, and a preliminary assessment of third-party interest in the commercial development of the TIVAN+ technology.
- In parallel, Tivan is advancing negotiations with government regarding a facilitation and funding agreement for the development of a TIVAN+ Pilot Plant.
- Tivan will provide further updates on both technology pathways in Q4 that will inform the Company's strategic direction in this area.

The Board of Tivan Limited (ASX: TVN) ("Tivan" or the "Company") is pleased to provide an update on the evaluation of the mineral processing technology pathways under consideration for the development of the Speewah Vanadium Titanomagnetite Project in Western Australia. The Company has over the past 12 months focused on evaluating the processing of vanadiferous titanomagnetite ("VTM") concentrate from Speewah utilising two alternative processing routes - the TIVAN+ critical minerals processing technology under development in strategic partnership with CSIRO, and a conventional salt roast technology.

In November 2023, Tivan announced it had secured a long-term commercial and strategic partnership with CSIRO through the execution of a Technology Licence Agreement ("TLA") and a Research Services Agreement ("RSA"), under which the parties are collaborating on integration of their intellectual property and know-how for the development and commercialisation of TIVAN+. TIVAN+ is designed to recover vanadium, titanium and iron from VTM concentrate.

The TLA provides Tivan with an exclusive and non-transferable 20-year worldwide (except India) licence to use CSIRO's specified VTM intellectual property, patents, know-how and any further improvements thereto for the recovery of vanadium that will form the basis for the TIVAN+ technology. The RSA formalised the on-going collaboration between the parties on the TIVAN+ technology development, detailing agreed workstreams and testwork programs ahead of a planned pilot plant project.

### Vanadium Technology Pathway Evaluation Update

The Company previously announced that excellent testwork results had been returned for both the TIVAN+ and salt roast technology pathways, providing significant development optionality for Tivan (see ASX announcements of 30 May 2024 and 19 June 2024). A summary of the results of each testwork program is provided below.

The initial stages of the technical evaluation of the dual pathways have been completed, culminating in an internal review on the technical outcomes of the development testwork programs. Owing to the Speewah VTM concentrate exceeding expectations for amenability to traditional salt roast processing, and the positive testwork results and significant third-party interest in the TIVAN+ technology (see below), both technologies are still under consideration as potential pathways for further development and commercialisation.

Additional work is required to be undertaken to complete the technical evaluation and inform pathway planning. This work will include completion of the salt roasting testwork program, targeting high purity V<sub>2</sub>O<sub>5</sub> for preparation of vanadium electrolyte to achieve specifications provided by Sumitomo Electric Industries (see ASX announcement of 28 February 2024). In addition, preliminary commercial assessments are being undertaken on each pathway. Further refinement of the commercial strategy for TIVAN+ is a key consideration, which includes discussions on project facilitation opportunities with government for the development of a TIVAN+ Pilot Plant, and with third-party owners of alternative VTM resources (see further below).

### ***TIVAN+ Program Summary***

The Company has been working with CSIRO since April 2023 (ahead of signing the TLA and RSA) on development of the TIVAN+ technology. As previously announced, Tivan and CSIRO successfully completed a significant development testwork program under the RSA. Testwork outcomes delivered excellent results that confirm the technical viability of processing Speewah concentrate with the TIVAN+ technology (see ASX announcement of 30 May 2024).

Development works completed or in progress have included the following:

Activities	Sponsor	Status	Description
Technology Review	Tivan	Completed	Tivan's review of the CSIRO patent
Comparative Location Study	Tivan	Completed	Tivan's assessment of potential TIVAN+ technology processing locations for the Speewah ore
Technology License Agreement	Tivan/CSIRO	Completed	Agreement that describes the licensing arrangement and commercial terms for Tivan implementation of the CSIRO IP
CSIRO Testwork Report	CSIRO	Draft	Technical report describing outcomes of the CSIRO testwork study which was covered under the RSA
TIVAN+ Environmental Screening	EcOz	Completed	Darwin, East Arm, pilot plant environmental pre-referral screening report
Middle Arm Renewable Energy Agreement	Tivan/Larrakia Energy	LOI	Letter of Intent with Larrakia Energy for the supply of up to 30 MW of renewable energy from 2026

*Table 1 – Core TIVAN+ technology activity summary*



As previously announced (see ASX announcement of 30 May 2024), positive testwork results included the following highlights:

- Near quantitative (100%) recovery of iron from solution.
- Iron grade of 69.4% Fe achieved, albeit at a lower recovery of ~92%. This product has potential as a DRI feedstock at these high grades.
- High vanadium extraction of 98.5% from concentrate.
- Repeatable leaching outcomes validate high vanadium extraction.
- Results support the position that the technology will be applicable to alternative VTM deposits.
- Titanium residue with 57-60% TiO<sub>2</sub> with sulphation titanium extractions in the range of 87.7%-94.2%.



Figure 1: Samples – titanium dioxide (leach trials), magnetite (iron recovery trials), “AMV” (ammonium metavanadate is a pre-cursor to the V<sub>2</sub>O<sub>5</sub> (preparation) and vanadium pentoxide (Source: CSIRO)

### **Salt Roast Program Summary**

In August 2023, Tivan announced the outcomes of an investigation into traditional processing methods of VTM ores. The Company determined that salt roasting technology can offer a shorter time to production and revenue, resulting in progression of a salt roast pathway evaluation in late 2023.

Development works completed or in progress have included the following:

Activities	Sponsor	Status	Description
Murdoch salt roasting testwork	Murdoch	Complete	Testwork program initiated by King River Resources Ltd ("KRR") and report received by Tivan after acquisition of the Speewah assets
Speewah salt roast historical testwork review	Tivan	Complete	Testwork summary report summarising and evaluating previous results in support of salt roast assessment
Salt roast study	Tivan	Complete	Technology review to assess the amenability of the Speewah ore to salt roasting
Hatch engineering review and workshop	Hatch Tivan SRD Consulting Orway Mineral Consultants Equipment vendors	Complete	Engineering review by Hatch to evaluate the detailed scoping work completed by Tivan and historic works prepared for KRR. Preparation of the basis of design for the Project ahead of the Pre-Feasibility Study ("PFS")
Salt roast PFS	Hatch	On-hold	PFS for a salt roast project at Speewah
Salt Roast Optimisation Testwork	ALS	Complete	Salt roast program optimisation testwork exploring salt dose, salt type, salt ratios, temperature and residence time impacts
V <sub>2</sub> O <sub>5</sub> Preparation	ALS	In-Progress	Vanadium recovery work and preparation of V <sub>2</sub> O <sub>5</sub> for vanadium electrolyte preparation
Middle Arm Renewable Energy Agreement	Tivan/Larrakia Energy	LOI	Letter of Intent with Larrakia Energy for the supply of up to 30 MW of renewable energy from 2026

*Table 2 – Core salt roast activity summary*

In February 2024, the Company appointed Hatch to commence work on a Pre-Feasibility Study ("PFS") for the Speewah Vanadium Titanomagnetite Project to assess the technical and economic feasibility of a conventional salt roast vanadium mining, beneficiation and processing operation. Initial phases of the PFS were progressed. The PFS was put on hold subject to the Company's determination on its technology pathway and prioritisation of the Speewah Fluorite Project.

The salt roasting development testwork was prioritised to optimise and test the process flowsheet through to vanadium electrolyte preparation. The primary purpose of the program is to achieve the high-purity vanadium electrolyte specifications provided by SEI, a Japanese manufacturer of large-scale, long-life vanadium redox flow batteries. The program supports the Company's planned Vanadium Electrolyte Facility at the Middle Arm Sustainable Development Precinct near Darwin (see ASX announcement of 31 October 2023).

As previously announced (see ASX announcement of 19 June 2024), highlights of the testwork program include:





- Vanadium extractions up to 98.3%; this was a large uplift on previous results (vanadium extractions up to 92.4%, see ASX announcement by KRR dated 10 May 2022)
- Repeatability demonstrated for vanadium extractions >97% at industrially relevant processing conditions
- Opportunities for cost reduction with sodium sulphate salt mixing
- Very low impurity dissolution for Fe, Ti, Al, Cr, Mn and Mg
- Silica dissolution is a little higher than is typical, however, initial testing indicates that this will be manageable

The testwork results have exceeded expectations and have demonstrated that the Speewah ore has high amenability to the traditional salt roasting technology. This amenability is further bolstered by the following Speewah deposit attributes:

- Very high VTM concentrate  $V_2O_5$  composition (~2.4%  $V_2O_5$ )
- Large resource size and long-life
- Orebody is suitable for open pit mining with a very low strip ratio

Tivan has materially advanced the salt roasting testwork program at ALS Metallurgy, finalising the salt roasting optimisation scope of work and are now executing the  $V_2O_5$  preparation scope of work. The testwork results for the  $V_2O_5$  preparation are being progressively received by Tivan, and an update on testwork status will be made in Q4 when the testwork is complete and all results have been evaluated.

### East Kimberley Development Synergies

Tivan is focused on progressing development planning and execution of the Speewah Fluorite Project. The vanadium development strategy review confirmed that the following site activities for the Project are expected to be beneficial for future development of the vanadium titanomagnetite deposit:

- *Environmental baseline surveys:* Cover a large area in the region, these will support and potentially reduce scope for future surveys specific to the vanadium deposit. Survey requirements for established infrastructure will be significantly reduced
- *Access road:* Will already be established and is designed for appropriately sized trucks that can support both product and reagent movements to and from site. This represents a significant capital saving
- *Experienced skilled workforce:* Similarities in operations (e.g. mining, comminution, dewatering, tailings, logistics and maintenance) expected to improve project start-up due to familiarised and skilled labour and contractors
- *Accommodation village:* Temporary accommodation camp location for construction will already be cleared and flattened, reducing cost for reestablishing the accommodation camp for construction and providing a location a permanent accommodation facility
- *Water Supply:* The established sites for water extraction may also be suitable for the vanadium project, reducing greenfield project development activities and potentially costs
- *Power transmission infrastructure:* The plan to establish connection to Ord River Hydro Power Station has potential to also benefit the vanadium project, depending on the spare capacity of the network.
- *Mining capability:* The fluorite mining equipment could potentially be utilised for development of the vanadium project area, reducing costs associated with site preparation works.

- *Social licence:* Tivan's workflows and Heritage Protection Agreements with the Kimberley Land Council are inclusive of the vanadium titanomagnetite resource at Speewah.
- *Project partner:* Tivan's Strategic Alliance with Sumitomo Corporation has raised the company's profile in Japan and enabled new dialogues to progress regarding the long-run development of the Speewah Vanadium Titanomagnetite Project.

### **Commercial Status of TIVAN+**

Since the publication of the CSIRO testwork results in May 2024, Tivan has received significant third-party interest in the technology, including from VTM resource owners in Australia and overseas. A common feature of this interest has been the potential utility of the TIVAN+ technology to produce high purity vanadium and direct reduced iron (DRI) / green steel.

Tivan is reviewing these opportunities for collaboration in conjunction with CSIRO and in accordance with the terms of the TLA. This includes a scoping level review of a local VTM asset held by an A-list Australian counterparty located in close proximity to a major industrial zone. Tivan expects to complete this review in Q4 2024 and will determine whether to pursue the opportunity.

Tivan notes that while there is significant third-party interest in the TIVAN+ technology, there is no guarantee or certainty that a commercial arrangement or sublicensing agreement will eventuate.

Tivan is also advancing negotiations with government regarding facilitation and funding to support the development of a TIVAN+ Pilot Plant. These negotiations are also expected to progress in Q4.

### **Next Steps in Q4**

Tivan will provide further updates on both vanadium development pathways in Q4 as progress is made.

Executive Chairman, Mr Grant Wilson, will present on Tivan's vanadium development pathways at the upcoming 40 Year Anniversary Flow Battery Symposium at the University of New South Wales on 16 October.

### **Tivan Executive Chairman Mr Grant Wilson commented:**

*"The principal purpose of Tivan's vanadium technology review was to consolidate the material progress we have made over the past eighteen months and to promote competitive tension between the two development pathways. The review has once again confirmed Speewah's credentials as a world-class vanadium resource and has highlighted the significant commercial synergies that will be generated by the successful delivery of the Speewah Fluorite Project.*

*The stellar testwork results for salt roast have kept the traditional technology pathway in the frame at Speewah. Meanwhile, the outstanding testwork results produced by CSIRO on TIVAN+ have advanced the prospect of achieving a step-change improvement in critical minerals processing technology in Australia.*



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*While it is premature for Tivan to recommence project studies phases for the Speewah Vanadium Titanomagnetite Project, the tangible progress we are making on technology pathways and achieving downstream specifications is generating significant third-party interest. This will also inform our strategic direction, especially in the ongoing development of the TIVAN+ technology.*

*We look forward to providing further updates in Q4.”*

This announcement has been approved by the Board of the Company.

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## **Competent Person's Statement Exploration Results**

Tivan's exploration activities are being overseen by Mr Stephen Walsh (BSc). The information that relates to exploration results in this report is based on and fairly represents information and supporting documentation prepared and compiled by Mr Walsh, a Competent Person, who is the Chief Geologist and an employee of Tivan, and a member of the Australasian Institute of Mining and Metallurgy (AusIMM). Mr Walsh has sufficient experience of relevance to the styles of mineralisation and the types of deposits under consideration, and to the activities undertaken, to qualify as a Competent Person as defined in the 2012 Edition of the Joint Ore Reserves Committee (JORC) Australasian Code for Reporting of Exploration Results. Mr Walsh consents to the inclusion in this report of the matters based on information compiled by him in the form and context which it appears.

### ***Speewah Vanadium Exploration Results***

The information in this report that relates to exploration results for the Speewah Vanadium Titanomagnetite Project has been extracted from the Company's previous ASX announcements entitled "Tivan & CSIRO successfully complete TIVAN+ Testwork Program" dated 30 May 2024 and "Update on Vanadium Electrolyte Testwork Program" dated 19 June 2024.

Copies of these announcements are available to view at [www.asx.com.au](http://www.asx.com.au) or [www.tivan.com.au/investors/asx-announcements/](http://www.tivan.com.au/investors/asx-announcements/). The Company confirms that it is not aware of any new information or data that materially affects the information included in those announcements. Tivan confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from those announcements.

### **Forward looking statement**

This announcement contains certain "forward-looking statements" and comments about future matters. Forward-looking statements can generally be identified by the use of forward-looking words such as, "expect", "anticipate", "likely", "intend", "should", "estimate", "target", "outlook", and other similar expressions and include, but are not limited to, the timing, outcome and effects of the future studies, project development and other work. Indications of, and guidance or outlook on, future earnings, financial position, performance of the Company or global markets for relevant commodities are also forward-looking statements. You are cautioned not to place undue reliance on forward-looking statements. Any such statements, opinions and estimates in this announcement speak only as of the date hereof, are preliminary views and are based on assumptions and contingencies subject to change without notice. Forward-looking statements are provided as a general guide only. There can be no assurance that actual outcomes will not differ materially from these forward-looking statements. Any such forward looking statement also inherently involves known and unknown risks, uncertainties and other factors and may involve significant elements of subjective judgement and assumptions that may cause actual results, performance and achievements to differ. Except as required by law the Company undertakes no obligation to finalise, check, supplement, revise or update forward-looking statements in the future, regardless of whether new information, future events or results or other factors affect the information contained in this announcement.