

## CRITICAL RESOURCES EXTENDS BATTERY TECHNOLOGY EVALUATION PROGRAM WITH THERMAL MANAGEMENT EVALUATION LICENCE

CRR takes an evaluation licence from NTU Singapore covering battery and electronics thermal management, extending CRR's solid-state battery development program with a prototype-validated cooling technology.

- **Evaluation Licence:** Critical Resources has taken an evaluation licence from NTUitive Pte Ltd, the innovation and enterprise company of Nanyang Technological University, Singapore (NTU Singapore), for certain intellectual property relating to the thermal management of lithium-ion batteries and data centre cooling infrastructure.
- **Integrated thermal management:** The evaluation licence covers thermal management for processors, graphics chips and lithium-ion batteries within data centre infrastructure. The licence extends CRR's lithium-ion solid-state battery evaluation program for operations in elevated-temperature environments.
- **Designed for warm climates:** The two-phase thermal management portfolio seeks to eliminate the requirement for refrigeration chillers by operating at ambient temperature, with greatest advantage in high-density, high-ambient-temperature installations where cooling costs are highest.
- **Dynamic Predictive Model Control:** The thermal management portfolio includes a 'Model Predictive Control' (MPC)<sup>2</sup> that adjusts energy use in real time, optimising processor performance and energy consumption — an approach directly applicable to battery management in high-temperature environments.
- Research led by **NTU School of Mechanical and Aerospace Engineering faculty:** Associate Professor Wong Teck Neng, with more than 35 years of expertise in spray cooling and two-phase thermal management of electronic systems; and Assistant Professor Ho Jin Yao, who has more than 10 years of experience in interfacial transport, phase change heat and mass transfer.
- **Integrated value-chain advantage:** The solid-state lithium-ion battery evaluation programs give Critical Resources direct insight across the lithium supply chain from its Mavis Lake Project through to downstream battery development, expanding the Company's optionality across partnerships, licensing, IP generation and future commercial pathways.

**Critical Resources Limited** ('Critical Resources' or the 'Company', **ASX:CRR**) is pleased to announce that it has taken an evaluation licence from NTUitive Pte Ltd, the innovation and enterprise company of Nanyang Technological University, Singapore (**NTU**), covering four technology disclosures for thermal management of lithium-ion batteries and high-density electronics within server and data centre infrastructure.

### ABOUT THE THERMAL MANAGEMENT TECHNOLOGY PORTFOLIO

Operating temperature directly affects ionic conductivity, interface stability, and the rate of performance degradation over time in advanced battery architectures. For solid-state battery architectures operating at elevated-temperatures, controlled thermal conditions are a prerequisite for repeatable, reliable performance.

CRR's solid-state battery evaluation program is generating datasets on electrolyte conductivity, interface stability and cathode/electrolyte construction. As that program progresses toward prototype configurations, thermal management becomes a practical development consideration. The NTU evaluation licence covers thermal management of lithium-ion batteries alongside processors and graphics chips. This connects CRR's lithium-ion value chain — from lithium supply at Mavis Lake through to downstream battery development.

The portfolio of thermal management technologies covers a two-phase spray cooling approach to remove heat from electronic components and battery systems. A dielectric fluid — electrically non-conductive and commercially available — is sprayed directly onto the surface of the heat-generating component. The fluid evaporates on contact (two-phase), removing heat far more efficiently than any approach that keeps the coolant in liquid form. The vapour is captured in a sealed enclosure, condensed back to liquid using near-ambient-temperature fluid, and recirculated in a closed loop.

The NTU thermal management technologies are supported by peer-reviewed publications in *Applied Energy* (2022)<sup>1</sup> and *Energy* (2023)<sup>2</sup>. Validated performance data from those studies includes a 25.8% reduction in total facility energy consumption, a Power Usage Effectiveness (**PUE**) of 1.08 compared to approximately 1.69 for conventional air-cooled systems, and a 7°C reduction in chip surface temperature at full load. The system operates with ambient-temperature fluid at approximately 30°C with no refrigeration chiller required.

The licensed portfolio includes a thermal model of the two-phase spray-cooled system — a physics-grounded predictive model characterising dynamic thermal responses to varying ambient-temperature and load conditions. This provides the foundation for Model Predictive Control (MPC) of cooling loads and, by extension, of battery operating temperatures within an integrated system.

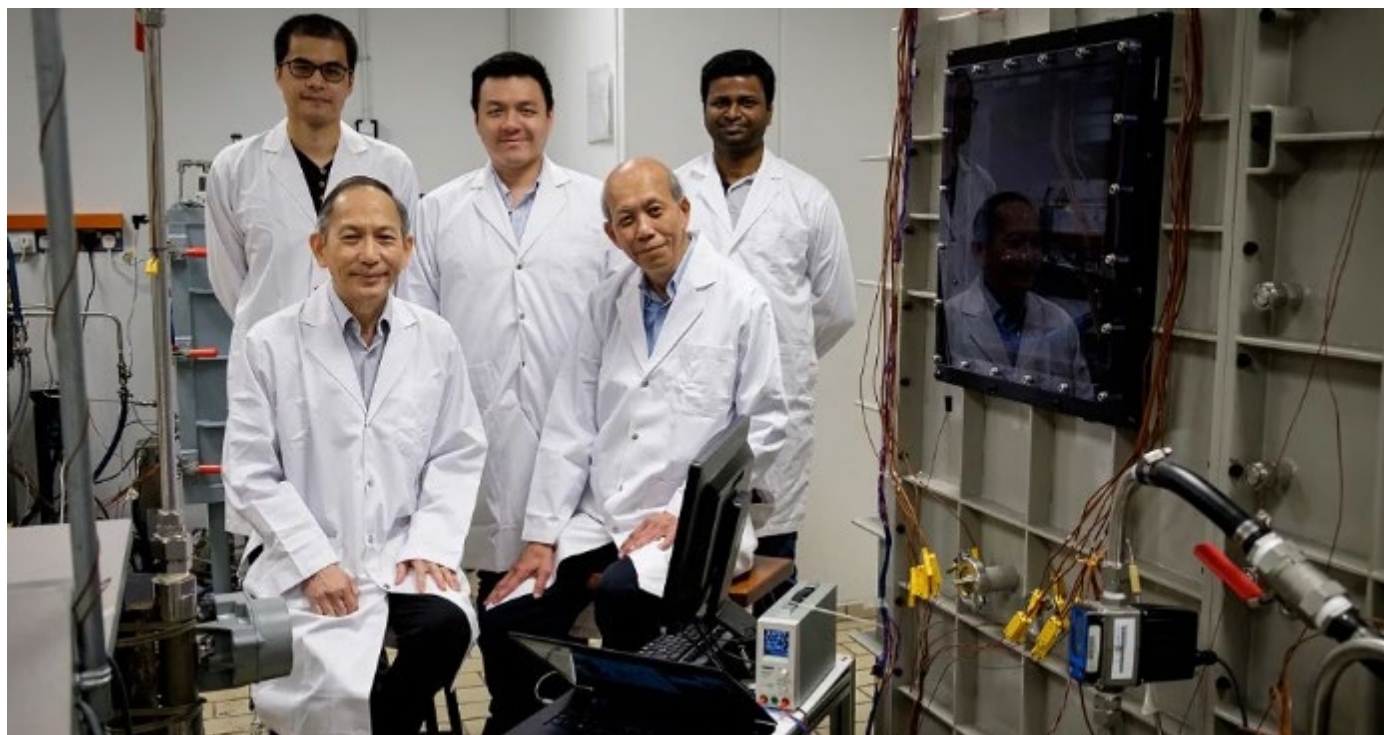
**Critical Resources Managing Director, Tim Wither, commented:** 'Our solid-state lithium-ion battery program gives Critical Resources insight across the lithium value chain - from supply at the Mavis Lake Lithium Project through to downstream next-generation lithium-ion battery development. Thermal management sits at the centre of that downstream work: heat directly affects battery performance, cycle life and safety. The NTU portfolio represents a potential future tool for this challenge.'

## ABOUT THE NTU RESEARCH TEAM

The NTU thermal management portfolio was developed under the leadership of **Associate Professor Wong Teck Neng** and **Assistant Professor Ho Jin Yao**, both faculty members of NTU's School of Mechanical and Aerospace Engineering. Assoc. Prof. Wong holds a Ph.D. in Mechanical Engineering from the University of Strathclyde and has spent more than 35 years developing expertise in two-phase flow, heat transfer, spray cooling, and thermal management of electronics. Prof. Ho holds a Ph.D. in Mechanical Engineering from NTU and has more than 10 years of experience in interfacial transport, surface micro/nanostructuring for enhanced two-phase heat and mass transfer, and phase change heat and mass transfer. The research team also includes research fellow Liu Pengfei, former research fellow Ranjith Kandasamy and former Associate Professor Toh Kok Chuan, whose work underpins the two peer-reviewed publications supporting this announcement.

**Associate Professor Wong Teck Neng commented:** 'Instead of cooling the entire data centre conventionally, we designed special sprays that target heat directly at the server level. The inspiration for our innovation is simple. By focusing cooling at the source of heat generation, the system enables more efficient heat removal and reduces unnecessary energy consumption. This targeted approach minimises thermal resistance and ensures that cooling capacity is utilised where it is most effective.'

**Assistant Professor Ho Jin Yao added:** 'This work demonstrates the potential of spray cooling as a high-performance solution for server thermal management. By leveraging phase change heat transfer and optimising liquid-surface interactions, the system can significantly enhance cooling efficiency for high-power electronic devices.'



**Figure 1:** (anti-clockwise from bottom left) Leader of the project, NTU Associate Professor Wong Teck Neng, former Associate Professor Toh Kok Chuan, research fellow Ranjith Kandasamy, Asst Prof Ho Jin Yao, and research fellow Liu Pengfei, with prototype cooling system for data centres on the right. Photo Credit: NTU Singapore.

## TRANSACTION TERMS

The evaluation licence is held by 62 Capital Pty Ltd and was executed with NTUitive Pte Ltd. Under the terms of the arrangement, Critical Resources has been nominated as the entity to hold the full commercial licence upon exercise of the option. An evaluation licence consideration of SGD\$10,000 has been paid to NTUitive.

The option to proceed to a full commercial licence may be exercised no later than 30 September 2026, which may be extended by express written agreement between the parties. The commercial licence terms are:

- 100% of IP registration and past patent filing expenses plus a 15% IP management overhead payable to NTUitive (quantum to be disclosed when quantified).
- The total scheduled licence consideration over the ten (10) year licence period is SGD\$220,000, exclusive of patent cost recovery obligations.

The Company will undertake a structured evaluation of the thermal management technology portfolio after a Research Collaboration Agreement with NTU is finalised, which remains under discussion. The Company's approach is capital-light and milestone-based, with each stage of development gated by independent technical and commercial validation. The evaluation program may be increased subject to successful completion of defined technical and commercial milestones. The evaluation is designed to assess technical performance and integration potential with the Company's existing battery programs.

**This announcement has been approved for release by the Board of Directors of Critical Resources.**

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## ABOUT CRITICAL RESOURCES LIMITED

Notwithstanding this transaction, Critical Resources Limited (ASX:CRR) is an Australian mining and technology company with a primary focus on the discovery and development of critical metals and next-generation lithium-ion battery technologies essential to a sustainable future. The Company holds a diversified portfolio including the Mavis Lake Lithium Project in Ontario, Canada, the Halls Peak Base Metals Project in New South Wales, and a growing gold portfolio in New Zealand. The Company will continue to direct the majority of its expenditure to these exploration projects in the foreseeable future.



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## FORWARD LOOKING STATEMENTS

This announcement may contain certain forward-looking statements and projections. This announcement also contains forward-looking statements regarding technology development, commercial licensing, pilot deployment, and integration of the NTU cooling portfolio with CRR's battery programs. These statements are subject to technology, development, regulatory, and commercial risks and actual outcomes may differ materially from those described. Statements regarding CRR's plans with respect to its mineral properties and programs are forward-looking statements. Such forward-looking statements/projections are estimates for discussion purposes only and should not be relied upon. Forward-looking statements/projections are inherently uncertain and may therefore differ materially from results ultimately achieved. There can be no assurance that CRR's plans for development of its mineral properties will proceed as currently expected. There can also be no assurance that CRR will be able to confirm the presence of additional mineral resources, that any mineralisation will prove to be economic or that a mine will successfully be developed on any of CRR's mineral properties. Critical Resources Limited does not make any representations and provides no warranties concerning the accuracy of the projections and disclaims any obligation to update or revise any forward-looking statements/projections based on new information, future events or otherwise, except to the extent required by applicable laws. While the information contained in this report has been prepared in good faith, neither Critical Resources Limited nor any of its directors, officers, agents, employees or advisors give any representation or warranty, express or implied, as to the fairness, accuracy, completeness or correctness of the information, opinions and conclusions contained in this announcement.

## REFERENCES

1. Kandasamy, R., Ho, J.Y., Liu, P., Wong, T.N., Toh, K.C., Chua Jr, S. (2022). Two-phase spray cooling for high ambient temperature data centers: Evaluation of system performance. *Applied Energy*, 305, 117816. <https://doi.org/10.1016/j.apenergy.2021.117816>
2. Liu, P., Kandasamy, R., Ho, J.Y., Wong, T.N., Toh, K.C. (2023). Dynamic performance analysis and thermal modelling of a novel two-phase spray cooled rack system for data center cooling. *Energy*, 269, 126835. <https://doi.org/10.1016/j.energy.2023.126835>