FIREBIRD SUCCESSFULLY DEMONSTRATES PROPRIETARY LMR CATHODE PERFORMANCE

Highlights

- **Firebird is among the first Western listed companies to publicly report electrochemical performance data for proprietary LMR cathode materials**.
- **Independent electrochemical testing confirms Firebird's LMR cathode** material achieved discharge capacity performance **comparable to a commercial reference.**
- Specific discharge capacity of 263.7 mAh/g (at 0.1C), approximately **65% higher than typical LFP and 26% higher than high-nickel NCM cathode materials.**
- **Twenty successful synthesis campaigns completed at Firebird's wholly owned Pilot Plant and R&D facility** in China, establishing stable LMR production capability.
- **Results validate Firebird's vertically integrated strategy,** extending from high-purity manganese sulphate production into advanced manganese-rich cathode materials.
- **Further optimisation will focus on improving cycle life and commercial performance,** with the proprietary LMR process planned to be demonstrated at **Firebird's Australian Demonstration Plant in Western Australia**.

Figure 1. Cataloguing coin cells for electrochemical testing, manufactured using Firebird's LMR technology.

Australian-owned Firebird Metals Limited **("FRB", "Firebird" or "the Company")** is pleased to provide an update on the development of its proprietary Lithium Manganese Rich (LMR) cathode materials technology, following the completion of six months of laboratory commissioning and process optimisation at the Company's China-based research facility.

During the period, the Company completed twenty (20) precursor synthesis batches and preliminary cathode material validation campaigns, establishing stable platforms for precursor co-precipitation, cathode sintering and electrochemical evaluation. Independent electrochemical testing confirmed that Firebird's LMR cathode material achieved first-cycle discharge performance in line with commercially sourced reference material, recording a 0.1C discharge capacity of 263.7 mAh/g and a 1C discharge capacity of 211.2 mAh/g. This represents an increase of 65% and 26% compared with conventional LFP (160 mAh/g) and high-nickel NCM (210 mAh/g) cathode chemistries (Figure 2).

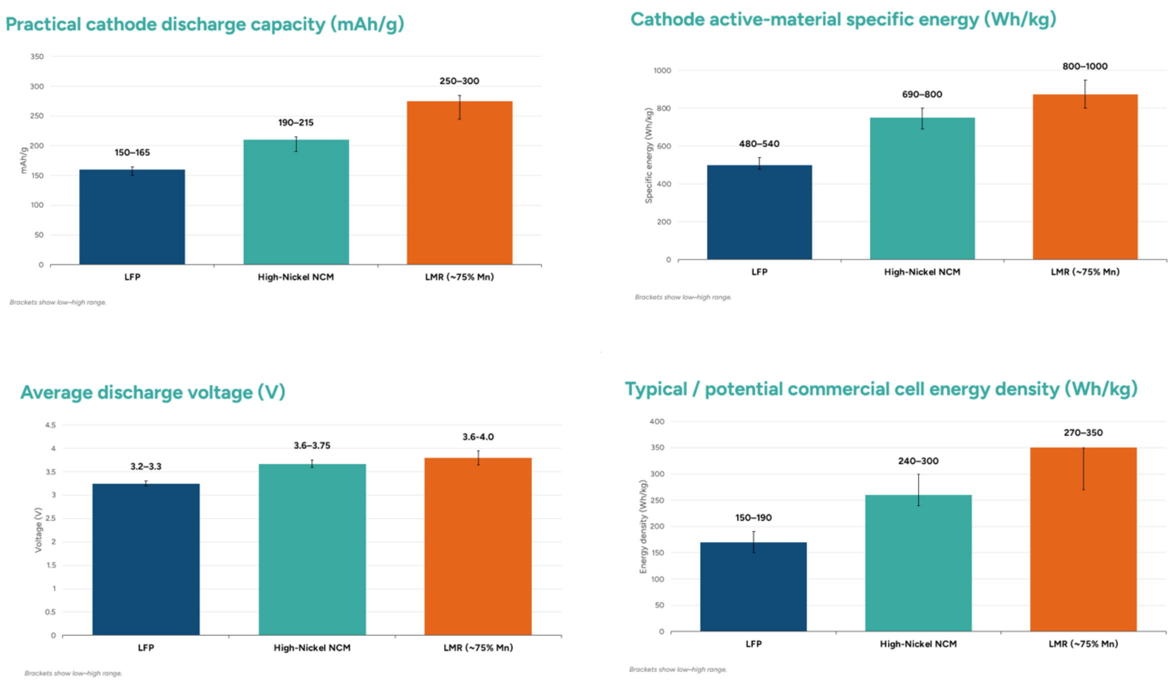

Figure 2. LFP, NCM and LMR performance comparisons.

A higher discharge capacity can support:

- greater energy storage and potentially higher battery energy density;
- longer vehicle driving range or device operating time for the same battery weight;
- smaller or lighter battery packs for a given energy requirement; and
- more efficient use of the cathode's active material.

LMR is widely regarded as one of the next-generation lithium-ion battery chemistries and is being actively developed by several global automotive and battery manufacturers for its potential to deliver higher energy density than lithium iron phosphate (LFP). In addition, it is being pursued for its potential as an alternative to high-nickel nickel cobalt manganese (NCM) battery cathodes reducing reliance on nickel and cobalt. Firebird believes achieving performance comparable with an established commercial reference represents an important milestone in validating the Company's proprietary processing technology.

Both General Motors and Ford have announced plans to develop LMR battery technology. Firebird believes it is among the first Western-listed companies to publicly report electrochemical performance data for proprietary LMR cathode materials. This milestone builds on the Company's established high purity manganese sulphate monohydrate (HPMSM) production capability and demonstrates its expanding downstream expertise in the development of high-value cathode active materials, as leading global automotive manufacturers continue to advance LMR as a next-generation battery chemistry.

Firebird CEO, Mr Ron Mitchell, commented:

"Our investment over several years in developing advanced manganese-based cathode materials is now delivering tangible results. Following the successful completion of our fully integrated LMFP cathode development program last year, Firebird is rapidly progressing development of a proprietary lithium manganese-rich (LMR) technology at the Company's wholly owned pilot plant and R&D facility in Hunan, China.

Achieving electrochemical performance comparable with an established commercial reference within six months of commissioning our LMR pilot program is a significant technical milestone. The results validate our proprietary development approach and demonstrate a clear pathway towards producing commercially competitive LMR cathode materials. These results represent an important first milestone rather than the final product. Our objective in China was to establish a high-performance pristine LMR capable of matching commercial reference material. Having now achieved that, the next phase of development will transition to our Australian Demonstration Plant, where we will apply proprietary doping strategies, Firebird's high-purity manganese sulphate and further process optimisation to improve cycle life, long-term stability and overall commercial performance.

This milestone marks another important step in Firebird's evolution into an integrated advanced battery materials company. Demonstrating the ability to produce high-performance LMR cathode materials capable of matching the electrochemical performance of commercially sourced reference products reinforces the strength of our technology platform and supports *our objective of establishing a fully integrated western manganese ore-to-cathode battery materials supply chain."*

Figure 3. Firebird's LMR reactor at the Company's China-based research facility.

Firebird's proprietary LMR co-precipitation reactor allows dissolved metal sulphate solutions to react under precisely controlled conditions to produce manganese-rich precursor particles. Careful control of temperature, pH, mixing and reaction conditions determines the particle size, morphology and purity of the precursor, providing the foundation for producing high-performance LMR cathode materials.

LMR Cathode Development Program

The development program forms a core component of Firebird's vertically integrated battery materials strategy, extending downstream from the Company's HPMSM production capability into advanced cathode materials.

The research workflow spans four stages: material synthesis, cell assembly, electrochemical testing and failure analysis, providing an integrated platform for iterative process optimisation.

Precursor Synthesis and Optimisation

Systematic optimisation has been undertaken across the precursor washing process, co-precipitation reaction conditions and key baseline quality indicators. Adjustment of washing temperature, washing cycles and washing time has effectively controlled impurity levels, while significantly improving washing efficiency. This provides the foundation for uniform growth of primary particles and full development of the layered crystal structure during subsequent high-temperature sintering. In parallel, optimisation of ammonia concentration, pH, reaction temperature and reaction atmosphere has improved precursor particle morphology, particle size distribution and tap density.

Uniform spherical particles support consistent cathode production, improved electrochemical performance and commercial-scale manufacturability.

Higher tap density enables more active material to be packed into a given battery cell volume, supporting higher volumetric energy density and improving the commercial competitiveness of the final cathode material.

Key physical properties and impurity levels of Firebird's precursor material compared against a commercial reference precursor material are summarised in Table 1.

Table 1. Characterisation results, Firebird's manganese-rich precursor.

Test Item	Industry Target Value	Commercial Reference	Firebird Result
Particle size – D10 (μm)	≥ 2	2.9	**2.9**
Particle size – D50 (μm)	3 – 6	4.2	**4.7**
Particle size – D90 (μm)	≤ 9	5.6	**7.8**
Tap density (g/cm³)	≥ 1.2	1.22	**1.0**

Na (ppm)	≤ 150	71.0	**71.6**
S (ppm)	≤ 1,500	1,323	**1,130**
Ca (ppm)	≤ 50	9.2	**12.4**
Mg (ppm)	≤ 100	3.5	**64.1**
Al (ppm)	≤ 50	16.9	**10.4**
Cr (ppm)	≤ 50	6.2	**11.6**
Zn (ppm)	≤ 50	3.2	**3.0**
Fe (ppm)	≤ 50	13.6	**14.6**

Scanning electron microscope (SEM) imaging confirms Firebird's precursor has developed well-defined spherical secondary particles comparable to the commercial reference. This morphology is considered important for achieving consistent processing, high tap density and reliable electrochemical performance in commercial cathode materials (Figures 4).

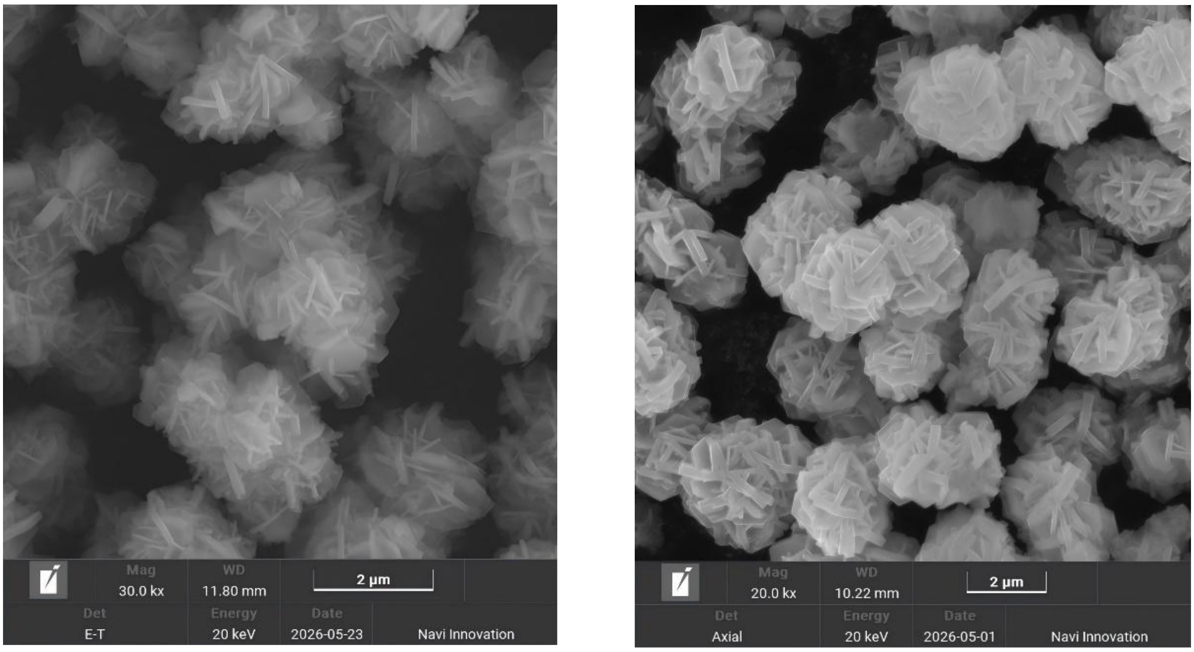

Figure 4. SEM image of Firebird's LMR precursor (left) and commercial reference (right).

Cathode Material Electrochemical Validation

Pure-phase sintering experiments were conducted using the optimised precursor to produce LMR cathode material samples. Following coin-cell assembly and independent electrochemical testing, the first-cycle charge/discharge capacity of Firebird's LMR cathode material was comparable to cathode material sintered from commercially available reference precursor material sourced in China. These results indicate the Firebird material is in line with industry reference levels in relation to core electrochemical performance which will support further optimisation and scale-up.

Table 2. First-Cycle electrochemical performance comparison, LMR cathode material.

Test Item	Test Conditions / Standard	Commercial Reference	Firebird Result
0.1C discharge capacity (mAh/g)	2.0 – 4.8 V; 260 – 280 mAh/g	261.3	**263.7**
1C discharge capacity (mAh/g)	2.0 – 4.8 V; 200 – 220 mAh/g	211.7	**211.2**

First-cycle voltage versus specific capacity curves for cathode materials produced by Firebird and a commercial reference (Figure 5 and 6).

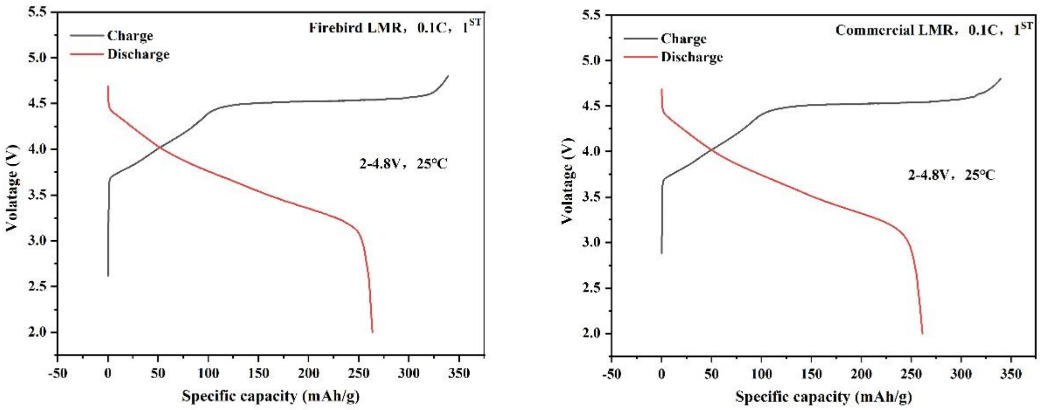

Figure 5. Firebird LMR, 0.1C first-cycle voltage vs specific capacity (left) and commercial reference (right).

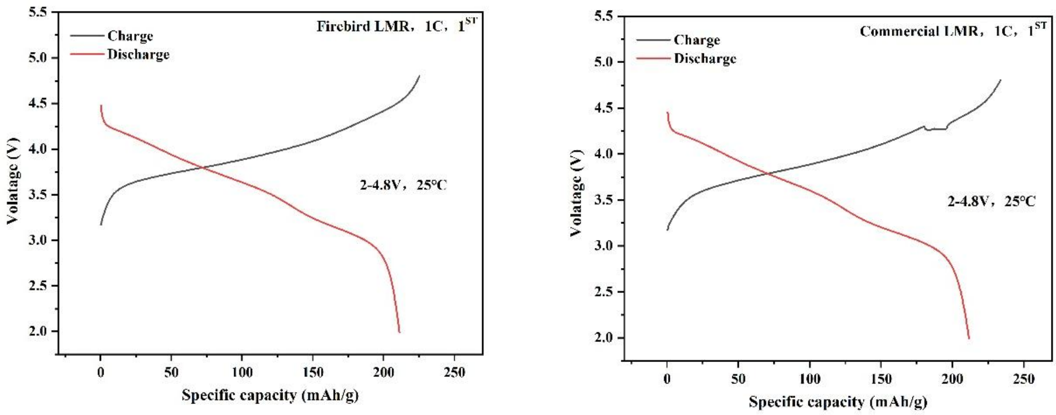

Figure 6. Firebird LMR, 1C first-cycle voltage vs specific capacity (left) and commercial reference (right).

Next Phase of Development

The electrochemical results reported in this announcement relate to Firebird's baseline (pristine) LMR cathode material developed at the Company's China R&D facility. Having successfully established a benchmark starting point, the next phase of development will transition to Firebird's Australian Demonstration Plant, where the focus will shift to advanced cathode optimisation aimed at improving cycle life, capacity retention, voltage stability and commercial battery performance. The next phase of the LMR program will focus on three priority areas:

1) **Particle morphology:** further improving the dispersion and sphericity of secondary precursor particles through optimisation of nucleation conditions, feeding method, stirring intensity, ammonia concentration and reaction residence time.

   Why particle morphology is important: uniform spherical particles support consistent cathode production, improved electrochemical performance and commercial-scale manufacturability.

2) **Tap density:** increasing precursor tap density towards the ≥1.2 g/cm^3 industrialisation target through improved particle densification and particle size distribution, supporting higher volumetric energy density in the final cathode material.

   Why tap density is important: achieving commercial reference level tap density is an important step towards producing cathode materials suitable for high-energy-density electric vehicle batteries; and

3) **Impurity reduction:** transitioning to Firebird's Australian-produced high-purity manganese sulphate as feedstock. Source-tracing analysis indicates magnesium (Mg) impurities in the current precursor originate primarily from third party industrial-grade manganese sulphate raw material. The use of Firebird's high-purity product is expected to reduce Mg impurities in the precursor by more than an order of magnitude, supporting further improvements in sintering behaviour, electrochemical performance and commercial product quality.

   Why lower impurities are important: reducing metallic impurities improves crystal quality during sintering, enhances electrochemical performance and cycle life, and is an important requirement for the production of commercial battery-grade cathode materials.

The transition to Firebird's own high-purity manganese sulphate feedstock represents a key step in demonstrating the Company's fully integrated flowsheet, from manganese ore through high-purity manganese sulphate to finished LMR cathode material.

This announcement has been authorised for release by the Board of Firebird Metals Limited.

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About Firebird Metals Limited (ASX:FRB)

Firebird is an Australian battery materials technology company developing **advanced manganese-based lithium-ion battery materials** for the EV and energy-storage markets. Its proprietary, patented and exclusively licensed technology enables the direct processing of manganese concentrate to cathode active materials (CAM) within a single integrated process line, pairing a high-efficiency kiln and advanced crystallisation with downstream processing know-how to target **lower cost and energy use**.

The Company's immediate focus is delivery of its **Australian Demonstration Plant (ADP) in Perth, supported by a $2 million grant from the Australian Renewable Energy Agency (ARENA)** under the Battery Breakthrough Initiative. The ADP, Australia's first demonstration-scale facility processing manganese concentrate into high-purity manganese sulphate (HPMSM) and downstream battery materials, including CAM, is advancing rapidly through 2026. It builds on Firebird's operating pilot facility, which has demonstrated the full flowsheet from manganese ore to high performance CAM, and will validate the process under Australian conditions while delivering HPMSM and cathode samples for customer qualification.

Firebird is advancing near-term HPMSM production for the lithium manganese iron phosphate (LMFP) market, alongside a lithium manganese rich (LMR) program for next-generation cathodes.

Firebird also holds 234 Mt of manganese resources in Western Australia, led by Oakover (176.7 Mt at 9.9% Mn, including Indicated 105.8 Mt at 10.1% Mn[1]) and Hill 616 (57.5 Mt at 12.2% Mn[2]). The Company has the flexibility to source manganese ore through third-party suppliers and stockpiles, with mining optionality retained within its broader portfolio.

JORC Compliance Statement

This announcement contains references to Mineral Resource Estimates, which have been reported in compliance with Listing Rule 5.8 and extracted from previous ASX announcements as referenced. The Company confirms that it is not aware of any new information or data that materially affects the information previously reported and that all material assumptions and technical parameters underpinning the Mineral Resource Estimates continue to apply and have not materially changed.

[1] See ASX announcement dated 23 March 2023: Indicated Resource of 105.8Mt at 10.1%; Inferred Resource of 70.9Mt at 9.6% for global Resource of 176.7 Mt at 9.9% Mn.

[2] See ASX announcement dated 1 December 2021: Inferred Resource of 57.5 Mt at 12.2% Mn.