



# Neometals

ASX RELEASE

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## NEOMETALS TO PILOT LITHIUM BATTERY RECYCLING PROCESS

### HIGHLIGHTS

- **Neometals to invest in pilot plant at its facilities in Montreal, Canada and conduct continuous test work to recover Cobalt, using its proprietary process, from Lithium-Ion Batteries typically used in Electric/Hybrid Vehicles.**
- **Scoping Study estimated operating cost of US\$4.45/lb contained Cobalt vs LME Spot/3 month/15 month Prices of ~US\$24.50/lb.**
- **Commenced discussions with potential partners around various commercialisation models**

Neometals Ltd (**ASX: NMT**) ("**Neometals**") is pleased to announce that, in line with its strategy to diversify into the downstream lithium/battery material supply chain, it will build a pilot plant in Canada to accelerate the commercialisation of the Company's technology to recycle lithium ion batteries to recover high value materials.

Neometals has co-developed a technology to economically recover high-value cobalt (99.2% recovery) as a material that can be re-cycled within the battery manufacturing chain. The cobalt supply chain is under stress due to the rapid increase in demand from battery manufacturing and a supply chain that is dominated by co-production in high sovereign risk locations. It is currently estimated that less than 5% of used lithium-ion batteries are recycled as disposal is typically either paid-for recycling or landfill.

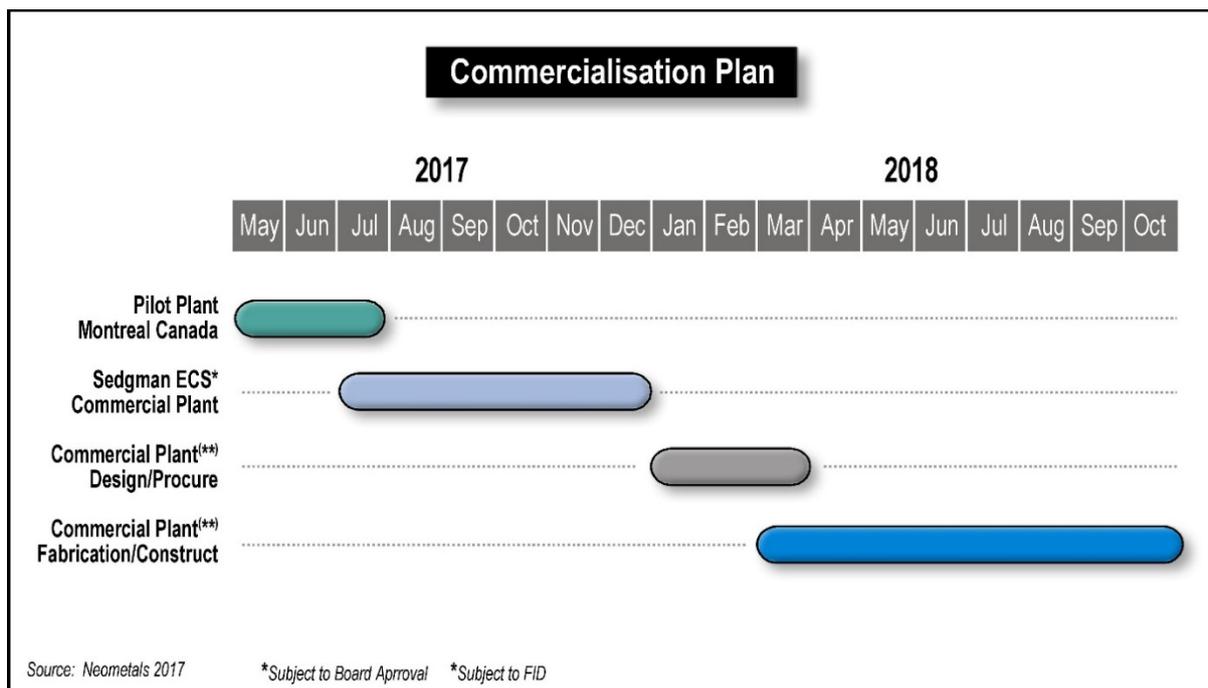
Agreements have been executed to construct the pilot-scale hydrometallurgical plant at Neometals' Montreal laboratory (image next page). The plant, which is anticipated to be operational in July, will complete continuous test work at a rate of 100kg/day of batteries, testing the recovery of high-purity cobalt, lithium, nickel and other base metals from lithium batteries typically used in the electric vehicles (Lithium-Nickel-Manganese-Cobalt or NMC). The plant will have the flexibility to treat lithium batteries from consumer electronics (laptops/phones) containing the Lithium-Cobaltate or LCO cathode formulation.



All the right elements

Neometals completed laboratory scale test work on spent lithium-ion laptop and phone batteries, and Sedgman completed a Scoping Study (see ASX announcement 20 February 2017) on a 10t/day plant using the technology. Results from the study, outlined in Appendix 1, have indicated strong potential for a viable processing operation via a modular plant to initially recover saleable Cobalt product from used lithium-ion batteries.

Subject to the success of the testwork, it is Neometals' intention to proceed with an Engineering Cost Study ( $\pm 15\%$  accuracy) to complete the technical and economic evaluation of a decision to proceed with the construction of a 10t/day Commercial Plant. Neometals has internal financial resources with which to fund evaluation, construction and commissioning of the commercial-scale plant and is in preliminary discussions with a number of interested parties from the lithium battery supply chain.



Neometals Managing Director, Chris Reed, commented: *“With the Mt Marion Lithium Project successfully in production, Neometals’ will accelerate the commercialisation of this environmentally and ethically responsible, end-of-life solution for lithium battery recycling. We will apply our knowledge and technology to recover and re-use lithium battery materials and create a more sustainable, circular sourcing solution for potential partners.”*

Neometals has a dedicated subsidiary, Urban Mining Pty Ltd, to hold its 50% interest in the intellectual property and exclusive rights to commercialise of the technology.



**ENDS**

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## APPENDIX 1: SCOPING STUDY HIGHLIGHTS

The highlights for an initial 10t per day (3,424tpa) throughput module, the subject of the study, are summarised below. Operating and Capital Costs are both valid as at January 2017 with an indicative accuracy in the range of  $\pm 30\%$ . All analysis is in US\$ dollars and assumes a selling price of US\$35,000/t for Cobalt.

Scoping Study Highlights	
Annual Production	666 t contained Co or 1,467,280 lb
Life of Plant (LOP)	10 years
Life of Plant (LOM) Revenue	US\$ 233 million
Pre-tax Cashflow	US\$ 144 million
Pre-tax NPV (10% discount rate)	US\$ 84 million
Average Net Operating Cost of recovered Co	US\$ 4.45/lb (US\$9,852/t)
Total initial capital costs	US\$ 4.5 million
Payback of capital costs	<1 year

### CAUTIONARY STATEMENT

*The Scoping Study referred to in this report is based on low-level technical and economic assessments, and is insufficient to provide definitive assurance of an economic development case, or to provide certainty that the conclusions of the Scoping Study will be realised.*

### DEVELOPMENT SCENARIO

The development scenario for this study, with the aim of refining the concept into a production unit that can be scaled up to full commercial operations, is characterised by:

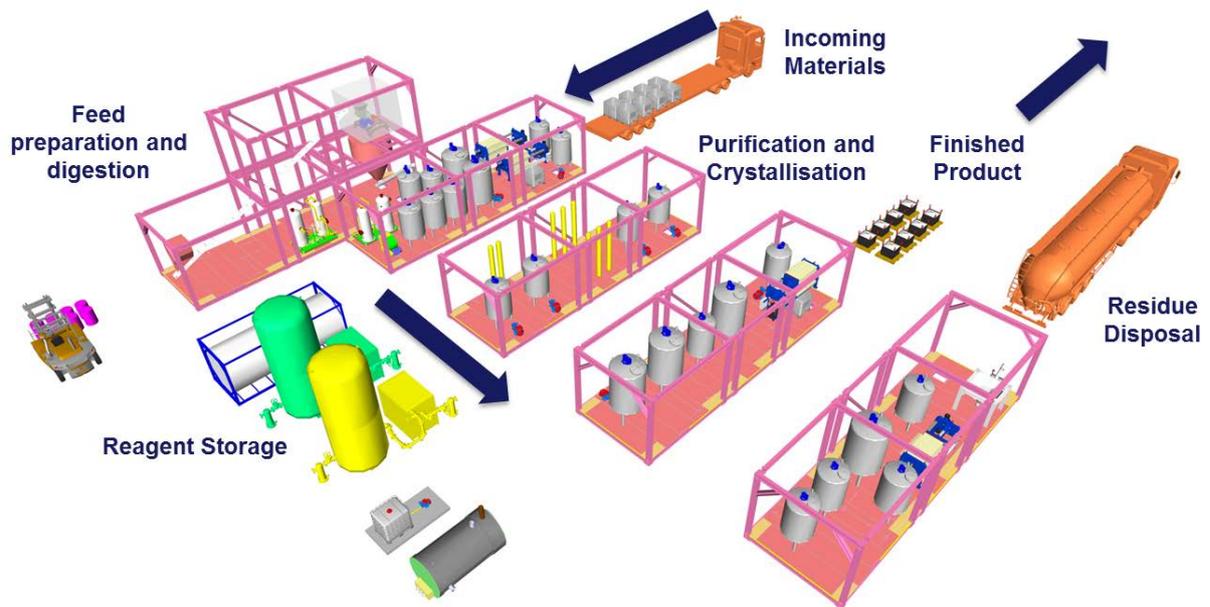
- Relocatable, modular plant with a throughput capacity of 3,424 tpa located in Montreal, Canada
- Lithium-Ion battery feedstock provided by OEM's and battery collectors.
- A new technology based on limited testwork will be used for high, low cost recovery of Cobalt with Lithium by-product.

#### *Processing*

The proposed process is based on the development test work that was conducted for the Company in Montreal, Canada.

The process comprises the following steps:

- Feed preparation - Pulverising and segregation of the used batteries
- Extraction - Acid leach of used battery feed to selectively dissolve up to 99% of the cobalt values. Purification - to remove other metal values from the cobalt solution
- Recovery - of pure cobalt carbonate (>99.9% pure) by hydrometallurgical methods.



Plant footprint approx. 30m x 50m

**Figure 1.** 3D Rendering of proposed Modular, Containerised Lithium Battery Processing Facility

Feed to the initial plant will be used rechargeable lithium ion batteries that predominantly arise from consumer electronics equipment such as smart phone, laptops and other portable electronic devices. These rechargeable batteries typically use battery chemistry that is generally known as lithium cobaltate (LCO) and have been in commercial use for at least 20 years. This cathode chemistry typically contains approximately 60% Co (eg 600kg contained cobalt per tonne of cathode feed into the plant) and has the best commercial potential for the operation. Several other rechargeable lithium ion battery cathode types also contain significant proportions of cobalt, although less than 60%, and will be tested in the future for viability as a source for the process.

Rechargeable lithium ion batteries are typically disposed of either through paid for waste disposal (including by voluntary battery collection points that aggregate batteries for disposal) or through uncontrolled landfill (eg batteries thrown into domestic garbage). The intended feed material to this plant will arise from the former source (legislated/mandatory recycling by battery makers and organised battery aggregators) and has had no revenue associated with it in the project model (eg the sources are assumed to be not paying Urban Mining for disposal). Urban Mining is in discussions with potential feed sources for both the pilot plant and initial proposed commercial operation.

Global used rechargeable lithium ion battery arisings from consumer electronics have been estimated to contain more than 30,000t of contained cobalt, based on being 60,000t of cathode materials available for recycling in 2016 (Argonne National Laboratory 2016).

#### *Project Infrastructure*

Sedgman proposed that the trial processing will take place at a site in Montreal, Canada where the Company already maintains pilot testing facilities. The footprint of the plant is 25m x 35m.

A suitable commercial-scale processing site will have access to local infrastructure such as:

- power generation and reticulation
- water
- buildings
- supply of used batteries

## **CAPITAL COST ESTIMATE**

### *Processing*

Sedgman developed the process design criteria for the facility and based the +/-30% capital estimate for the process plant on budget price estimates from equipment suppliers using those criteria after internal and external review.

### *Project infrastructure*

Infrastructure costs such as buildings, hardstand foundations, waste disposal, dismantling and erection were not allowed for by Sedgman but have been estimated in the economic analysis.

## **OPERATING COST ESTIMATE**

### *Processing*

The processing facility operating cost was estimated by major cost type and is considered a concept level estimate with a nominal accuracy of  $\pm 30\%$ . The estimated cash cost for processing is US\$4.45/lb Co.

## **MARKET AND MARKETING**

Cobalt is traded on the London Metal Exchange (LME), a terminal market that publishes daily prices for cobalt. The price for cobalt at the time of writing is ~US\$55,000 per tonne and cobalt compounds used in battery materials typically attract a price premium.

Assessment of the market by Neometals using third party commodity research and current spot prices, led to the US\$35,000/t Co price assumptions.

The plant scope is to recover and produce high purity cobalt carbonate and/or cobalt sulphate at a specification that is used in the manufacture of rechargeable lithium ion battery cathode materials. The tests to date have demonstrated the process is capable of producing the required purity of product for this market.

## **ECONOMIC ANALYSIS**

Neometals prepared a simplified discounted cash flow analysis to provide an early indication of the potential of the project. The analysis makes the following assumptions:

- no allowance was made for tax
- no allowance was made for inflation
- NPV is calculated against the full capital cost of process plant and does not include for credit or any other type of funding of the project.

The important economic and technical assumption inputs are summarised as:

- 99.2% recovery of Cobalt contained in the used battery feed material achieved in testing of the process (19.8% Cobalt by weight).
- Price US\$35,000/t contained Cobalt.
- 10% gross sales royalty to cover processing technology license
- US\$4.5 M capital cost for processing plant (installed) excluding infrastructure (+/- 30% estimate from Scoping Study).

Initial economic assessment indicates potential for a viable operation. The project highlights are:

- Pre-tax NPV<sub>10%</sub> of US\$87 M
- Life of Plant Revenue of US\$233 M
- conservative Plant life 10 years
- payback period of less than one year
- average net operating cost of US\$4.45/lb (US\$9,852/t) of recovered Co
- annual production of 666t Co as cobalt carbonate.