

Lithium Battery Recycling

Analyst**Trent Barnett****Date****13th July 2021**

Going to be a huge industry – Battery Recycling

Event

The market is under-estimating battery recycling in the EV space;

Impact

Lithium battery recycling is going to be a very large and fast-growing industry;

There is a big arbitrage between the market expectations on long term primary battery metal supply (eg lithium miners) and the emerging recycling industry;

Action

Buy battery recyclers;

NMT (Neometals Ltd, we have a Buy recommendation) is listed on the ASX. There are several listed in North America (we have no recommendation);

Growth in primary metal sources is still going to be enormous to meet demand, but the ultimate steady state (2040) requirements will be less than predicted by those that aren't factoring recycling into their long run supply models;

Key Catalyst

- New EU battery regulation passing Parliament;
- Market awareness of the TAM (Total Addressable Market) of battery recycling;
- Rising valuations of listed and private battery recyclers;
- Feedstock agreements and M&A;

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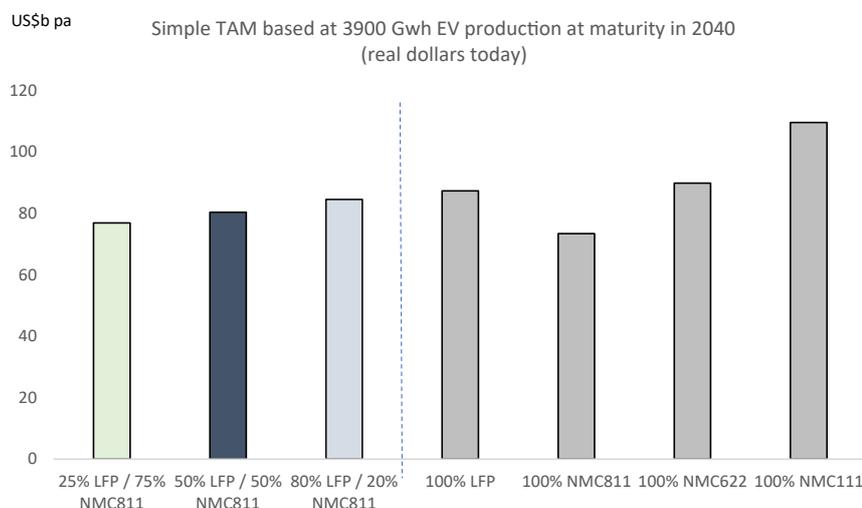
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Analysis

There are several reasons to expect battery recycling will be a big part of the supply solution

1. Recycling will be required to meet demand for battery metals, as there is limited primary supply even at high prices without crowding out other industries;
2. The economics of high nickel battery recycling are very strong;
3. Regulation, especially in Europe, makes recycling mandatory and requires minimum recycled content levels by decade end.
4. Recycling provides responsible and ethical supply. ESG and consumer expectations give auto makers with strong recycling credentials a margin and cost of capital advantage;
5. The CO₂ intensity of EV manufacturing (is double ICE vehicles) unless the metals are re-used;
6. The largest auto markets in the world (Europe, USA, China, Japan) rely on long supply chains for primary metals – recycling closes the loop and de-risks that supply chain (via resilient domestic supply);
7. The TAM (total addressable market) is huge, and should attract meaningful capital;

Euroz Hartleys estimate EV battery recycling TAM (total addressable revenue)



Source: Euroz Hartleys

The highest profile battery recycling company is Redwood Materials, which is run by Tesla co-founder, JB Straubel.

North America also has two large listed fully integrated companies, Li-Cycle (PDAC.nys) and American Battery Technology (AMBL.nqo). Australia has one listed fully integrated battery recycler, NMT.asx, which owns 50% of Primobius in JV with the very large German EPC contractor, SMS Group. LIT.asx is also listed and is currently producing black mass.

In the unlisted space, there is a long list of pure plays and larger JV's either currently recycling batteries, in advanced development, or in an early R&D phase.

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List of industry participants in Battery Recycling

Peer	Comment
Pure plays	
NMT.asx	https://www.primobius.com/
PDAC.nys	https://li-cycle.com/
AMY.tsx	https://americanmanganeseinc.com/
ABML.nqo	https://americanbatterytechnology.com/
LIT.ASX	https://lithium-au.com/recycling/
Redwood Materials	https://www.redwoodmaterials.com/
Battery Resourcers	https://www.batteryresourcers.com/news
Accurec	https://accurec.de/
Duesenfeld	https://www.duesenfeld.com/recycling_en.html
Stena Recycling	https://www.stenarecycling.com/news/stena-recycling-invests-heavily-in-new-battery-recycling-plant/
Shenzhen Pandpower	http://www.pandpower.com/en/col.jsp?id=2#fai_365_top
Sungeel Hitech Co Ltd	http://www.sungeel.com/page/history.php?lang=en
Taisen Recycling	https://taisen-recytech.com/about/
Tes-Amm	https://www.tes-amm.com/battery-recycling
Large companies / JVs	
Volkswagen / BASF	https://www.basf.com/global/en/who-we-are/sustainability/whats-new/sustainability-news/2020/closing_the_loop_in_e-mobility.html
Eramet / BASF / Suez	https://www.eramet.com/en/activities/innovate-design/relieve-project
Veolia / Solvay	https://www.veolia.com/en/news/recycling-lithium-ion-batteries-electric-vehicles-solvay-veolia
Glencore	https://www.glencore.com/what-we-do/recycling
CATL (Brunp)	https://www.catl.com/en/solution/recycling/
Umicore	https://csm.umicore.com/en/battery-recycling/our-recycling-process#tabs
Northvolt / Hydro	https://www.hydro.com/en/media/news/2020/hydro-and-northvolt-launch-joint-venture-to-enable-electric-vehicle-battery-recycling-in-norway/
Fortum	https://www.fortum.com/products-and-services/fortum-battery-solutions/recycling/lithium-ion-battery-recycling-solution
SNAM	https://www.snam.com/activites/recycling-snam.php
Nissan / Sumitomo	https://global.nissanstories.com/en/releases/4r
002340 CN	http://en.gem.com.cn/en/UsedBatteryRecycling/index.html

Source: Euroz Hartleys

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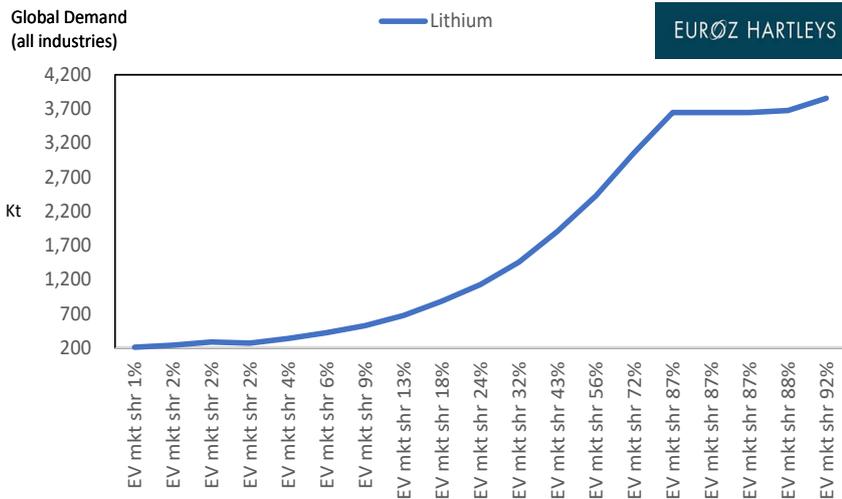
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In our view, lithium battery recycling will be a very large industry, and should be considered in medium term supply / demand models.

1. Recycling will be required to fill the supply;

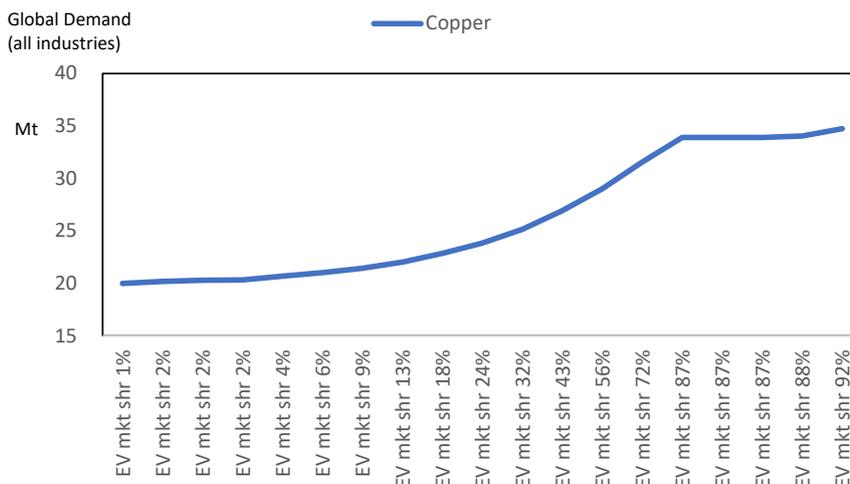
The metal demand required to satisfy EV demand is huge. Some of the supply will need to come from recycling. Efficiency rates for the recycling industry are very high for those companies using hydrometallurgy (as opposed to pyrometallurgy). Consequently, recycling will be a big source of supply in a mature market. Remember, ‘recycled supply’ will soon be required in EU to make new batteries.

Potential Lithium Demand



Source: Euroz Hartleys

Potential Copper Demand



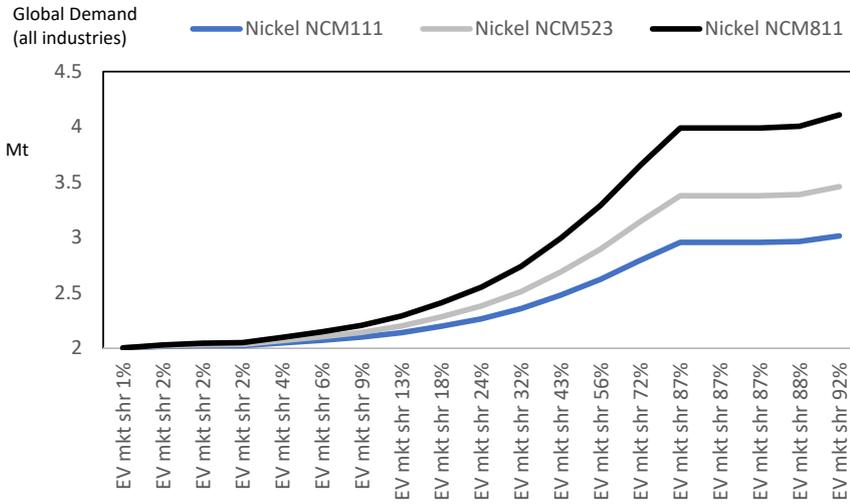
Source: Euroz Hartleys

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Potential Nickel Demand



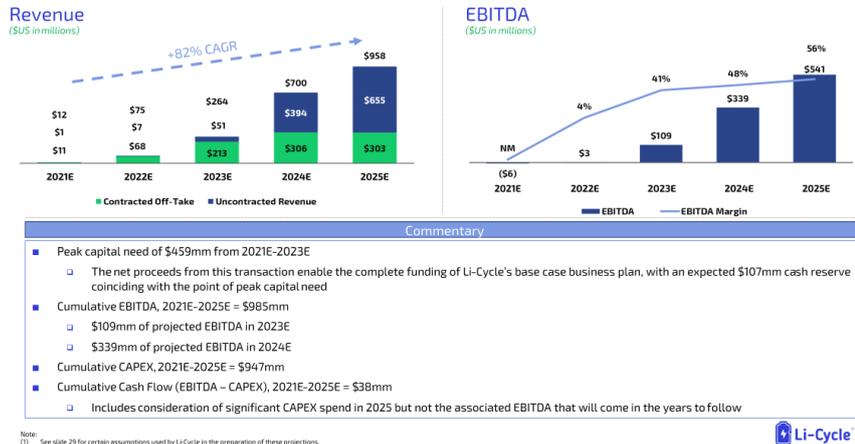
Source: Euroz Hartleys

2. The economics of high nickel battery integrated recycling are very strong;

The payback on investment for high nickel battery recycling plants are very high. The barriers to entry are flowsheets that are efficient and safe.

Li-Cycle financial projections

Li-Cycle Financial Projections



Source: Li-Cycle Analyst Day Presentation

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3. Regulation, especially in Europe, makes recycling mandatory;

EU proposals for battery regulation

Measures	Option 2 - medium level of ambition	Option 3 - high level of ambition	Option 4 - very high level of ambition
1. Classification and definition	New category for EV batteries Weight limit of 5 kg to differentiate portable from industrial batteries	New calculation methodology for collection rates of portable batteries based on batteries available for collection	/
2. Second-life of industrial batteries	At the end of the first life, used batteries are considered waste (except for reuse). Repurposing is considered a waste treatment operation. Repurposed (second life) batteries are considered as new products which have to comply with the product requirements when they are placed on the market	At the end of the first life, used batteries are not waste. Repurposed (second life) batteries are considered as new products which have to comply with the product requirements when they are placed on the market.	Mandatory second life readiness
3. Collection rate for portable batteries	65% collection target in 2025	70% collection target in 2030	75% collection target in 2025
4. Collection rate for automotive and industrial batteries	New reporting system for automotive, EV and industrial batteries	Collection target for batteries powering light transport vehicles.	Explicit collection target for industrial, EV and automotive batteries
5. Recycling efficiencies and recovery of materials	Lithium-ion batteries and Co, Ni, Li, Cu: Recycling efficiency lithiumion batteries: 65% by 2025 Material recovery rates for Co, Ni, Li, Cu: resp. 90%, 90%, 35% and 90% in 2025 Lead-acid batteries and lead: Recycling efficiency lead-acid batteries: 75% by 2025 Material recovery for lead: 90% in 2025	Lithium-ion batteries and Co, Ni, Li, Cu: Recycling efficiency lithium-ion batteries: 70% by 2030 Material recovery rates for Co, Ni, Li, Cu: resp. 95%, 95%, 70% and 95% in 2030 Lead-acid batteries and lead: Recycling efficiency lead-acid batteries: 80% by 2030 Material recovery for lead: 95% by 2030	/
6. Carbon footprint for industrial and EV batteries	Mandatory carbon footprint declaration	Carbon footprint performance classes and maximum carbon thresholds for batteries as a condition for placement on the market	/
7. Performance and durability of rechargeable industrial and EV batteries	Information requirements on performance and durability	Minimum performance and durability requirements for industrial batteries as a condition for placement on the market	/
8. Nonrechargeable portable batteries	Technical parameters for performance and durability of portable primary batteries	Phase out of portable primary batteries of general use	Total phase out of primary batteries
9. Recycled content in industrial, EV and automotive batteries	Mandatory declaration of levels of recycled content, in 2025	Mandatory levels of recycled content, in 2030 and 2035	/
10. Extended producer responsibility	Clear specifications for extended producer responsibility obligations for industrial batteries Minimum standards for PROs	/	/
11. Design requirements for portable batteries	Strengthened obligation on removability	New obligation on replaceability	Requirement on interoperability
12. Provision of information	Provision of basic information (as labels, technical documentation or online) Provision of more specific information to end-users and economic operators (with selective access)	Setting up an electronic information exchange system for batteries and a passport scheme (for industrial and electric vehicle batteries only)	/
13. Supply-chain due diligence for raw materials in industrial and EV batteries	Voluntary supply-chain due diligence	Mandatory supply chain due diligence	/

Legend: green = preferred option; light green = preferred option pending a revision clause.

Source: [European Commission Proposal for a Regulation on Batteries and Waste](#)

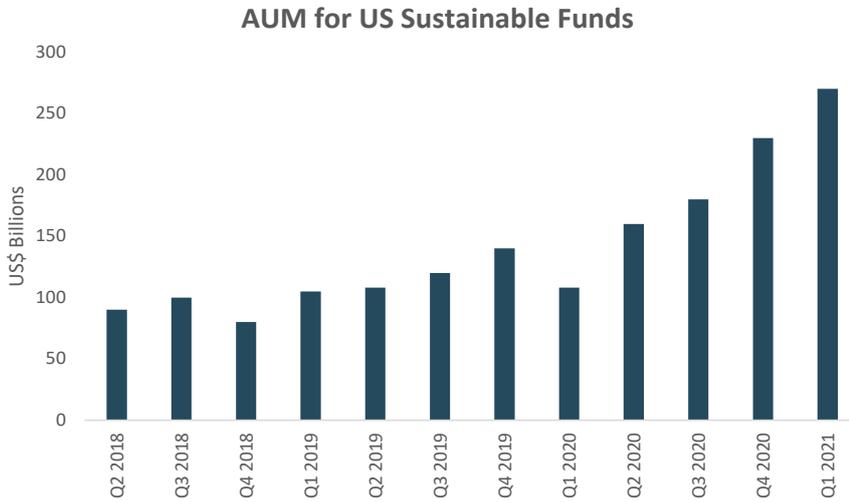
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4. ESG and consumer expectations give auto makers with strong recycling credentials a marketing advantage;

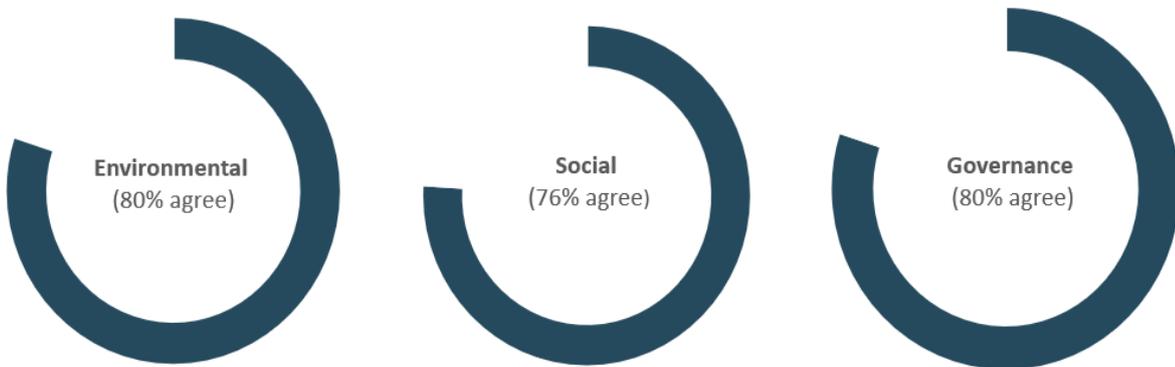
Investment ESG fund flows increase



Source: Morningstar - Sustainable fund flows reach new heights (article)

ESG affecting brands perceptions / value

As a consumer, I am more likely to buy from a company that stands up for



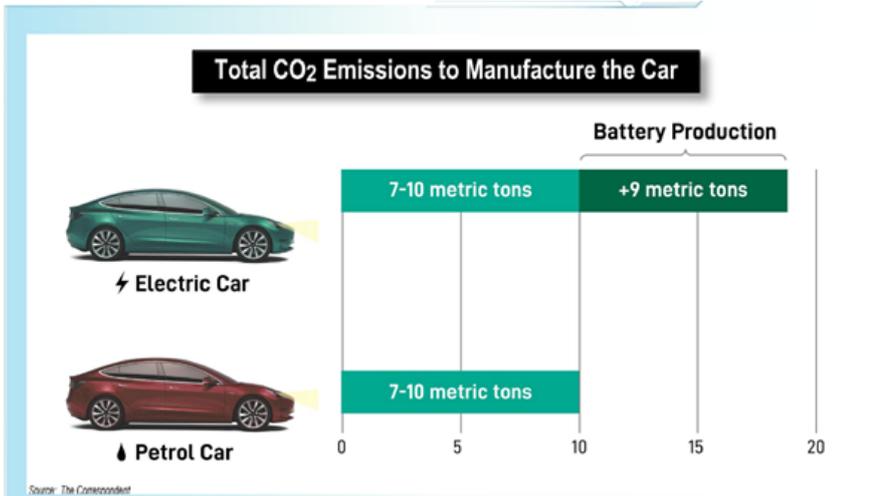
Source: PWC - Consumer Intelligence Series

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5. The CO₂ intensity of EV's is very high unless the metals are re-used;

The CO₂ intensity of primary battery metals means the CO₂ emissions for new EVs are higher than ICE cars, during the 'production' phase. Recycling the battery metals is an obvious source of reducing CO₂ intensity.

Comparison of ICE and EV carbon intensity for brand new car



Source: NMT, 26 May 2021

6. The largest auto markets in the world (Europe, USA, China, Japan) rely on long supply chains for primary metals - recycling closes the loop and de-risks supply chain;

Government policy is driving circular economy.

EU has an action plan for a circular economy

The screenshot shows the top navigation bar with the European Commission logo, language selection (EN English), and a search box. Below is a blue header for 'Environment' and a breadcrumb trail: Home > Strategy > Circular economy action plan. The main heading is 'Circular economy action plan' with a sub-heading 'The EU's new circular action plan paves the way for a cleaner and more competitive Europe.' The text describes the adoption of the Circular Economy Action Plan (CEAP) in March 2020 as part of the European Green Deal. A green graphic on the right reads 'Circular Economy Action Plan The European Green Deal'.

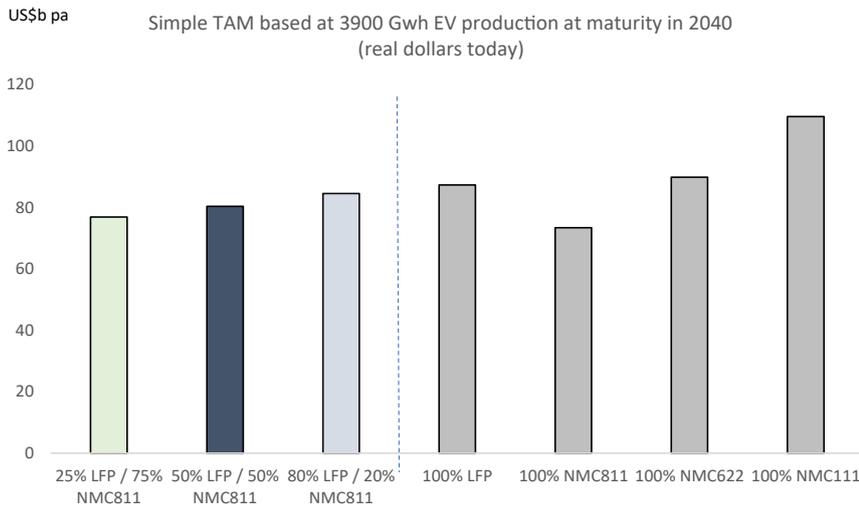
Source: [European Commission - Circular economy action plan \(article\)](#)

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7. The TAM (total addressable market) is huge, and should attract meaningful capital;

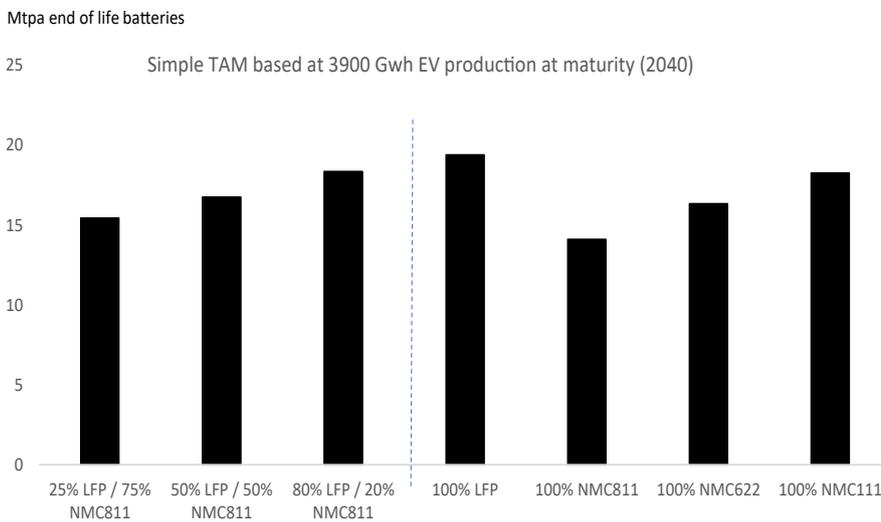
Global battery recycling feedstock volumes, at maturity of 3.9Gwh, will be in the order of 14-20mtpa. We calculate the TAM is -US\$60-80b pa, real terms at maturity in 2040.

Euroz Hartleys estimate EV battery recycling TAM



Source: Euroz Hartleys

Euroz Hartleys estimated TAM volume at 3.9Gwh



Source: Euroz Hartleys

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Conclusion

Markets are driven by sentiment and at the moment there is much excitement in the EV segment around resources primary supply, which is well deserved and a big driver for higher prices. We can equally see that sentiment for recycling is less well understood, yet the growth drivers are exactly the same. Consequently we see a relative arbitrage between expectations in primary supply and secondary supply. This is a relative call - in an absolute sense we expect both markets to continue to perform strongly over the coming decade.

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