The EV revolution and its impact on Raw Materials

March 2018

EV: A transformational event for metals demand but many variables

- EV revolution will strongly impact metals demand, but difficult to quantify in terms of timing/volume

- EV demand drivers: regulatory environment, infrastructure development, customers' acceptance, what xEV mix for what use/range, impact of ride sharing

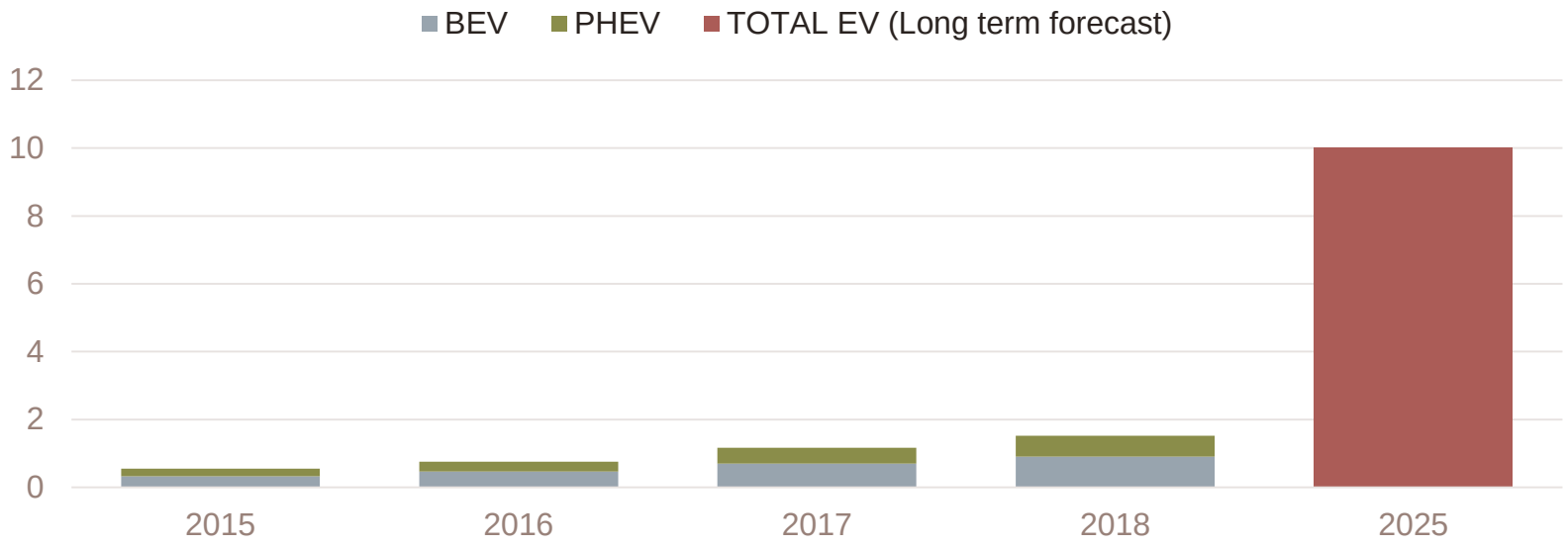
  > *Will define EV penetration*

- Raw material demand drivers: battery chemistry, battery characteristics, battery performance

  > *Will define Ni/Co loadings per car*

- Longer term – recycling will play an important part and Glencore is already active in this space

EV Global sales 2015-2017, forecast 2018-2025 (base case scenario)



Source: BMO Capital Market, Glencore

The world is changing - Electric vehicles will be a disruptive force

How much metal is required to realise the Electric Vehicles Initiative target[(1)] of 30 million electric vehicle sales by 2030?

- We commissioned CRU to model the metal requirements across the supply chain, from generation and grid infrastructure through to storage, charging and vehicles
- In 2030, forecast metal requirements are c.4.1Mt of copper (18% of 2016 supply), c.1.1Mt of nickel (56% of 2016 supply) and 314kt of Cobalt (314% of 2016 supply)
- As early as 2020, forecast EV related metal demand is becoming material, requiring an additional c.390kt of copper, c.85kt of nickel and 24kt of cobalt
- Transportation/mobility will be transformed – driven by environmental pressures, political mandates, consumer experience and technological progress

Generation and grid infrastructure

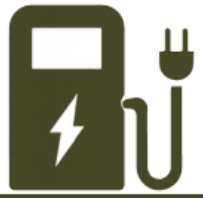
kt	2020	2025	2030
Cu	40	170	536

+

Grid storage

kt	2020	2025	2030
Cu	24	86	180
Ni	20	71	150
Co	7	26	55

+



Charging infrastructure

kt	2020	2025	2030
Cu	23	115	392

+

Non-ICE vehicles

kt	2020	2025	2030
Cu	304	1068	2972
Ni	66	299	985
Co	17	80	259

=

Vehicle sales

M	2020	2025	2030
Total	91	103	107
EV	2.1	10.1	31.7
%EV	2%	10%	30%

Total

kt	2020	2025	2030
Cu	391	1439	4080
Ni	86	370	1135
Co	24	106	314

Source: Glencore

Commercial implications are manifold

Glencore has had exchanges with a number for players all along the EV battery supply chain from salts producers to OEMs and a number of themes are emerging:

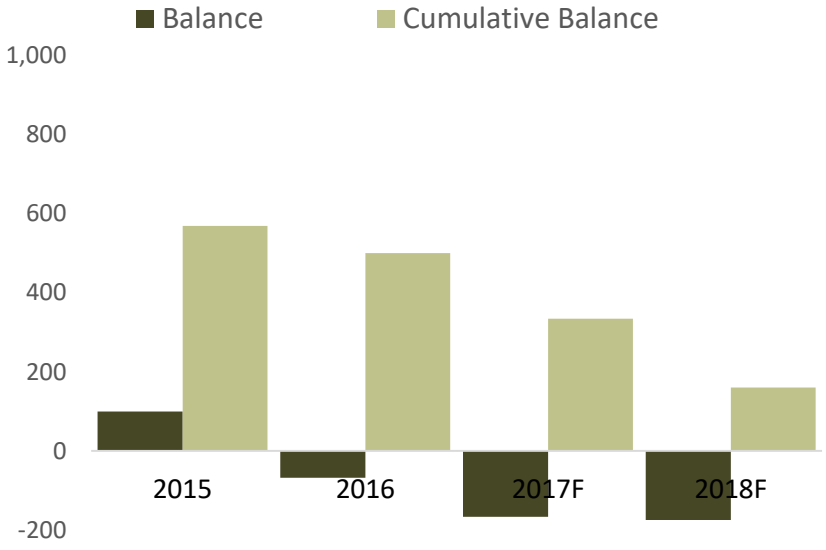
- Sustainability will be a critical factor especially for OEMs and Glencore is well positioned on this
- Who is to source metals? – industry players at various stages of the supply chain showing interest
- How to secure supply amid fast-growing requirements? – multi-year contracts, mining investment
- Can/should price volatility be managed? Eg hedging approach
- Counterparty risk – will everyone succeed in delivering what are very ambitious targets?

Source: BMO Capital Market, Glencore

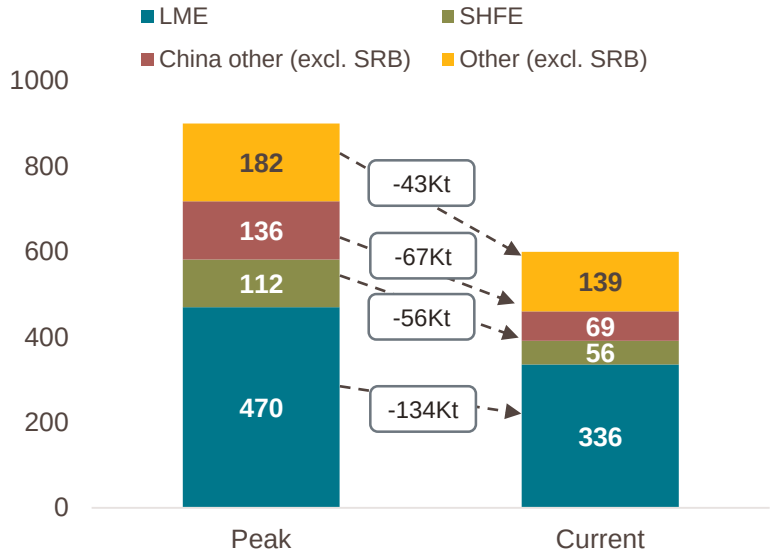
Nickel Market: Significant structural deficits already there

- Following a 166Kt deficit in 2017, We project a 174Kt nickel supply shortage for 2018, as a strong demand offsets supply gains.
- Market tightness is evident in high and rising premiums and substantial stock draws from peak levels.
- Significant structural supply deficits exist, before the contribution of battery demand becomes material.
- Global nickel inventory down from a peak of 900Kt to ca. 600kt today, visible (LME) stocks starting to decline in 2018 – Ni price immediately reacted.

Nickel market balance (Kt Ni)



Nickel inventories (Kt Ni): sizable decrease

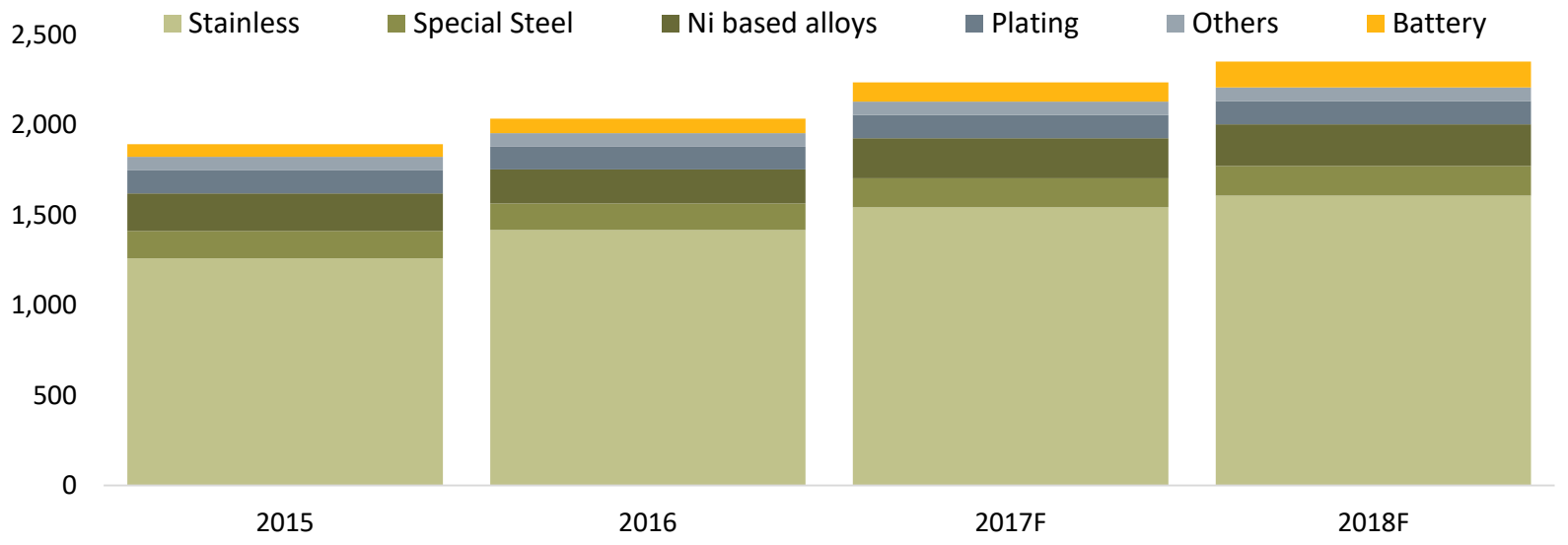


Source: Glencore

Strong nickel demand across all regions and industries continues

- Strong growth in stainless steel further supported by solid demand growth in non-stainless:
  - Oil & Gas We've seen a steady return of demand, reflected in strongly improved offtake from special steel and nickel based alloy producers.
  - Automotive A solid upswing in the European automotive market provides additional support to special steel.
  - Batteries Continue strong growth in Korea, Taiwan and China with nickel consumption tracking +30% YoY.
- We estimate 2018 global primary nickel demand will increase by close to 5% to over 2.35Mt on the prior year, when demand increased an estimated 10%, to 2,24Mt Ni.

Global primary nickel demand by industry (Kt Ni)

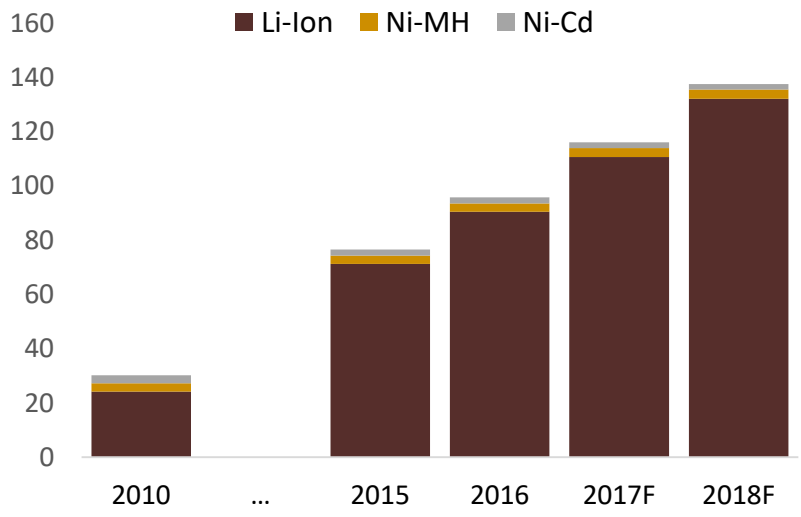


Source: Glencore

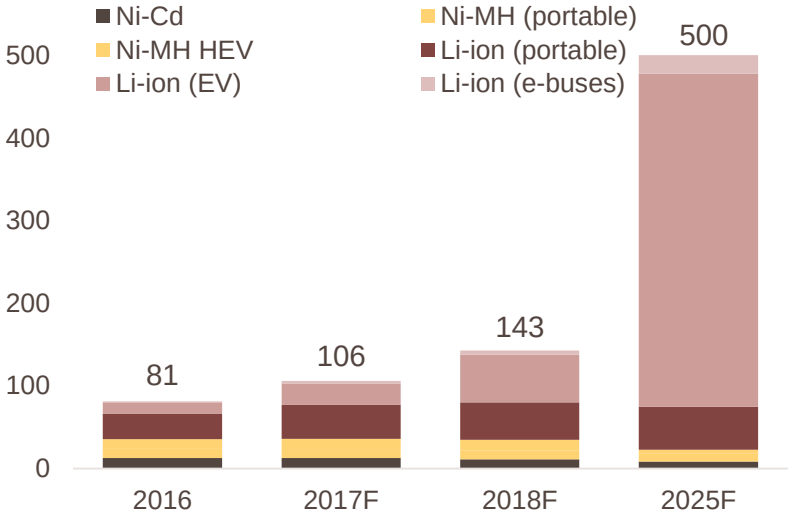
And all this with very limited primary nickel demand in batteries

- Short-term growth potential driven by substitution within the Li-ion battery segment to NMC/NCA cathodes, and within the NMC cathode segment towards higher Ni-content chemistries.
- Long-term growth potential reflecting the projected growth trajectory of EVs and ESS. Even the lower end of the range of forecast EV penetration generates considerable Ni unit demand from 2025 onwards.
- We conservatively estimate more than 10M EVs will be sold a year in 2025 and that will generate net additional primary nickel requirements of close to 400Kt Ni in 2025 only.

World rechargeable battery production (GWh)



Primary nickel demand in batteries (Kt Ni)

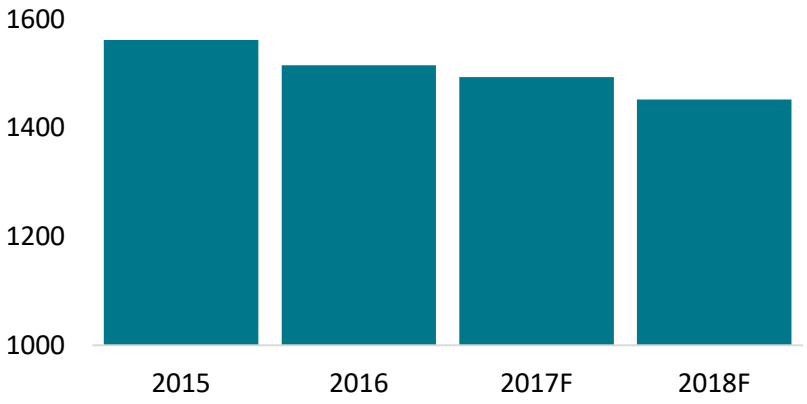


Source: Glencore

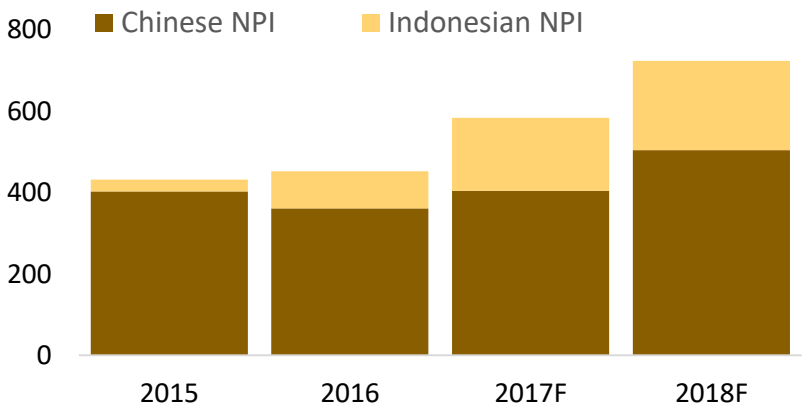
Supply implications: where will needed primary Ni come from?

- Current inventory will help as battery demand accelerates but new supply will be needed longer term
- Nickel Pig Iron (ferroalloy) will provide additional supply but these Ni units will be used in stainless steel
- Only part of primary Ni production (Ni sulphate, Ni briquettes/powder) is currently used in batteries but we don't buy into the class I/II Ni market bifurcation story – it's all about economics and which demand capture units
  - More so-called class I Ni (essentially Ni metal) can be made available for battery consumption
  - So-called class II Ni (eg ferronickel/NPI) could also be converted into class I – processing routes are well established
- New projects needed and will come subject to incentive price being there (not the case today)
  - Generally Ni resources/production processes are well known
  - Chinese are likely to be first movers

Global non-NPI supply (Kt Ni)



Nickel pig iron supply (Kt Ni)



Source: Glencore

Cobalt Market: general information

- **Cobalt is a small market: 100’000mt**

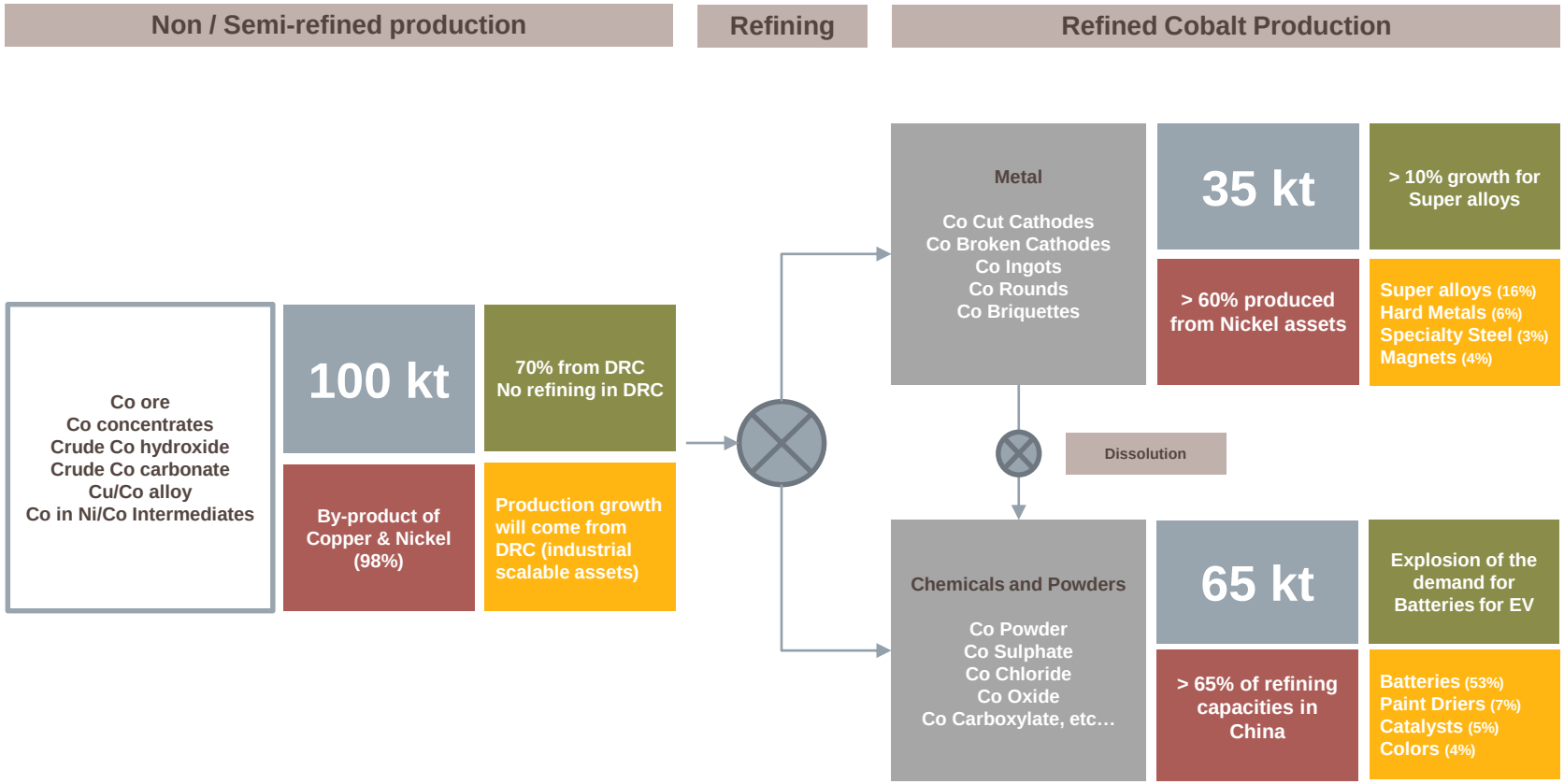
- **Cobalt is by-product of Copper (approx. 60%) or Nickel (approx. 38%)**
  - Industrial supply: Limited price elasticity on the short run
  - Artisanal supply: Only swing supplier // much more reactive

- **DRC – China trade flow**
  - Increase in supply in the DRC and increase in Chinese refining capacity have generated a predominant material flow from DRC to China
  - DRC supply concentration (¾)
  - China central role in the current supply chain

- **All of the above has created a perception of a risk of a future scarcity of industrial material**

Source: Glencore

Cobalt Market: simplified supply chain



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Cobalt Demand: Key facts

- **Two main applications : Batteries and Superalloys (>66% of total consumption)**
  - Main growth drivers
  - Strategic
  - Long visibility

- **Batteries**
  - Demand for batteries went from 20% to more than 50% in less than 5 years
  - Segment share to grow with the EV revolution

- **Superalloys**
  - Healthy growth in excess of 7% due to aerospace
  - Aerospace is ⅔ of superalloy demand: long term visibility due to the length of order books

- **Assessment of demand: a very difficult activity**
  - Risk of Double counting
  - Stockpiling at different levels along the supply chain
  - Speculative position taking: Funds, Traders
  - Constantly evolving forecast on EV penetration, Battery Chemistry, Substitution, etc..
  - Strategic reserves: SRB in China

Source: Glencore

Cobalt supply and sustainability

- **DRC is the main source of supply and the main source of new supply; geographical concentration of supply will only increase**

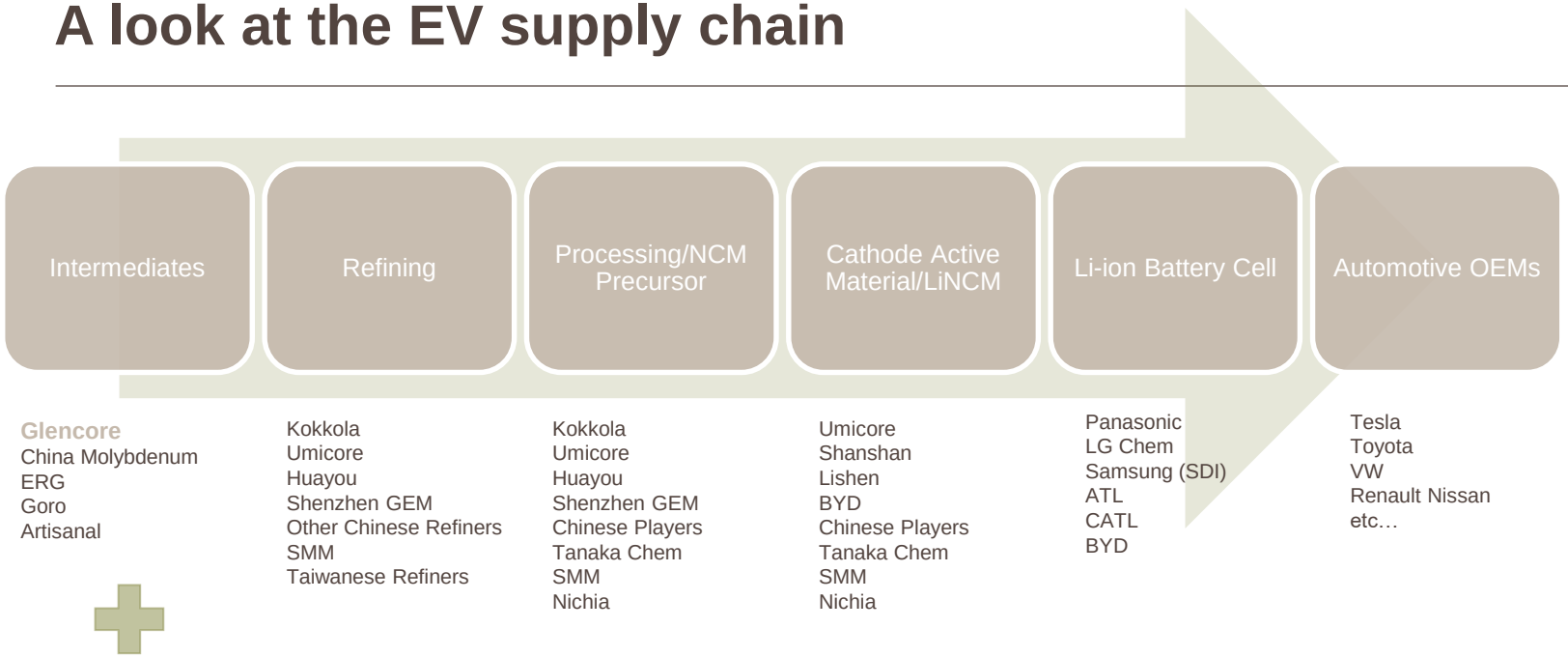
- **Many players have expressed concerns on:**
  - the perception of country risk
  - the pervasive occurrence of child labor in artisanal mining: it has been highlighted by several organizations

- **Artisanal Mining**
  - Child labor is unacceptable to most players in the automotive industry
  - Artisanal ore/concentrates sold at a large discount with respect to industrial production

- **Several «laundering» schemes at play to keep child labor risk hidden**

Source: Glencore

A look at the EV supply chain



Key facts

- **Supply chain moving from electronics to automotive**
- **Massive expansion capex across the chain**
- **High probability of vertical integration and/or tolling:**
  - **Concerns about scarcity of units**
  - **Concerns about origin of Cobalt units (artisanal mining)**
  - **Strong focus on quality control and Intellectual Property**

Source: Glencore


Questions?

Glencore Nickel and Cobalt producing assets

Nickel

> Integrated Nickel Operations (**INO**):
Mines Raglan, Nickel Rim South, Fraser, Onaping Depth (project), Nickel Rim Depth (project)
Sudbury Smelter
Sudbury Recycling capacity of +30Kt gross of materials, including spent catalysts, batteries
Nikkelverk Refinery
2017: 86.5Kt Ni (99.98% Ni+ purity), 22.7Kt Cu and 3.5Kt Co, mostly cathode

> Murrin Murrin
2017: 42Kt Ni (LME grade 99.8% Ni) and 3.0Kt Co in briquettes/powder

> Koniambo
2017: 17.5Kt Ni in FeNi

Copper

> Katanga
2017: restart December, 2.2Kt Cu metal, 2.7Kt Cu in conc, 2018: planned production of 150Kt Cu, 11Kt Co

> Mutanda
2017: 198.8 Cu, 23.9Kt Co

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