NAATBatt

Black mass as a commodity?

Siddarth Subramani
Principal, Hatch Advisory

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Agenda

01 Role of black mass

02 Why commoditize?

03 Challenges and barriers

04 What can we learn from other commodities

05 Conclusion and path forward

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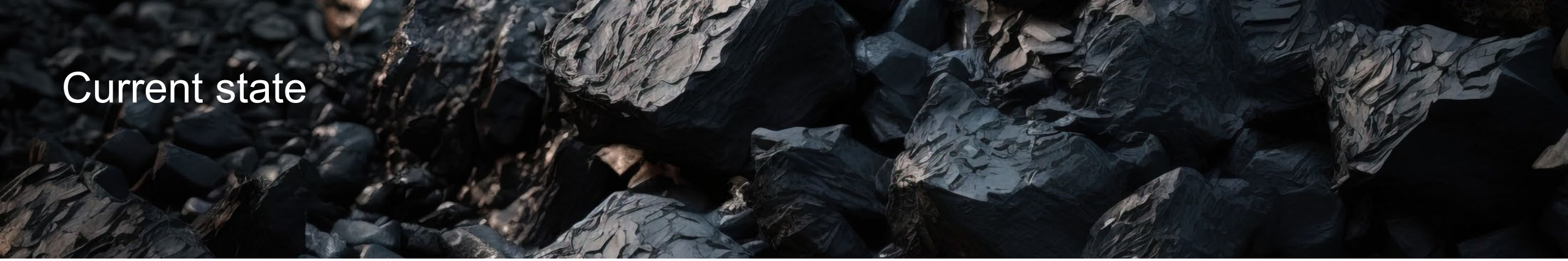

Current state

Context

- There will be an exponential growth in the number of end-of-life (EOL) batteries for recycling in the next two decades
- The black mass that will be available on the market for the foreseeable future will be very heterogenous given the composition of EOL batteries
- No standard pricing mechanism and transparency on contract pricing

Challenges

- Inconsistent black mass composition will be a hindrance as volumes increase over the next decade
- Regulations around black mass are changing and more countries beginning to restrict trade of black mass

Can black mass move towards commoditization which would allow for efficient trading and recycling of the anticipated volumes?

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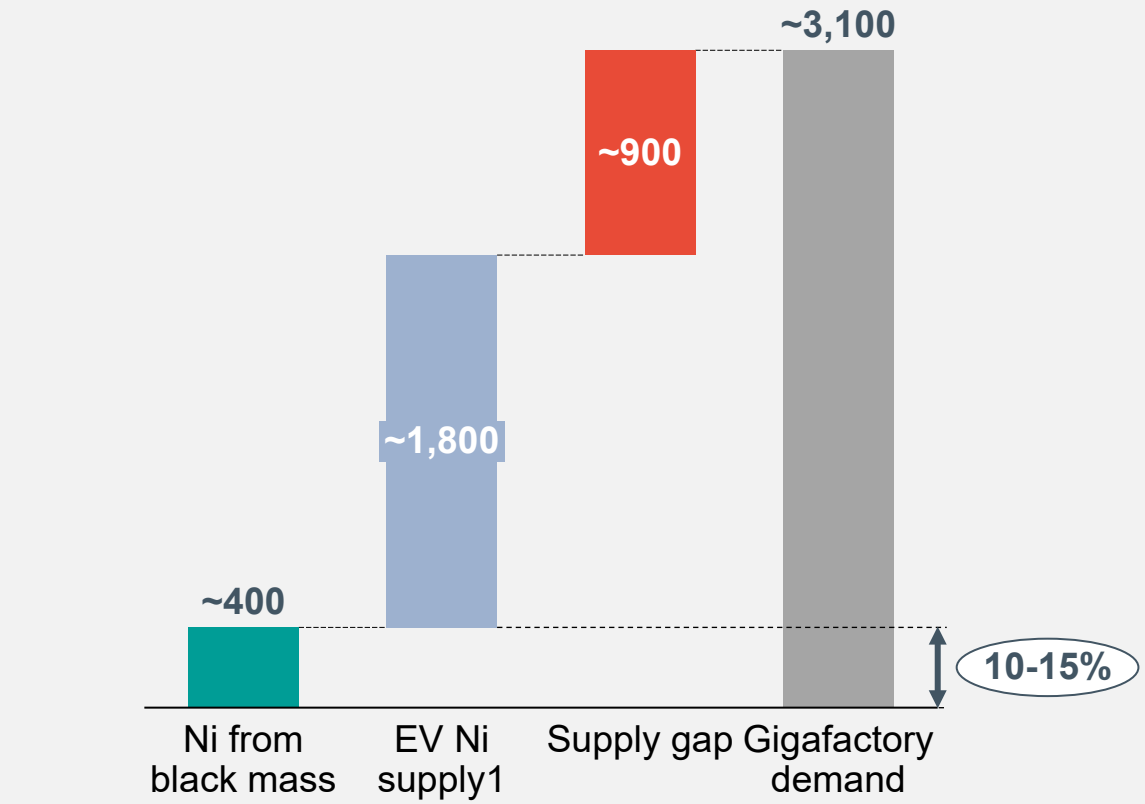
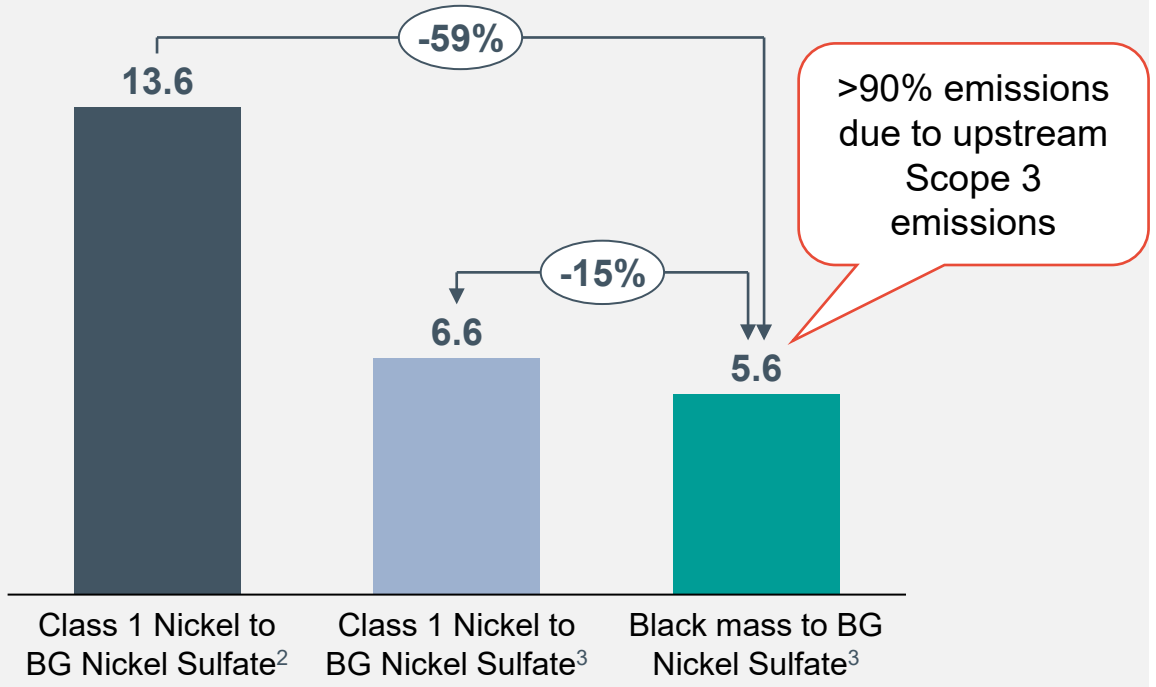
Black mass will be a key cornerstone in enabling the sustainable electrification of the mobility industry

2040 Battery Metal Supply – Nickel example, kt Ni



Recycled battery metals from black mass is expected to satisfy 10-15% of gigafactory demand by 2040

Battery-Grade (BG) Nickel Sulfate Carbon Intensity[1,2]



Materials from recycled LIBs will have better ESG profiles and 15 - 40% less carbon intensity compared to virgin materials[3]

[1] Considers 60% of Class 1 Ni supply in 2040; [2] Paulikas et al., 2020, modeled using 60-85% production from pyrosulfidic sources;
[3] Hatch analysis: Includes Scope 1, 2, and upstream Scope 3 emissions; Class 1 Nickel modeled using low-carbon grid

Source: Rho Motion, Hatch research & analysis

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Trading black mass as a commodity would have four main advantages for the industry

Alleviate supply concerns

- Help bridge gap in supply imbalance across regions
- Increase supplier pool to potential purchasers

Flexible material supply

- Provide relief to temporary spikes in demand
- Optimize lead times with longer term primary supplies

Pricing transparency

- Liquidity to enable quick transactions settlement and lower transaction costs
- Enable business to manage risk effectively and minimize exposure to volatility

Consistent product

- Enable confidence in black mass composition
- Feed can be used by refiners without major process changes

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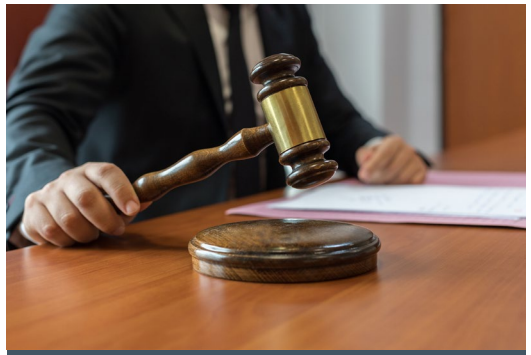
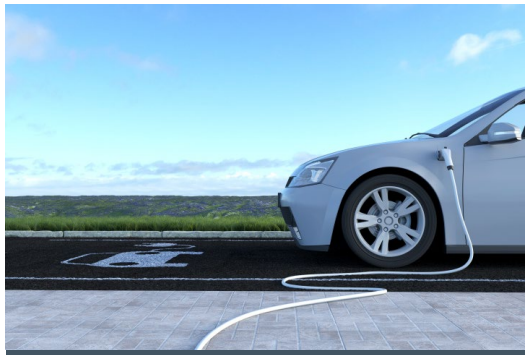
However, there are some important headwinds that are hampering the establishment of global black mass commodity market



Regulatory Aspects

- Growing number of regional regulatory initiatives will drive emergence of regional disconnected markets
- Inflation Reduction Act (IRA) in the US
- EU Regulatory Framework for Batteries in the EU



OEM Strategy

- Recycled material will be quick-win to satisfy regulations and subsidy requirements
- OEMs will continue to compete for scarce battery materials driving captive markets for both primary and recycled battery materials

Technology

- Several battery types exist and more expected in the future
- Multiple battery chemistries will inhibit standardization of black mass

Volume

- Potential longer EV LIB life can reduce the projected black mass volumes
- Additional long-term OEM-recycler agreements will further reduce non-captive black mass market

Over **60%** black mass market will be captured by the OEMs by 2030

Non-captive black mass market volume expected to be only **~120 kt** by 2030

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What can we learn from other commodities?

		Key Takeaway
Oil	Large volumes give rise to physical and financial trading opportunities Multiple regional benchmarks reflecting quality and geography that mostly move in tandem to global ones	Volume and liquidity is critical
Natural Gas	No global benchmarks due to high transportation costs. Has several regional markets that can move independently of each other	Storage and transportability for trade imbalance
Coal	First benchmarks between Japanese and Aust. Supplier. Reference Price Systems in the 1990s. Spot market in the 2000s and three widely used benchmarks today for similar quality products	Consistency of product is important to achieve scale. Some amount of variability is accepted
Iron Ore	Pre-2000s iron ore supplied by small producers and priced annually in bilateral contracts. Move from monthly to spot pricing took 8 – 10 years due to Chinese replacing Japanese demand	Customer behavior can drive structural change in the market

Even for commodities with large markets, benchmarks, liquidity and standardization can take decades to appear

Note: Commodity market sizes in 2020 figures

Source: IEA, OEC, Brent, Hatch research & analysis

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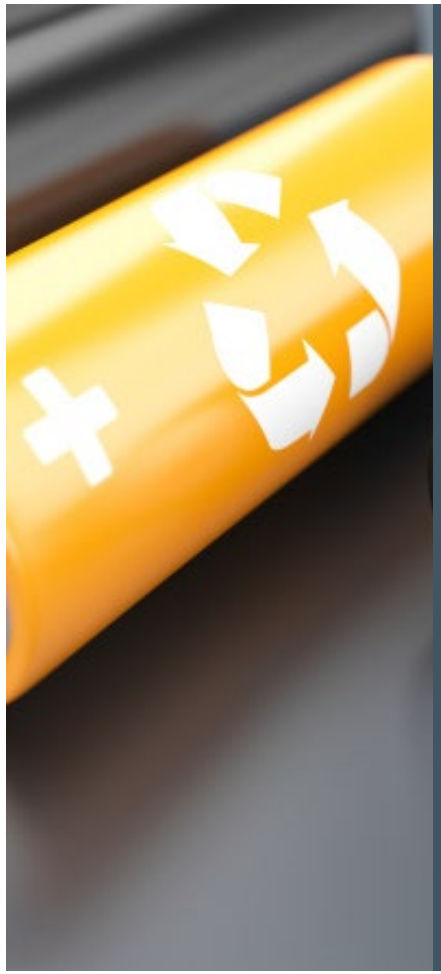
What levers can industry and policy makers pull to support the black mass market?



	Current State	Future State
Volume / Liquidity The feedstock for black mass will increase steadily over the next decade with EOL batteries coming online, however OEM's likely closed loop strategy will limit feedstock availability for trading	●	↗
Storage & Transportability Black mass will be easily stored and transportable facilitating intraregional or global trading	✓	↑
Consistency With the development of new technologies, the consistency of black mass will remain an issue	●	⇄
Legal & Regulatory Frameworks Regulations will continue to favor regional / local security of supply for a large nascent industry which is likely to reduce global trade opportunities	⇄	⇄

> "We do not see black mass becoming a commodity as its composition and quality varies too much. It is a complex product that requires the right processes to recover battery-grade materials" - **LIB recycler**

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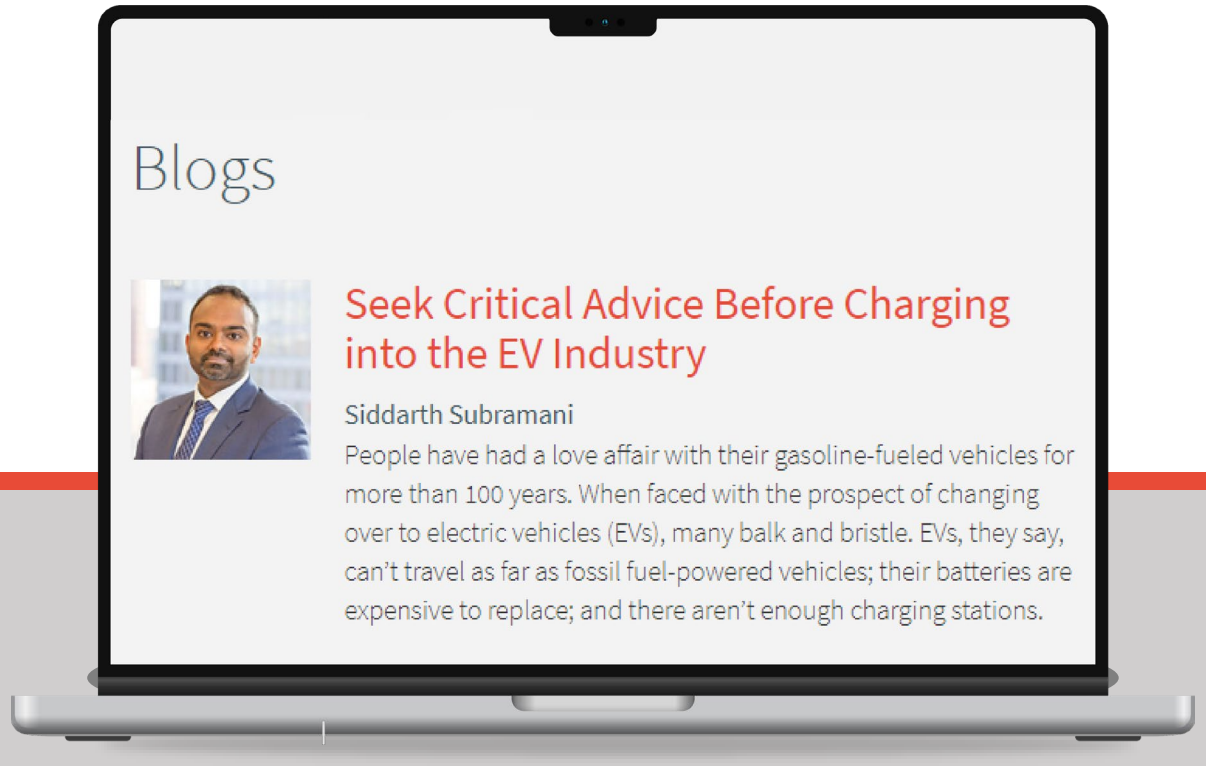
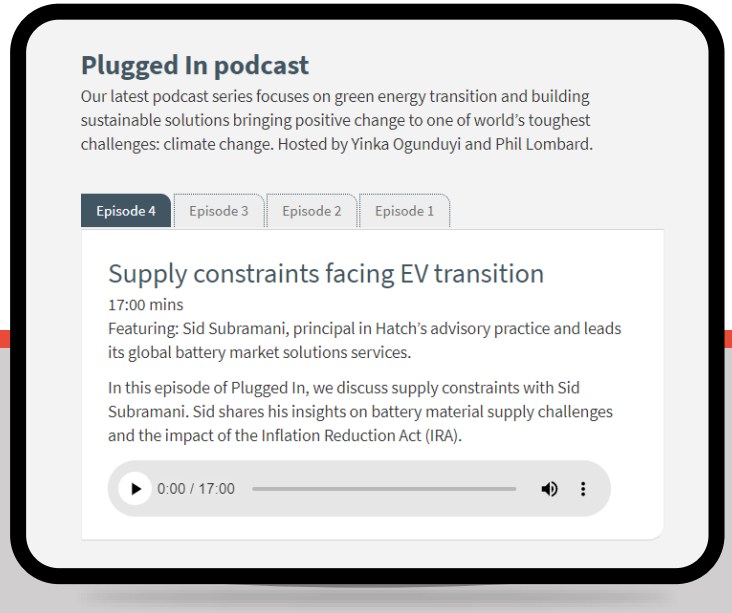
Hatch experts can help address your challenges across the battery-value chain





North and South America

Sid Subramani

Principal, Hatch Advisory

siddarth.subramani@hatch.com

Europe, Middle East and Africa

Alain Masuy

Senior Principal, Hatch Advisory

alain.masuy@hatch.com

Asia and Australia

Alfredo Remy

Senior Principal, Hatch Advisory

alfredo.remy@hatch.com

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