The Race to Secure Metals that are Core to the Decarbonization Value Chains

4 March 2024
Nordic Day

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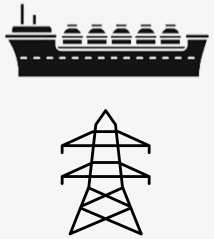
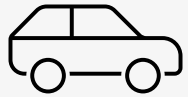
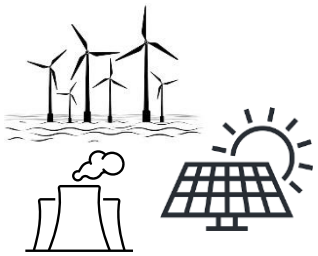
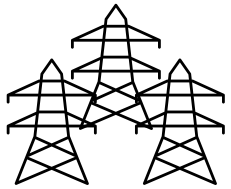
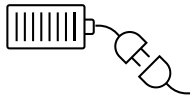
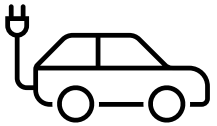
Our world is undergoing unprecedented change

Our society began and will continue to retool for the Green Age

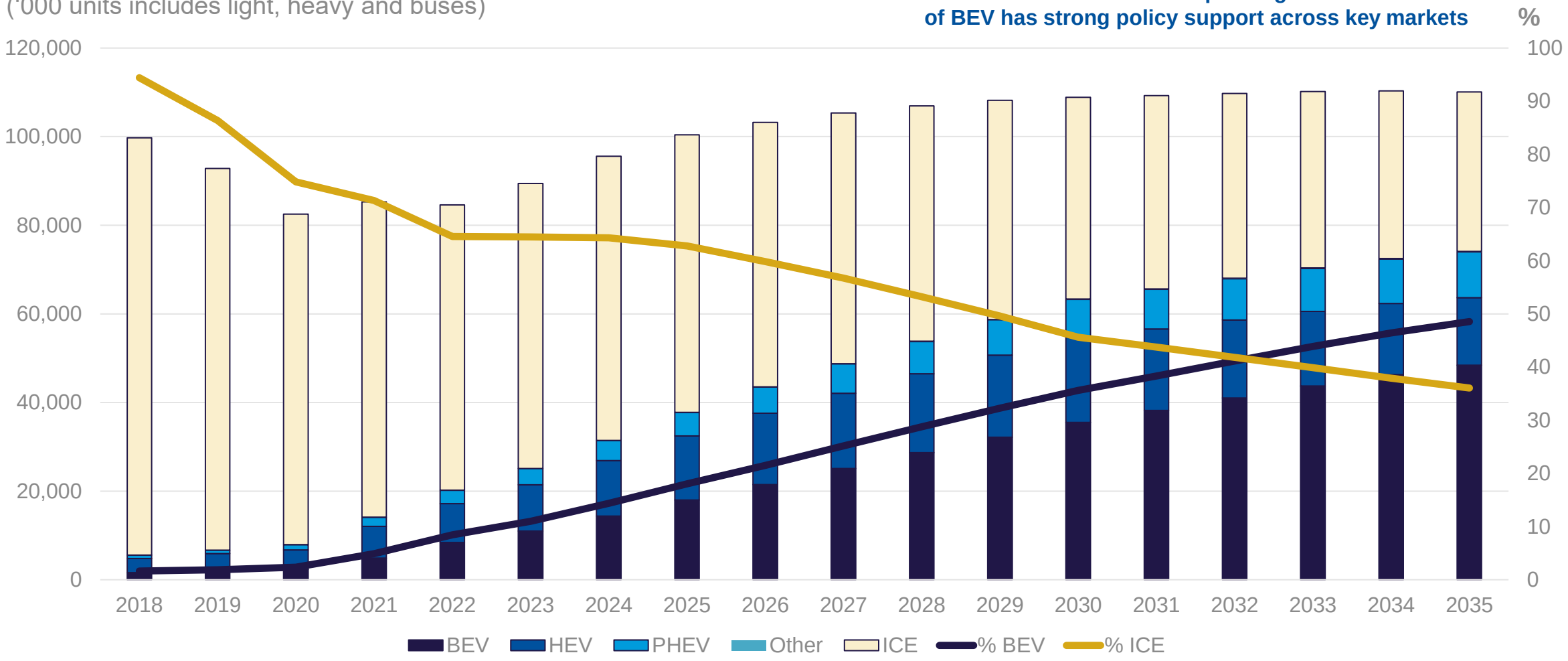
	How we generate energy	How we transport energy	How we store energy	How we use energy
Fossil Age				
Green Age				

Global Energy Transition

Although there are many facets of decarbonization, the most visible is the EV

Global Vehicle Sales
('000 units includes light, heavy and buses)

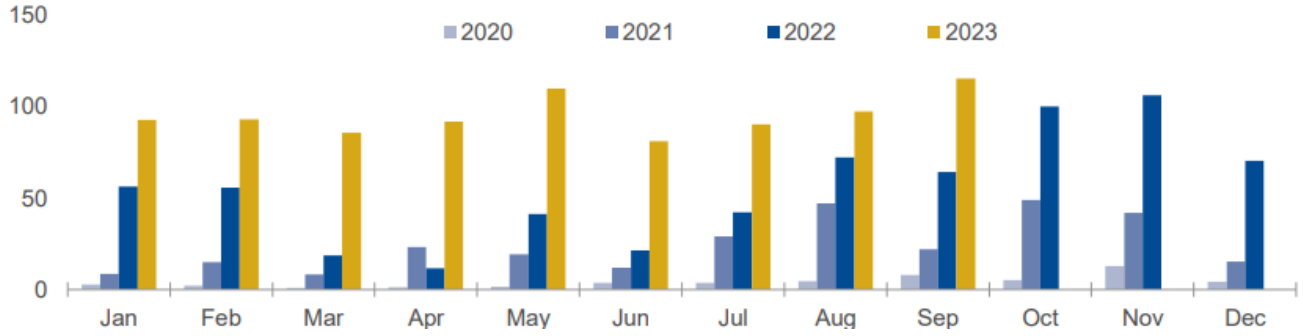
Transitioning to BEVs is critical for the decarbonization effort and phasing out ICEs in favor of BEV has strong policy support across key markets



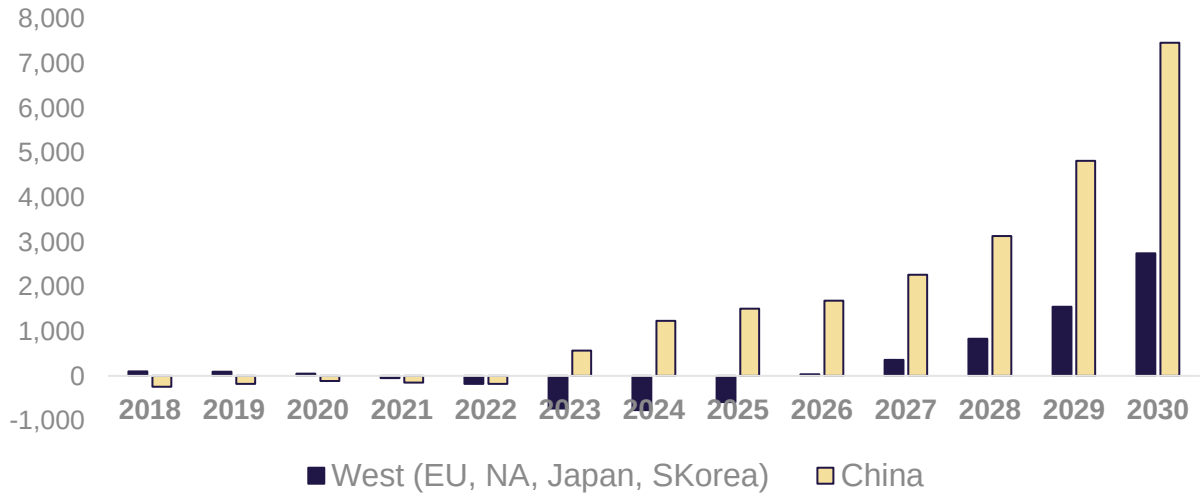
Source: CRU Battery Value Chain Market Outlook December 2023

China has leapfrogged the west in BEV production and will turn to massive exports

China BEV exports, thousand units



Potential for Chinese BEV Exports (‘000 units)
(Simple Balance of Domestic Production and Domestic Market for BEVs)

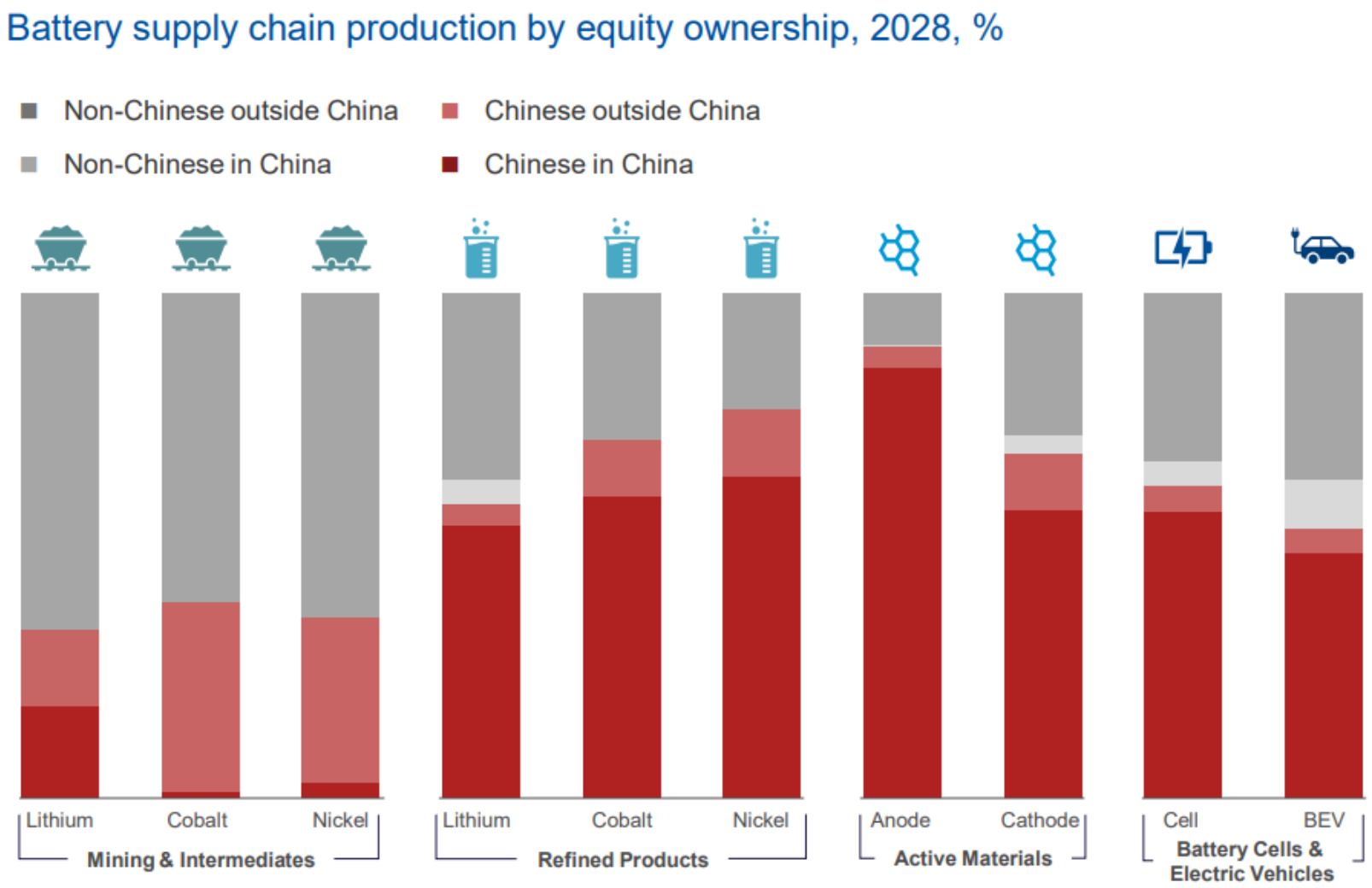


Most of the Chinese brands have plans for exports

	Brand positioning			Likelihood of disruption in ex. China markets
	Low Cost	Mass Market	Premium	
BYD				Very high
ROEWE MAXUS SAIC WULING				High
XPENG				High
ORA 长城汽车				High
GEOMETRY ZEEKR GEELY				High
NIO				High
				Medium
ARCFOX BAIC				Medium
EXEED CHERY				Medium
VOYAH DFM				Medium
HOZON				Medium
HiPhi				Low
JAC				Low

Source: CRU Battery Value Chain Market Outlook December 2023

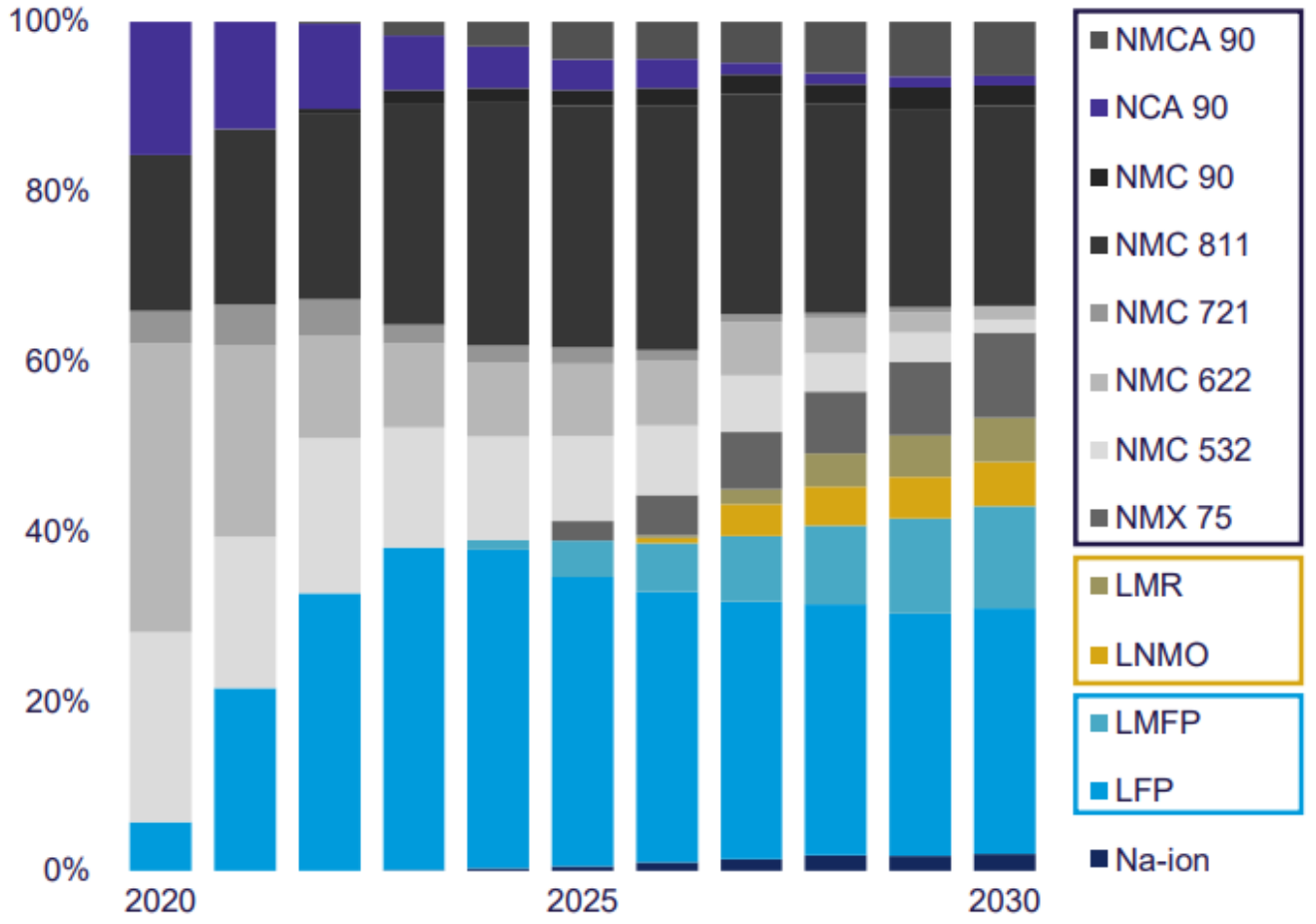
Part of that success can be attributed to being ahead of others in securing the value chain



Source: CRU Battery Value Chain Market Outlook December 2023

Battery chemistry continues to be a dynamic to manage as it determines which specific metals are needed, and how much

Global cathode usage in BEVs, % on GWh basis



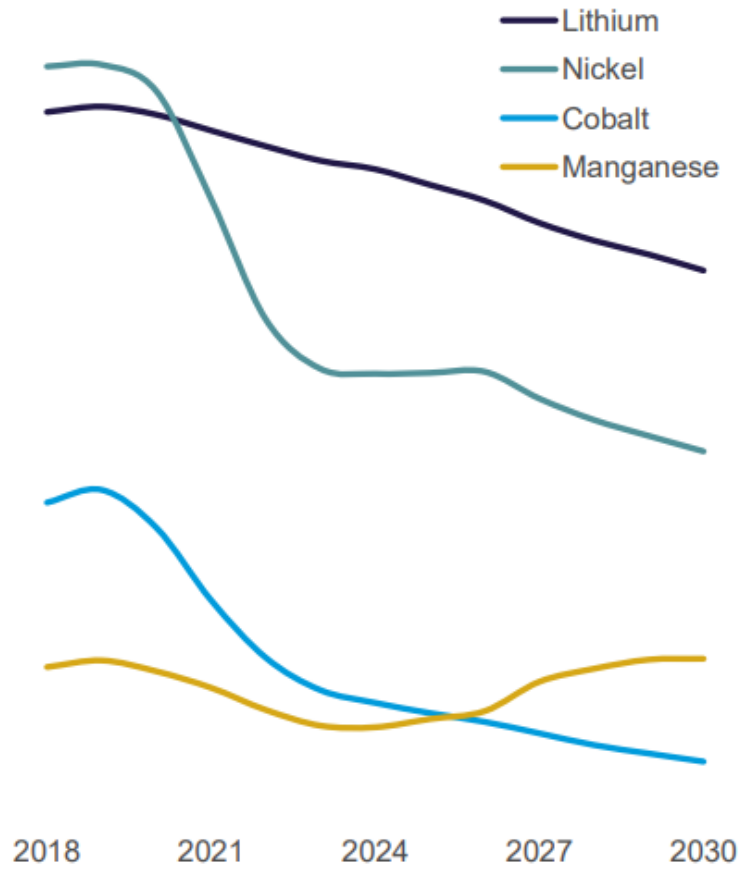
Vehicle manufacturers

	Current/legacy	Long term
VW	NMC 5/6	LFP, LMR, NMC 8
STELLANTIS	NMC 5/6/8	LxFP, NMX, NMC 8
TESLA	LFP, NMC 8, NCA 9	LxFP, LNMO/NMX, NMC 8
BYD	LFP	LxFP
HYUNDAI	NMC 5/6/8	LFP, NMC 8, NCA 9, NMCA 9
RENAULT KOREA MOTORS	NMC 5/6/7	LxFP, LNMO/LMR, NMC 7/8
gm	NMC 8, NMCA 9	LxFP, NMC 8, NMCA 9
Ford	NMC 8/9	LFP, NMC 8/9
GEELY	LFP, NMC 5	LFP, NMC 8
SAIC	LFP, NMC 5	LFP, NMC 8
BMW	NMC 8	NMC 9
Mercedes-Benz	NMC 6/8	LFP, NMC 8
TOYOTA	NMC 5/6	LFP, NMX, NMC 6/8
HONDA	NMC 5/6	NMC 8, NMCA 9
长安汽车 CHANGAN	LFP, NMC 5/8	LFP, NMC 8

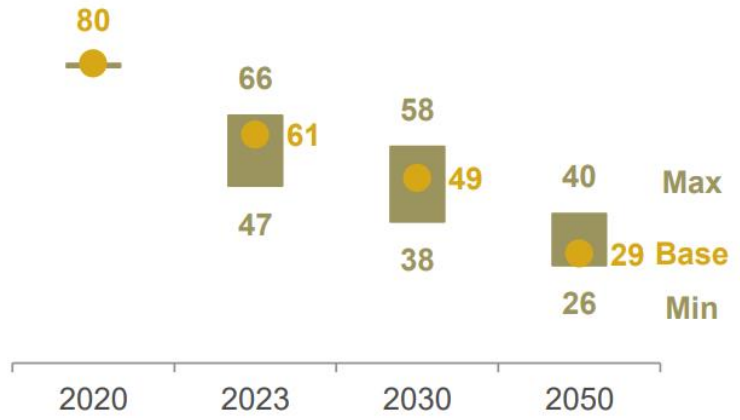
Source: CRU Battery Value Chain Market Outlook December 2023

However, anticipated thrifting in metal intensity, not just in the battery but in other decarbonization applications, looks to manage demand to some extent

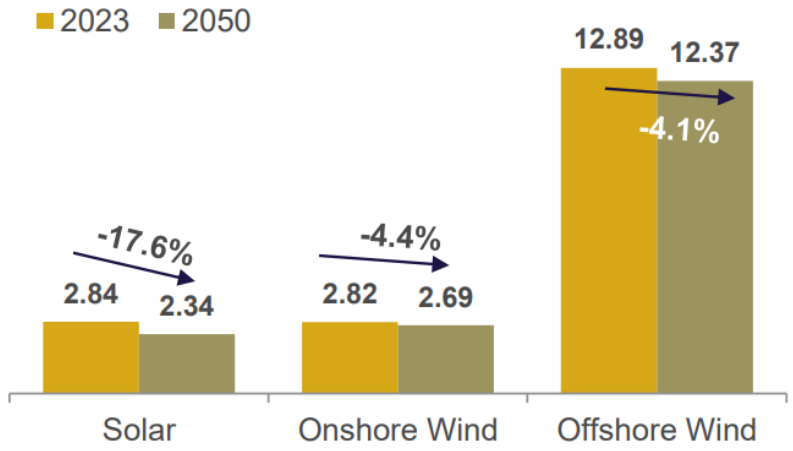
Average metal Intensity in the battery (kg/kwh)



Average copper use in a BEV (kg per car)



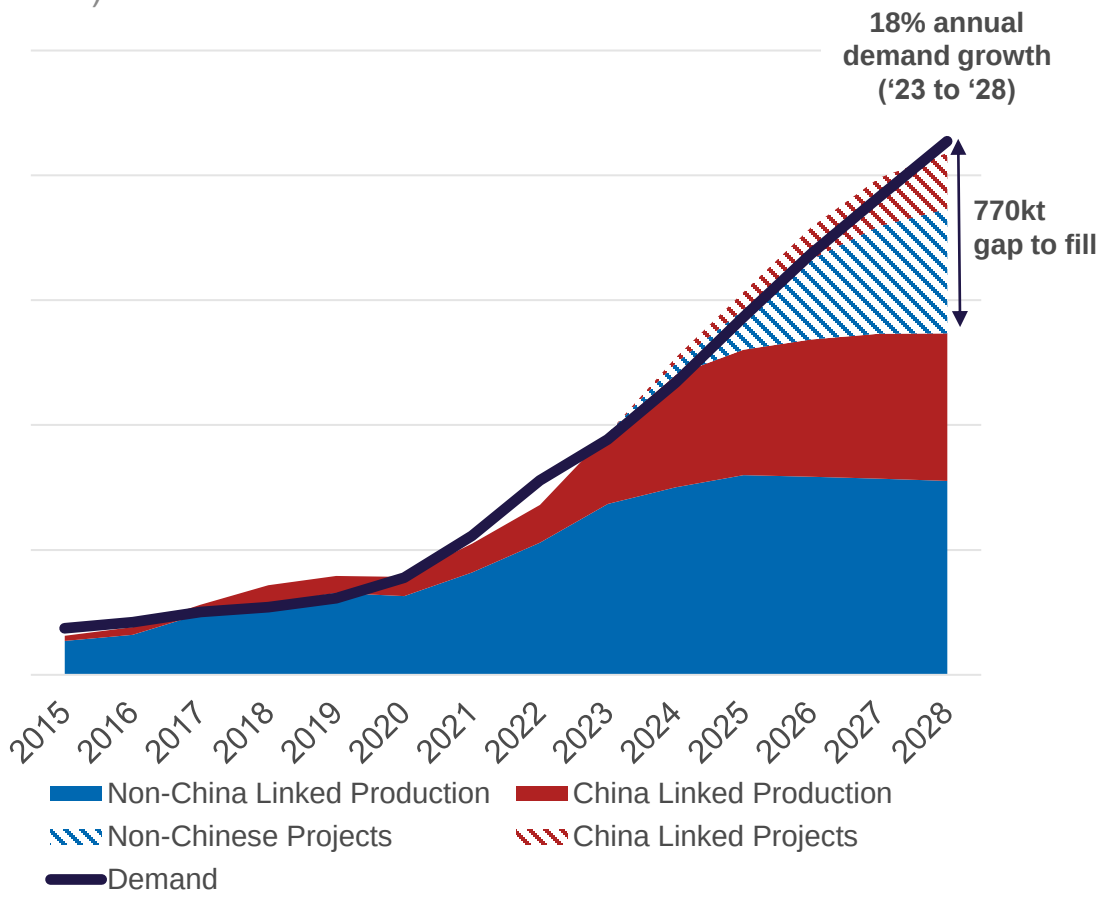
Average copper use in renewable energy ('000t/GW)



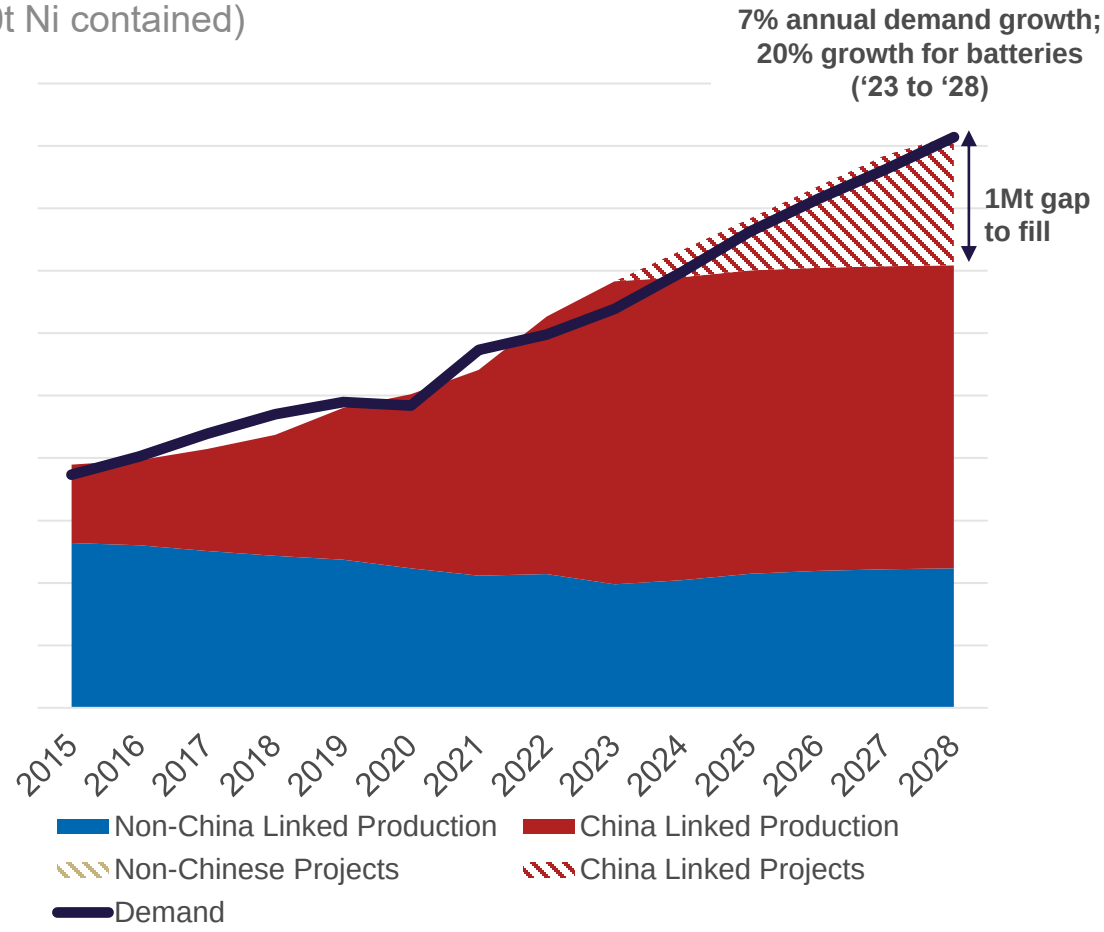
Source: CRU Battery Value Chain Market Outlook December 2023 and CRU Copper Market Outlook December 2023 Report

Despite this, the demand growth continues to be strong with, again, China is playing a key role in closing the supply gap

Lithium Market Supply and Demand
('000t LCE)



Nickel Market Supply and Demand
('000t Ni contained)



Source: CRU Lithium Market Outlook February 2024 and CRU Nickel Market Outlook December 2023 Report

However, the changing geopolitical landscape has introduced more risk and uncertainty, and this is impacting access to core materials

great power struggles and potential for escalation

emergence of a powerful new trading / economic block

disruptions of key trade lanes

trade restrictions (REs, Graphite) and sudden disruptions core raw materials

The US is responding with historical policies to secure and onshore their decarbonization value chains

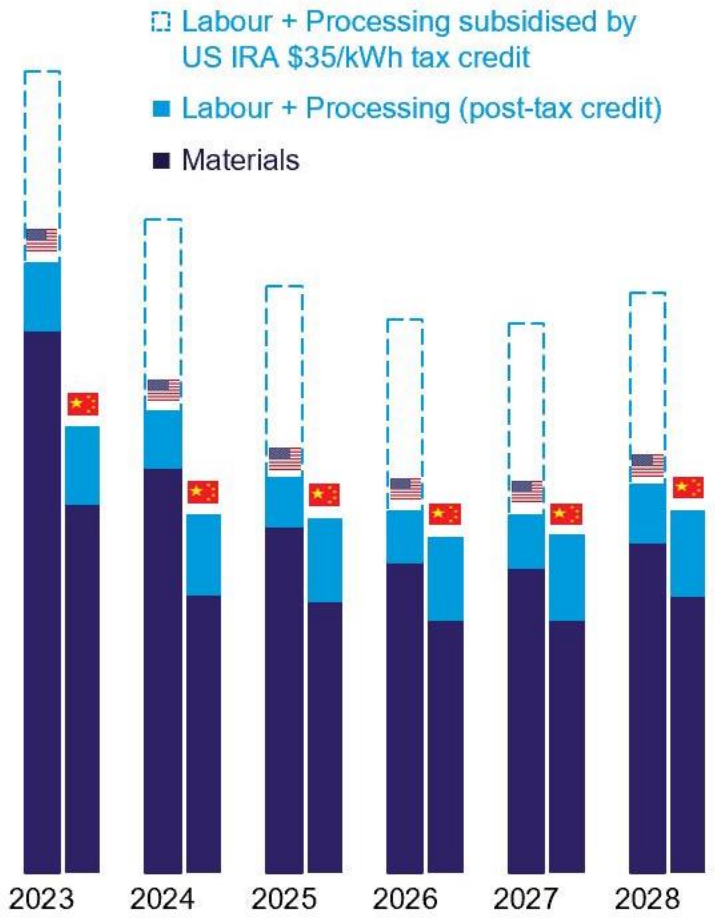
Incentive for producers: AMPC (45X)

Battery components and critical minerals produced in the US may qualify for tax credits under certain requirements.

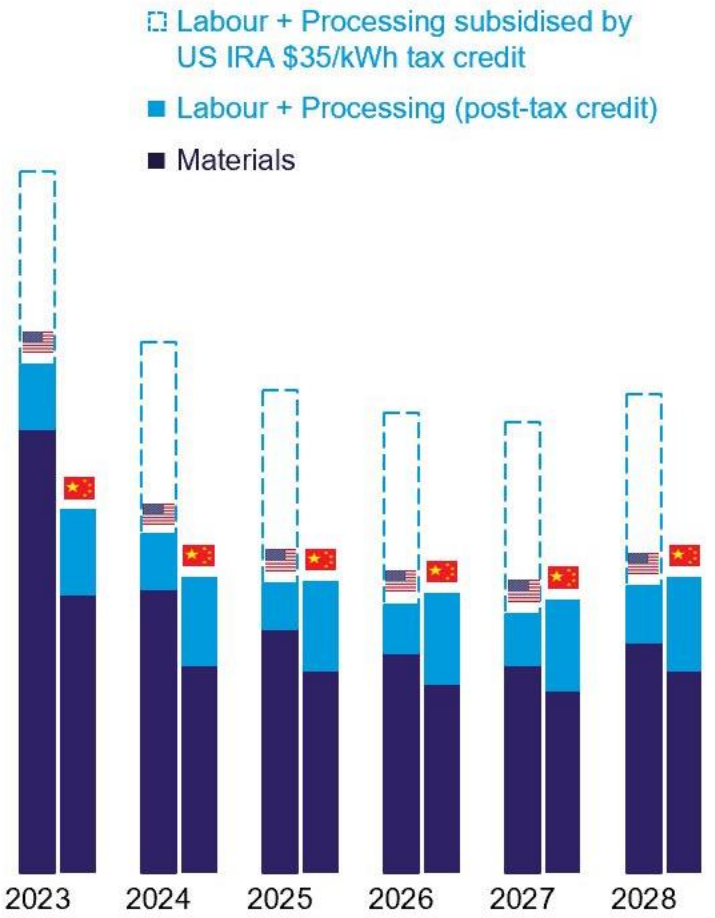
	2023-2030 Full credit
Battery modules ($/kWh)	10.00
Battery cells ($/kWh)	35.00
Electrode active materials (% of production cost)	10.0
Critical minerals (% of production cost)	10.0

As per latest guidance, the cost of raw material extraction or acquisition used to produce the critical mineral or active material is excluded from the tax credit.

NMC 811 battery pouch cell production cost for US vs China, $/kWh

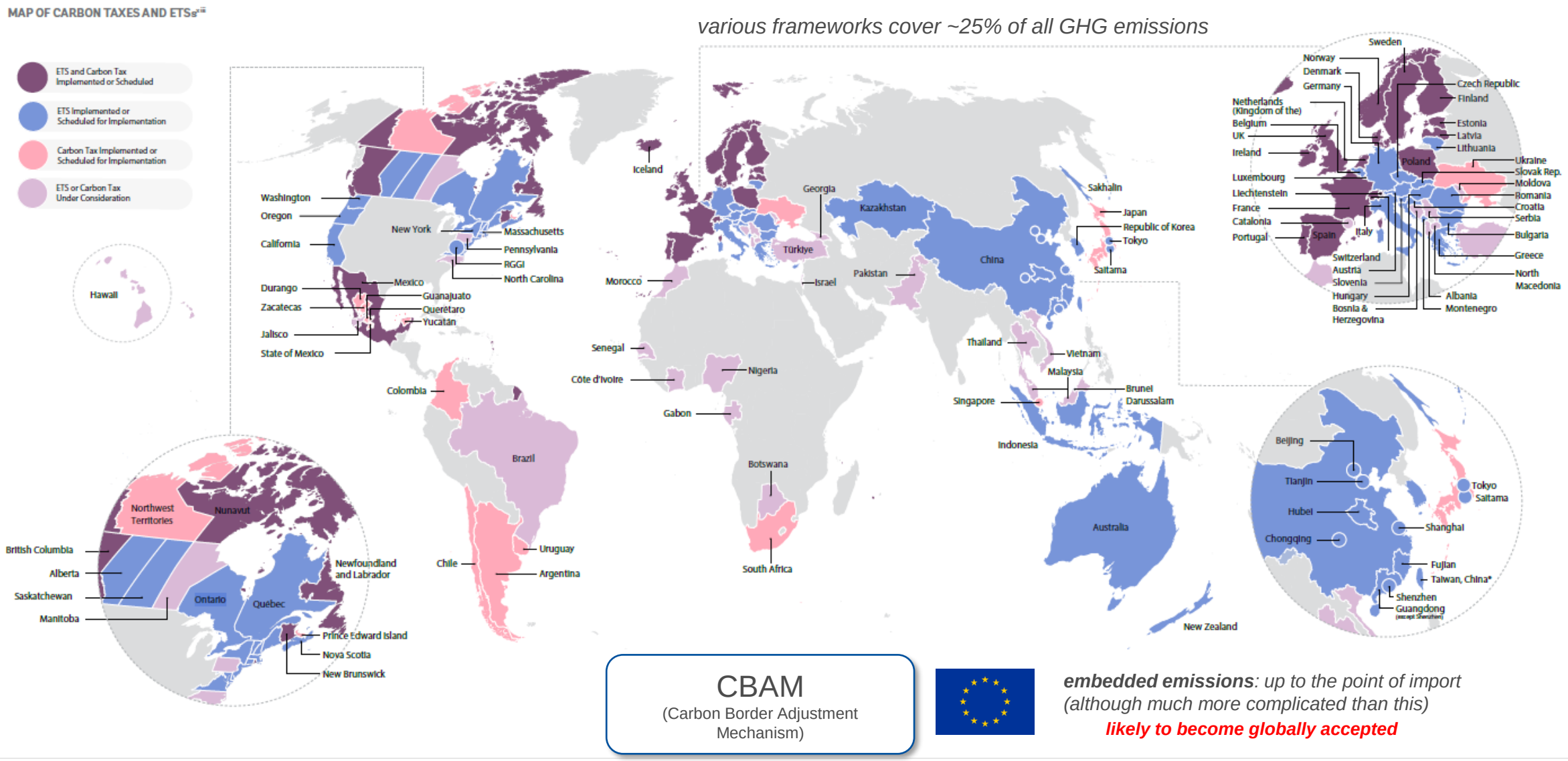


LFP battery prismatic cell production cost for US vs China, $/kWh



Source: CRU Battery Value Chain Market Outlook December 2023

While various carbon mechanisms have emerged to facilitate decarbonization and with CBAM an attempt to “even out” the carbon playing field



various frameworks cover ~25% of all GHG emissions

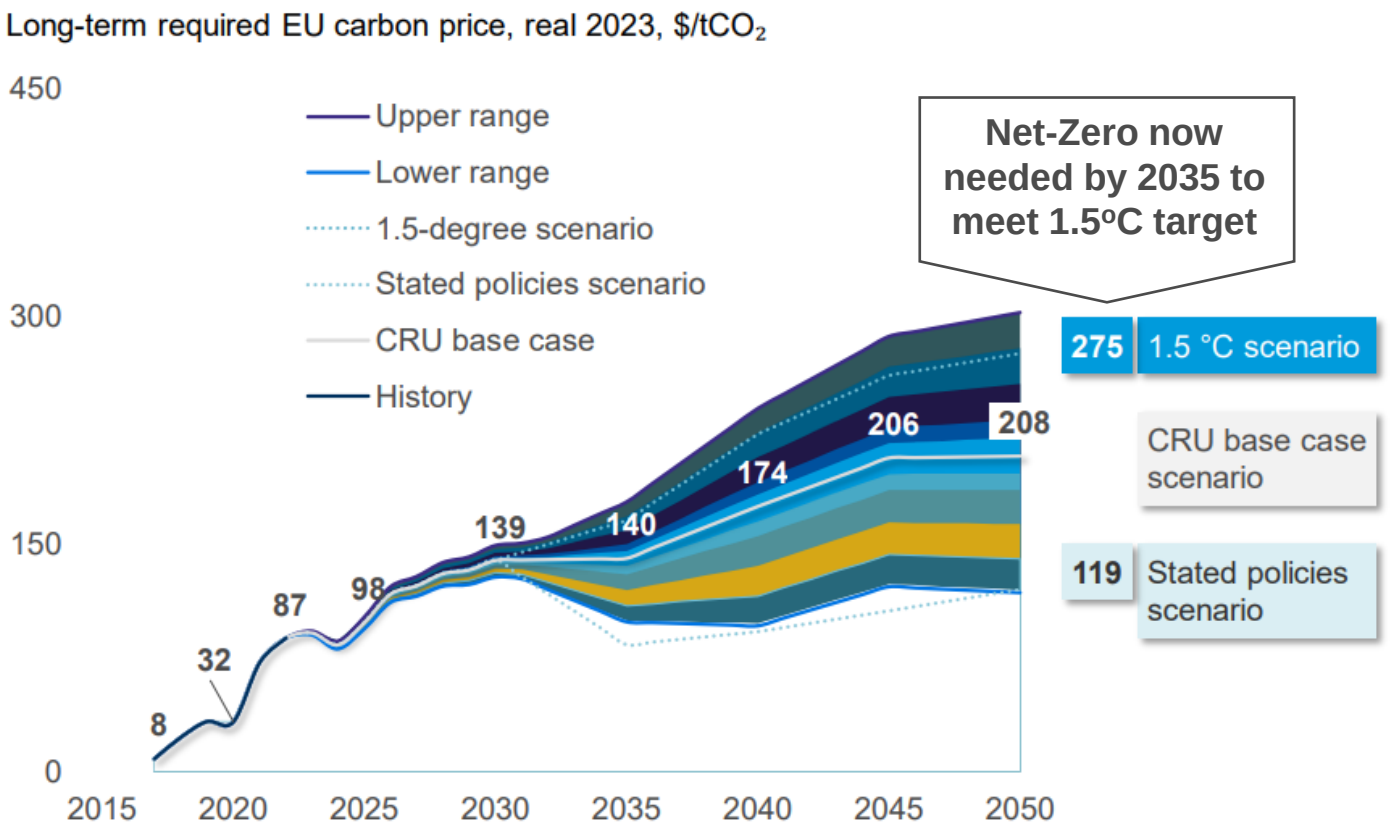
CBAM
(Carbon Border Adjustment Mechanism)

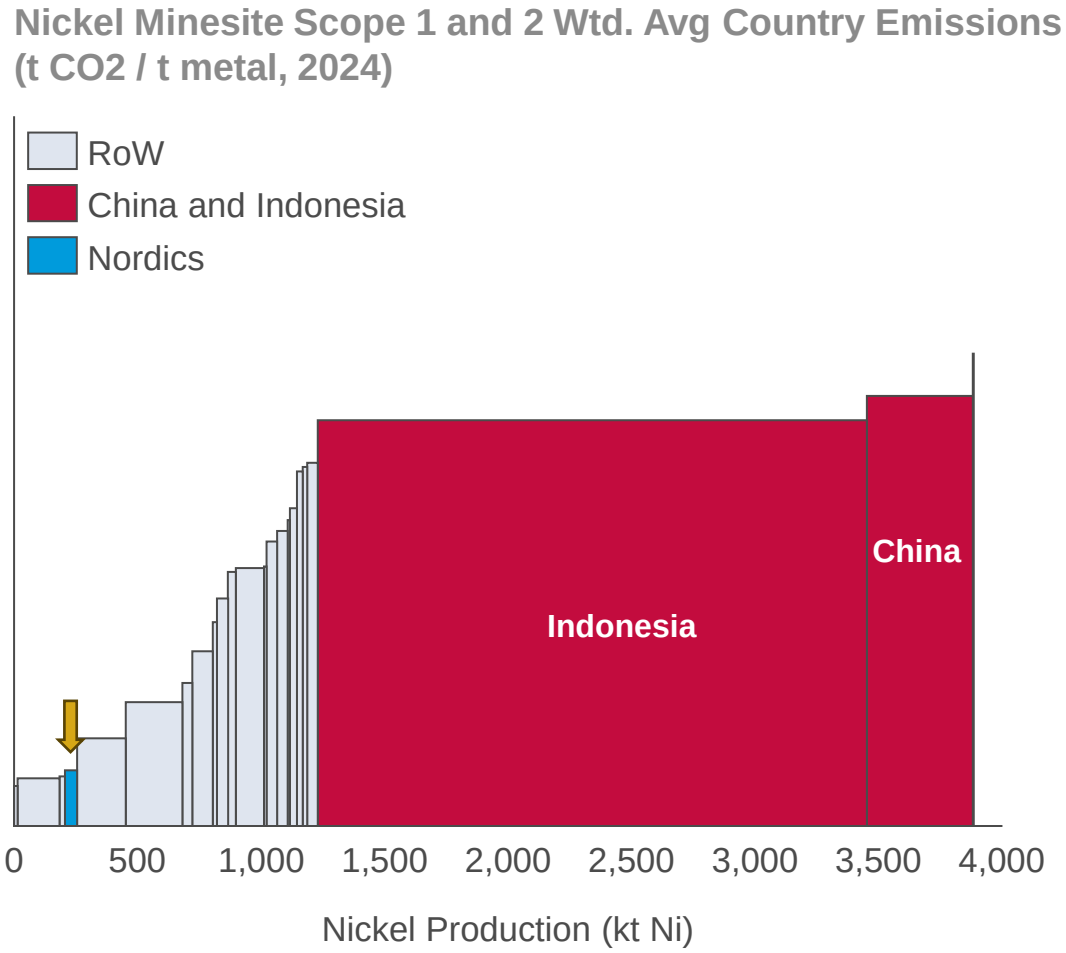
***embedded emissions**: up to the point of import (although much more complicated than this)*

likely to become globally accepted

Source: World Bank

This means that investment in low-carbon production will quickly become a key competitive advantage in the years to come

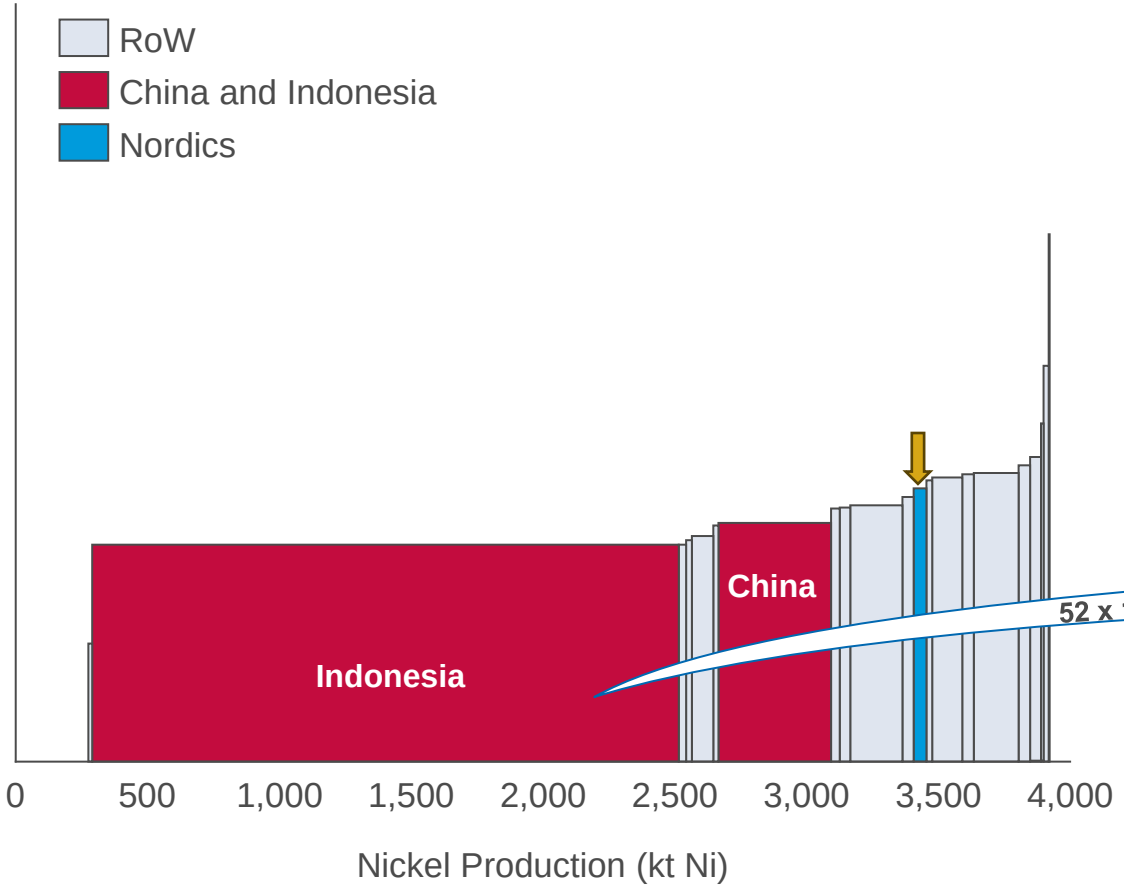




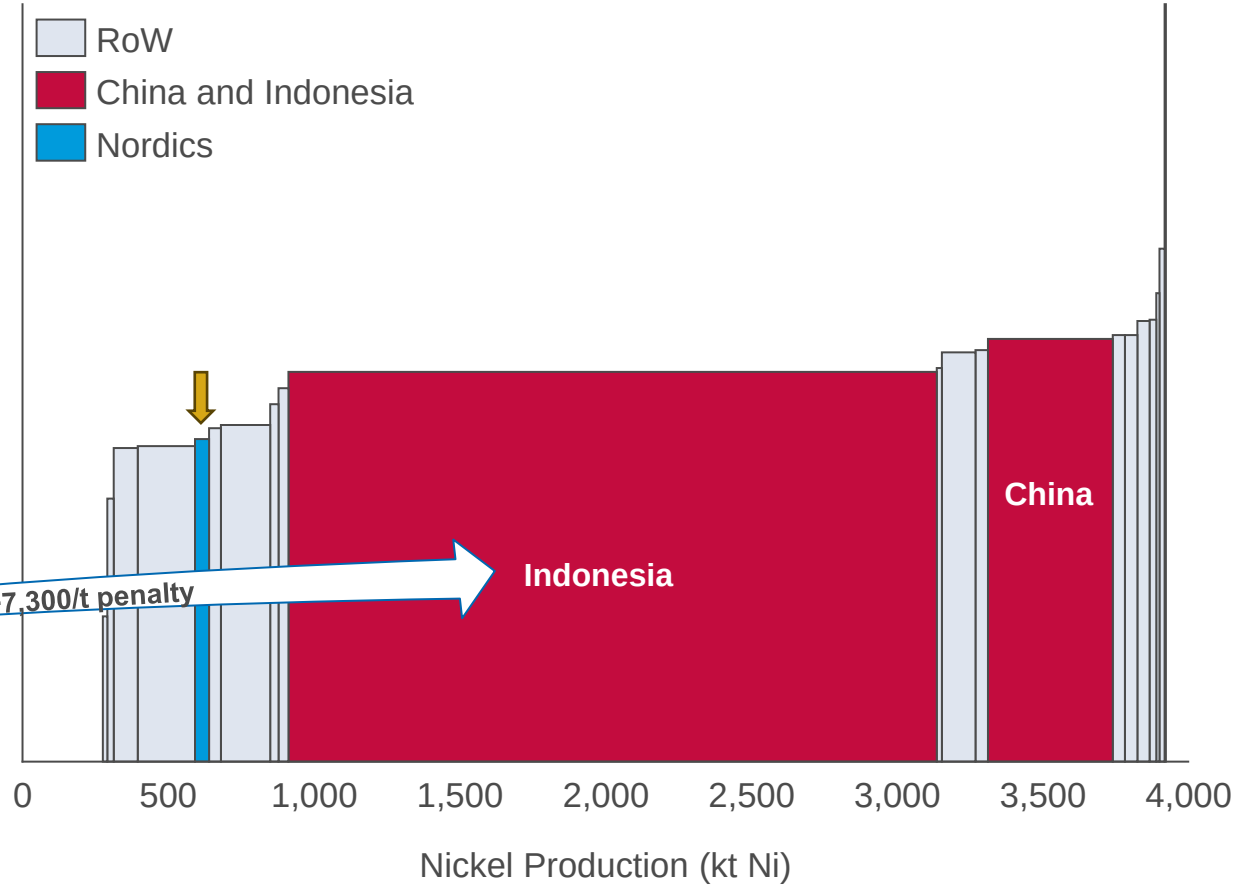
Source: CRU Long Term EU Carbon Price Report December 2023, CRU Commodities Emissions January 2024 Report, and CRU Emissions Analysis Tool for Nickel Mine Industry

…particularly when a carbon barrier is fully enacted and enforced

Nickel Mine CRU All-in Sustaining Wtd. Avg Country Costs (US $ / t metal, 2024)



Nickel Mine CRU All-in Sustaining Wtd. Avg Country Costs with a $140/t CO2 carbon price applied (US $ / t metal, 2024)



Source: CRU Mine Cost Analysis Tool for Nickel Mine Industry

Nordic nations have a unique opportunity to become established as an anchor for the supply of core metals

Nordic Advantage

1. Rich resource base of core metals
2. Human capital and advanced technical knowhow
3. Renewable energy and focus on low-carbon
4. Access to large sovereign funds to facilitate and accelerate development

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