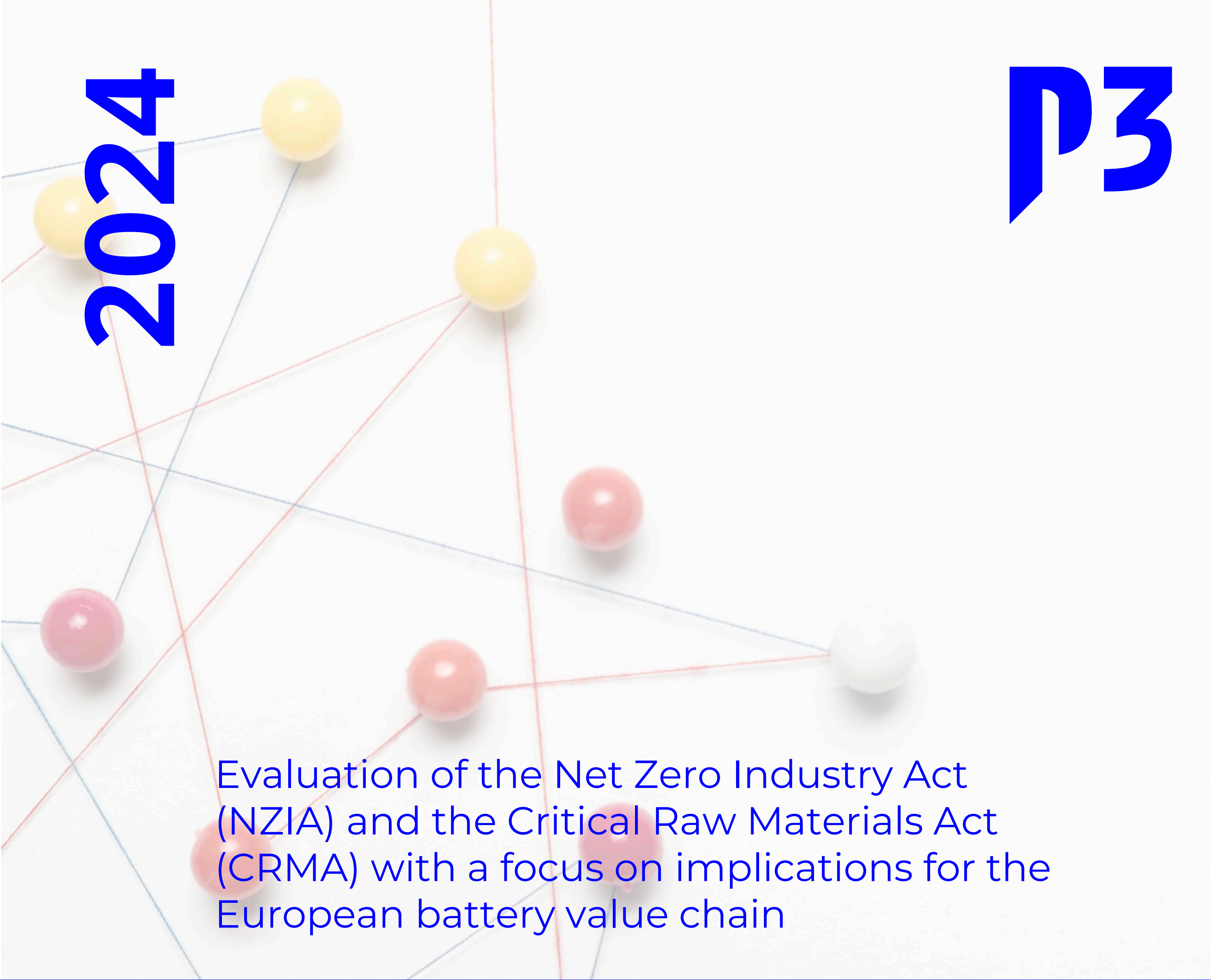
2024



Evaluation of the Net Zero Industry Act (NZIA) and the Critical Raw Materials Act (CRMA) with a focus on implications for the European battery value chain

Localised battery value chains in Europe – How strong is the announced political support?

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"Within this Act, the EU is upping its game in terms of extracting, refining, recycling and diversifying to ensure secure and sustainable access to critical raw materials."

Thierry Breton, EU Commissioner for Internal Market, on the Critical Raw Material Act draft presented by the EU Commission on 16.03.2023

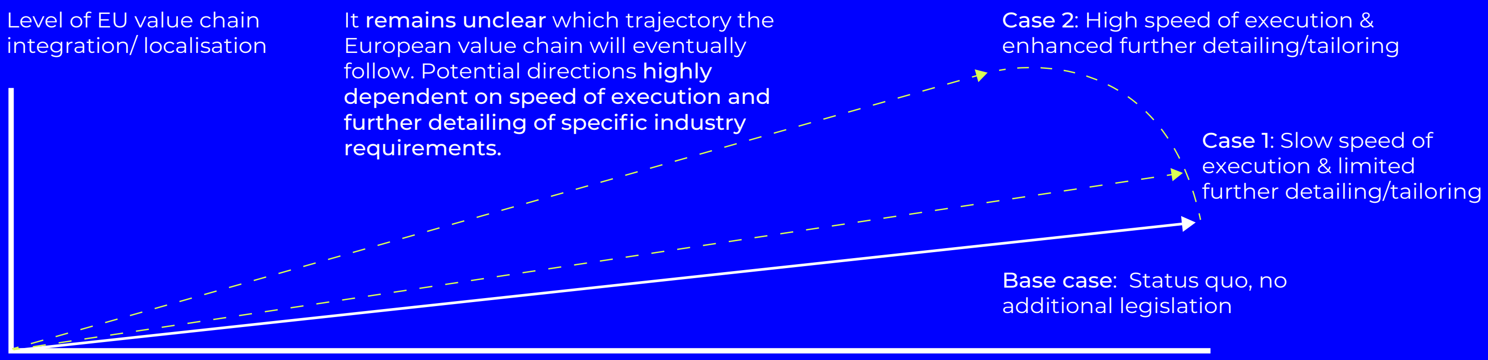
01

Management Summary

ASSESSMENT OF EUROPEAN LEGISLATION AS ANSWER TO THE U.S. INFLATION REDUCTION ACT

Short-term effectiveness until 2026	Clarity of incentive structures, predictability	Theoretical availability of tools, mechanisms and programs
Medium – Speed of execution requires to be observed	Low – Lack of detailing in incentive mechanisms and programs	High – Toolbox with many available instruments, approaches and funds

THE EUROPEAN BATTERY VALUE CHAIN IS ON A GENERAL UPWARDS TRAJECTORY



Europe's strategic position in the battery value chain, driven by a robust automotive legacy and a heightened focus on reducing CO2 emissions, is apparent. With the value chain's future resilience in mind, the EU is actively working to strengthen the European next-gen technology ecosystem further, aiming to compete with incentive systems like the US Inflation Reduction Act.

To achieve this, the EU is advancing two key legislative acts — the Net Zero Industry Act and the Critical Raw Materials Act — to foster industrialization and secure raw materials for the emerging battery industry. Both acts are setting local production capacity targets for 2030. Within the legislation, stated EU target production capacities indicate attainability in the cathode and anode active material sector. However, concerns arise regarding insufficient ambition for battery cell production capacities.

Specific quotas for raw materials, covering extraction, processing, and recycling, reveal achievable goals for lithium but anticipate challenges for nickel due to limited local mining and processing activities.

Ambitious recycling targets for lithium and nickel, considering current feedstock availability projections for 2030, underscore future challenges. In forthcoming political discussions, the EU's imperative lies in securing local End-of-Life and scrap materials, engaging in import agreement negotiations, and navigating the tension between enhancing battery lifespan and fulfilling recycling quotas.

Though the evaluated acts reflect thoughtful intentions, the absence of specific details leaves incentive structures unclear. Despite essential approaches, prompt execution of crucial matters, like expediting permitting speeds, is pending. The growth trajectory of the European battery ecosystem awaits decisions in the upcoming years.

Table of content

What challenges is the battery sector facing, and how does the EU intend to respond strategically?

Driven by increasingly established industrialisation subsidies for clean-tech players worldwide, the EU is progressively forced to develop incentive and security mechanisms to keep its competitive edge in future technologies.

The Inflation Reduction Act (IRA) from 2022 led to significant disruptions in the global landscape of renewable-related industries. The tax credit model of rewarding both the supply and demand side for domestic sourcing and production efforts is significantly driving new US localisation and industrialisation announcements. Priorities are being shifted, and investments are being replanned to rely on the US as a base to serve Western markets.

At the same time, geopolitical insecurities and tensions involving China and Russia show the necessity of establishing secured and reliable supply chains, especially given the still witnessed central dependence on critical raw materials from those countries.

The EU is now aiming to tackle both challenges with legislative jurisdictions. In early 2023, the Commission drafted the Green Deal Industrial Plan to secure future European industry localisation and ensure granted access to required raw materials.

This proposal aims to strengthen Europe's positioning in the global race for next-generation technology and environmental industrialisation.
Within the Industrial Plan framework proposal, two main acts, the **Net Zero Industry Act (NZIA)** and the **Critical Raw Materials Act (CRMA)**, play an essential role.

Both are being investigated in this whitepaper. Particular focus will lie on the estimated impact on the European battery landscape – especially in comparison to the IRA. Furthermore, it is important to note that in December 2023, the EU parliament ratified the here depicted CRMA draft after agreeing with the EU Council of Ministers. A NZIA legislation settlement is expected in early 2024.

US LOCALIZATION
OF KEY PLAYERS

The IRA legislation from August 2022 directly led to **US localization** announcements of major **clean-tech** and automotive players such as Tesla, Panasonic, GM and LG. Already announced EU expansions (e.g. from Northvolt in Heide) were questioned and priorities shifted towards US projects.

RAW MATERIAL
DEPENDENCIES

Currently, the EU is dependent on raw material supply from non-allied countries such as China. Implications of geopolitical crises can therefore be severe and pose a risk to the supply chain.

Net-Zero Industry Act and Critical Raw Materials Act function as the legislative backbone of the Green Deal Industrial Plan.

To establish a robust European supply chain and production environment, the two acts aim to implement a simplified regulatory environment and to establish at least initial target values for 2030.

NET ZERO INDUSTRY ACT

MAJOR AIM

Overarching aim is to simplify, accelerate and align incentives to preserve the competitiveness and attractiveness of the EU as investment location for the net-zero industry. The domestic manufacturing capacities shall cover at least 40% of the EU's annual deployment needs for defined categories1) by 2030.

GOALS

Act based on **seven pillars**:

- **Streamlined permitting**: Setting up single points of contacts and rules and criteria for strategic projects
- **Support carbon capture**: Establish market and support storage sites
- **Accelerate market access for netzero tech**: Foster demand from public and private sector
- **Enhance workforce skills**: Target need for skills
- **Promote net-zero innovations**: Regulatory sandboxes for controlled testing
- **Improve strategic governance**: Netzero platform to coordinate actions
- **Monitor and track progress**: Set up monitoring systems for objective tracking

CRITICAL RAW MATERIALS ACT

MAJOR AIM

A two-pronged approach is being followed: Ambitious internal targets for local sourcing and accelerated permitting processes next to external, 'diplomatic' approaches to create material partnerships and free trade agreements. **Specific EU target values for extraction, processing and recycling are stated for 2030.**

GOALS

Act formulates clear benchmarks for domestic capacities along the strategic raw material supply chain:

- **Extraction**: At least 10% of the EU's annual consumption (to the extent that the Union's reserves allow for this)
- **Processing**: At least 40% of the EU's annual consumption
- **Recycling**: At least 25% of the EU's annual consumption
- **Third Country Criterion**: Not more than 65% of the EU's annual consumption of each strategic raw material at any relevant stage of processing

Note:
1) Categories include batteries as well as required cathode and anode materials (CAM, AAM).

What target metrics have been established for 2030 concerning the European Union's battery value chain?

NET ZERO INDUSTRIY ACT

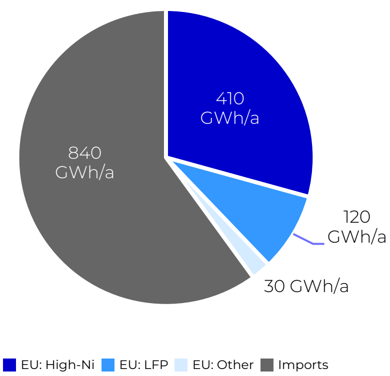
The Net Zero Industry Act aims to cover at least 40% of the EU's annual deployment needs by 2030. The Annex of the act specifies this target to eight strategic net-zero technologies, namely solar and wind, geo-thermal energy, electrolysers and fuel cells, biogas, carbon capture, grid and battery technologies.

The act details that battery production, as well as cathode and anode active material production capacities, shall be considered for the 40% target value. Therefore, the chemicaloriented battery production processes are in focus rather than the mechanical module and pack assembly steps.

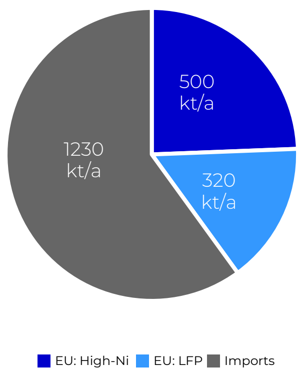
According to P3 market data, the **total overall EU battery demand**[1] is **expected to reach 1,400 GWh in 2030**. Hence, the following depicted values of EU battery, cathode active material (CAM) and anode active material (AAM) production need to be reached according to NZIA:

2030: Required domestic EU capacities according to NZIA (40% goal)

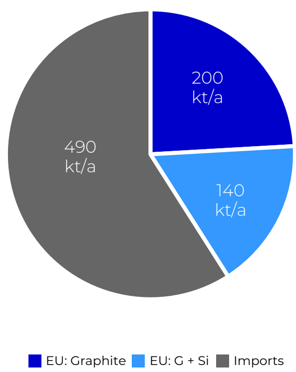
Required amount of **domestic EU battery production**



Required amount of domestic **EU CAM (High-Ni and LFP) production**[2]



Required amount of domestic **EU AAM production**[3]



Notes:
1) Demand for passenger and commercial vehicles as well as ESS systems taken into consideration.
2) Energy density of NMC and LFP different, leading to comparably high LFP share in the depicted diagram. Estimate based on an expected CAM share of ca. 70% High-Ni NMC and >20% LFP in 2030. Other chemistries not taken into account.
3) Depiction with expected pure graphite and graphite + silicon anode EU demand for 2030. Share of non-graphite anodes to be neglected.

Regarding **cathode chemistries**, the market is estimated to be mainly divided between High Nickel materials (NMC, NCA) and Lithium-Iron-Phosphate (LFP). Technology roadmaps have been mainly driven by increased energy density and improved performance – resulting in higher nickel contents or Silicon integration on the anode side. That development led to most automotive BEVs containing nowadays NMC chemistries in their cathodes.

LFP, on the other hand, is a cathode chemistry developed in its basic structures over 25 years ago. Due to its lower capacity and energy density than mentioned layered oxide CAMs like NMC, western cell manufacturers and automotive OEMs rarely focused on LFP in the 2010s. However, with the intellectual property related to LFP not protected in China and therefore freely accessible and usable for commercial purposes ("freedom to operate"), many Chinese cell developers like CATL and BYD began investing heavily in LFP technology. They integrated LFP – driven by a political tailwind from the respective five-year plans - as a potential low-cost and low-range alternative to NMC batteries.

As a result, China became the dominant market for manufacturing and developing LFP materials and cells. With the rapid global adoption of entry-level battery electric vehicles (BEVs) and increasing tconcerns about the availability of raw materials, European and American automotive companies have recently announced plans to produce LFP-based vehicles. This is mainly driven by securing market shares and not letting Chinese players ultimately control the budget BEV markets. For that market segment, the utilisation of NMC is, due to cost reasons, hardly feasible. Therefore, P3 expects the **EU share of LFP** batteries **to climb to over 20% by 2030**.

A clear trend towards integrating Silicon into the graphite-based material composition is currently seen on the anode side. Silicon-enriched anodes offer higher energy density, faster charging, and reduced heat generation in lithium-ion batteries compared to traditional graphite anodes. However, they also face challenges related to volume changes during cycling, which researchers are working to overcome for widespread adoption.

As stated in the Net Zero Industry Act, the EU aims to reach 40% local production for battery cells, CAM and AAM by 2030.

CRITICAL RAW MATERIALS ACT

In 2023, the EU Commission released its fifth update of its critical raw material list, replacing the previous version from 2020. Increasing battery material scarcities have been taken into account. Therefore, copper, manganese and nickel have been defined as critical in addition to the previously listed materials cobalt, lithium and natural graphite.

To evaluate and define the scope of the mentioned domestic CRMA quotes (10% local extraction, 40% local processing and 25% local recycling with the 2030 demand as baseline), a definition and clear segregation of the terms extraction, processing and recycling is initially needed. Within the act, the following definitions are given:

EXTRACTION	PROCESSING	RECYCLING
'Union extraction capacity means an aggregate of the maximum annual production volumes of extractive operations for ores, minerals, plant products and concentrates containing strategic raw materials, including processing operations that are typically located at or near the extraction site, located in the Union.'	'Union processing capacity means an aggregate of the maximum annual production volumes of processing operations for strategic raw materials, excluding such operations that are typically located at or near the extraction site, located in the Union.'	'Union recycling capacity means an aggregate of the maximum annual production volume of recycling operations for strategic raw materials, including the sorting and pre-treatment of waste and its processing into secondary raw materials, located in the Union.'
Example: Mining of lithium-containing rock including refinement into lithium spodumene concentrate	Example: Processing of lithium spodumene concentrate into lithium hydroxide	Example: Processing scrap and End-of-Life (EoL) batteries to extract lithium

As per definition, extraction subsequently refers to obtaining natural resources or materials directly from the Earth's crust or other sources in their natural state. The annexa 'to the extent that the Union's reserves allow for this' considers the required geological availability.

However, **no further details are given yet, specifying how the availability of reserves is precisely defined and in what cases the planned target values of 10% EU extraction can be neglected.**

A further clause surrounds the mentioned aspects:

“THIRD COUNTRY CRITERION”

‘For some raw materials, the Union is almost fully dependent on a single country for its supply.

Such dependencies entail a considerable risk of supply disruptions. To limit such potential risk and increase the Union’s economic resilience, efforts should be undertaken to ensure that, by 2030, it is not dependent on a single third country for more than 65% of its supply of any strategic raw material, unprocessed and at any stage of processing, giving however special consideration to countries with whom the Union has established a Strategic Partnership on raw materials giving rise to greater assurances regarding supply risks.’

With this clause, the European Union aims to lower dependencies on single countries – especially on China, which is currently dominating global technology and material supplies.

At first, the definition does not differ between allied and non-allied states. However, the highlighted ‘special consideration’ of countries ‘with whom the Union has established a Strategic Partnership on raw materials’ possibly opens up a chance for single allied, resourcerich states to stay above the stated 65% supply threshold.

Based on stated target values for 2030 and the forecasted EU battery demand (as indicated previously), **the following extraction, processing and recycling capacities** are therefore required for battery-related critical raw materials:

All values in [kt/a]	Li	Ni	Mn	Co	C	Cu
2030: Expected demand	**100**	**600**	**80**	**60**	**780**	**1100**
2030: Required EU extraction capacities	10	60	8	6	78	110
2030: Required EU processing capacities	40	240	32	24	312	440
2030: Required EU recycling capacities	25	150	20	15	195	275

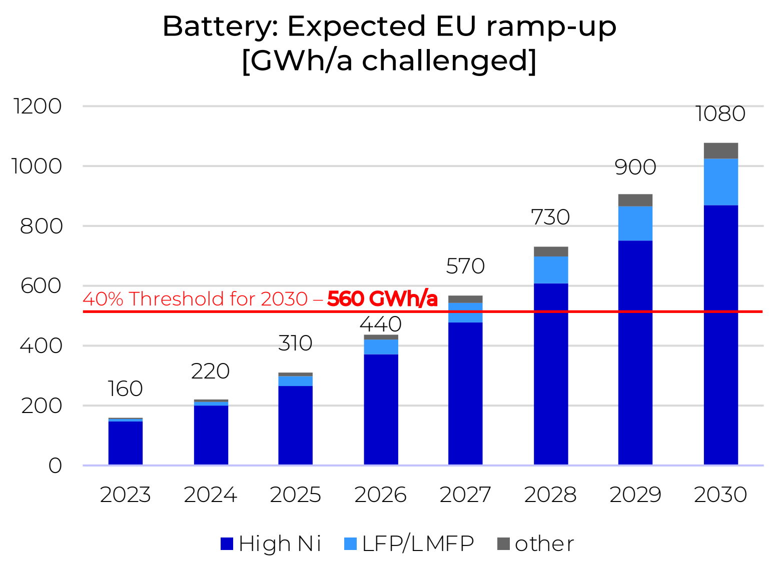
Batteries, CAM and AAM: What is the anticipated capacity trajectory in relation to specified target levels?

The NZIA aims for manufacturing capacities to cover at least 40% of the EU's annual deployment needs by 2030.

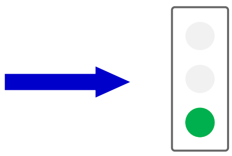
This leads to 560 GWh/a of battery production, 820 kt/a of CAM production and 340 kt/a of AAM production. The following segment provides three insights into expected market rampups – based on announced and challenged production capacities (derived from supply side[1]).

For the first investigated field of production - domestic battery production capacities - stated target values are expected to be reached for 2030 due to significant capacity announcements of leading key players. The ramp-up depicted here is based on challenged values, which means that P3 has assessed public announcements to derive a realistic output considering the respective players' experience, expected ramp-up times, and overall localisation strategies.

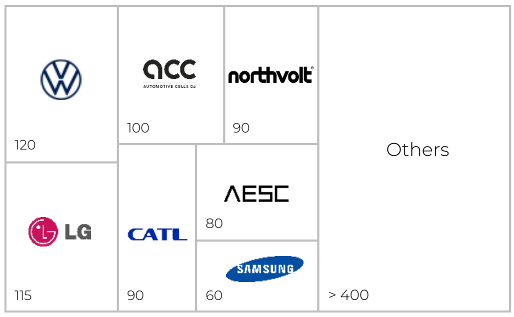
BATTERY PRODUCTION



Expected fulfillment probability of 2030 goal (560 GWh/a EU domestic production):



Largest EU cell producers and estimated capacities 2030 [GWh/a, challenged]



The stated EU cell production output of 560 GWh/a by 2027/2028 will likely be exceeded – only by the challenged ramp-ups of the most prominent players such as Volkswagen, LG and ACC.

Volkswagen publicly announced even higher target capacities of 240 GWh in six European gigafactories by 2030. However, with only Salzgitter (Germany) and Valencia (Spain) as confirmed sites, it remains open, which capacities will eventually be set up by 2030. Moreover, the April 2023 publicly announced Canada site indicates that serving the North American market has become a prioritised target. Implications on the overall EU expansion pace are yet unclear.

By adding several lines, LG focuses on expanding their Wroclaw (Poland) factory to 115 GWh. Currently, it provides 70 GWh output per year, making it already the most extensive current cell production in Europe.

ACC, as the player with the third-highest expected output for 2030, is backed up by Stellantis, Mercedes-Benz and Total Energies/Saft. Their first gigafactory in Douvrin (France) opened in June 2023, and the second site in Kaiserslautern (Germany) is currently under construction, with the expected start of production in 2025. Plans for a third factory in Termoli (Italy) have already been announced.

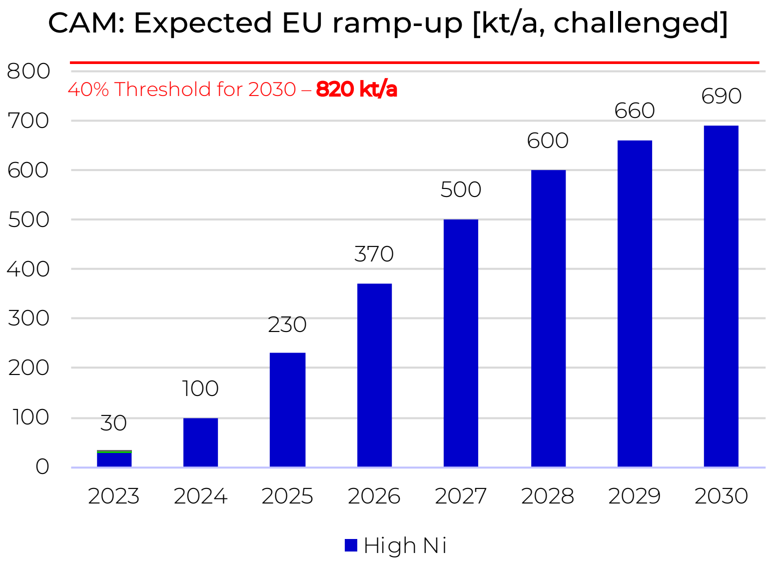
Further players such as CATL, Northvolt and AESC are expected to set up primary capacity volumes of > 80 GWh by 2030.

In the context of cathode cell chemistries, NMC-811 and NCA will continue leading the highvolume automotive cell market due to the aforementioned advantages in energy density and fast-charging capabilities. However, for safety reasons, sustainability, and cost factors, LFP/LMFP chemistries are expected to gain traction increasingly by the end of the decade and replace low nickel chemistries in the entry-level segment.

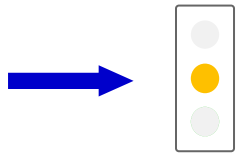
Given current announcements on the CAM side, the NZIA-targeted value of 820 kt production in 2030 still exceeds announced capacities, even considering potential site expansions and communicated ramp-up potentials.1) Furthermore, no large-scale LFP setup is in the concrete planning stages – all output is related to high nickel chemistries.

Currently, FREYR is actively engaged in a feasibility study to explore the production of LFP in collaboration with the Finnish Minerals Group. This initiative is based on licensing arrangements with the Taiwanese player Aleees. However, no concrete plans have been officially announced yet.

CATHODE ACTIVE MATERIAL (CAM) PRODUCTION



Expected fulfillment probability of 2030 goal (820 kt/a EU domestic production):



Largest EU CAM producers and estimated capacities 2030 [kt/a, challenged]

The current capacities mainly consist of initial post-commissioning outputs of Umicore's Nysa facility as well as Northvolt's and BASF's CAM factories in Skellefteå and Schwarzheide. All three began initial line production in 2023.

For 2025, EcoPro and the Easpring/SK joint venture announced that production will start with facilities in Hungary and Finland. Moreover, further Northvolt expansions, such as Northvolt Fem and Upstream 2, are expected to begin industrialised mass production.

The further depicted ramp-up towards 2030 is mainly driven by capacity expansion and further line commissioning of the stated facilities. Umicore (also in collaboration with PowerCo through Ionway joint venture) and Northvolt are expected to reach an output capacity of > 200 kt/a by the decade's end.

Non-linked capacities (marked as 'rest') belong to BASF and EV Metals Group. The latter acquired a former Johnson Matthey site with plans to produce 10 kt/a from 2025.

Further announcements have been made by players such as XTC New Energy Materials, who will set up a CAM factory in France together with the industrial group Orano. The planned start of production is 2026. However, no capacity announcements have been made so far. Another France-based project was announced by Axens and Hunan Changyuan Lico, who signed a Memorandum of Understanding (MoU) to establish a CAM factory of unknown capacity by 2027.

Additionally, both POSCO and Redwood Materials announced that they would pursue expansion plans in Europe and North America, but no concrete EU construction projects have yet been announced.

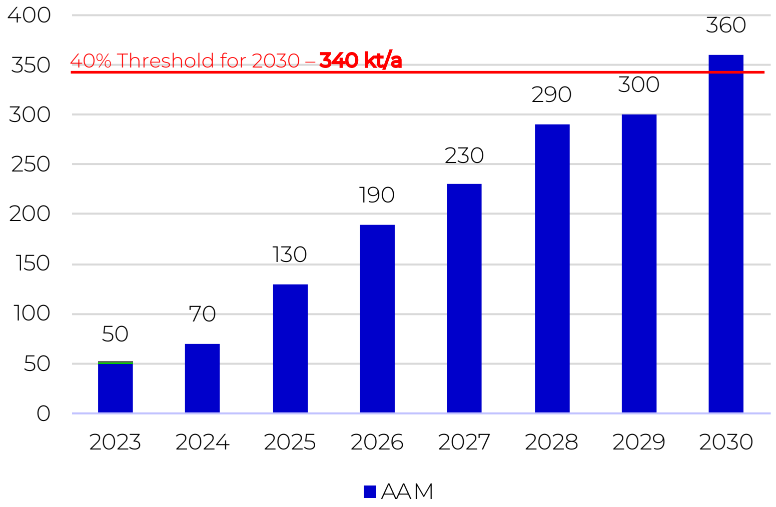
Overall, the expected and challenged production ramp-up based on the available capacity announcements will not be sufficient to fulfil the stated threshold value of 820 kt in 2030. **However, based on the mentioned additional projects, it remains realistic that the missing 130 kt/a will be covered by 2030**. Concrete announcements are expected for 2024 and 2025.

Despite the significant number of expected EU-domestic CAM capacities, challenges remain. Recent announcements of leading Chinese CAM producers to ensure IRA-compliant US supplies not from Europe but Morocco indicate that the EU still struggles to provide an attractive investment environment. The combination of high energy prices, administrative burdens, and unclear incentive structures poses a major challenge that requires attention.

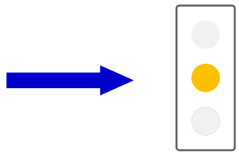
Regarding **anode** active material (AAM) production, the set coverage is expected to be reached around 2029/2030. A reliable distinction of ramp-up capacities between pure graphite and silicon-enriched AAM was not possible based on accessible public datasets.

CATHODE ACTIVE MATERIAL (CAM) PRODUCTION

AAM: Expected EU ramp-up [kt/a, challenged]



Expected fulfillment probability of 2030 goal (340 kt/a EU domestic production):



Largest EU AAM producers and estimated capacities 2030 [kt/a, challenged]

As for CAM producers, the timeline of the AAM production phases is defined by modular extensions.

The capacities in 2023 and 2024 stem from early test phases by graphite producers. Natural graphite players like MRC, Graphintec, Leading Edge Materials, and Talga aim to reach about 70 kt/a by 2024 due to their vertical integration efforts in Scandinavia.

Synthetic graphite producers Vianode and Superior Graphite plan a gradual capacity increase from 2025-2028, contributing roughly 70 kt/a alongside the rise in natural graphite production. Both natural and synthetic producers are expected to hit their maximum capacities by 2030, yielding a total AAM mass of approximately 270 kt/a. Limited data prevents estimating the production capacity of Graphite + Si anode active material by 2030.

Chinese graphite leader Putailai intends to produce an additional 100 kt/a of AAM in two 50 kt/a phases, starting construction in 2024 near Northvolt's gigafactory. This move strategically reduces CO2 emissions from AAM logistics and secures Putailai's position in the European battery market.

Although AAM sourcing has been so far reliant on China, and anode active material production in Europe is just at its start, the announced ambitious market entry and growth of graphite producers is expected to cause tight competition among the AAM manufacturers.

For 2030, anticipated AAM production capacities are projected to meet the 40% EU threshold by only a thin margin of 20 kt/a.

However, most candidates lack a history in AAM supply, and early adopters forming solid relationships with OEMs and cell manufacturers will likely survive. Ultimately, the proclaimed capacities are anticipated to fall short of complete realisation due to intense competition and projected market consolidations. It, therefore, remains to be seen whether sufficient capacities will be available to match the EU's 2030 goal.

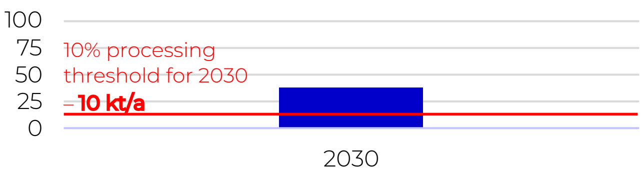
After the investigation of EU ramp-ups regarding battery cells, CAM and AAM and subsequent assessment of the 40% NZIA goal for each manufacturing process, the focus of the following chapter now shifts to the CRMA and its respective target value assessments for lithium and nickel.

Lithium and nickel: What is the anticipated capacity trajectory in relation to specified target levels?

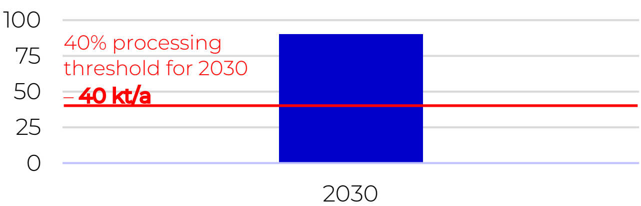
Coming from both AAM and CAM, industrialisation efforts further upstream are the baseline to provide sufficient battery materials. Previously stated 2030 CRMA target values for domestic extraction, processing, and recycling are the baseline the following segment assesses and matches against expected ramp-ups. For that, both lithium and nickel will be investigated. All values refer to elementary lithium and nickel as baselining calculation units (as referred to in the act's draft). Necessary unit transformations (e.g., calculation from Li hydroxide into Li) have been made. Recycling statements are derived from expected 2030 feedstock (EoL batteries and production scrap).

LITHIUM

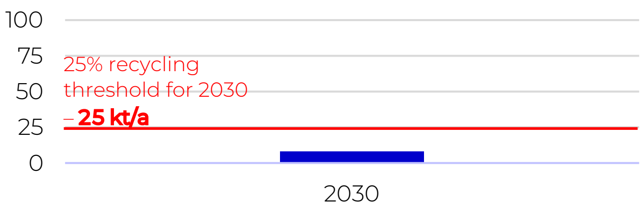
Expected extraction and processing capacity (combined processes) [kt/a][1)]



Expected processing capacity [kt/a][2)]



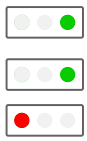
Expected availability of recycled lithium from EoL batteries and scrap [kt/a][3)]



Expected fulfillment probability extraction

Expected fulfillment probability processing

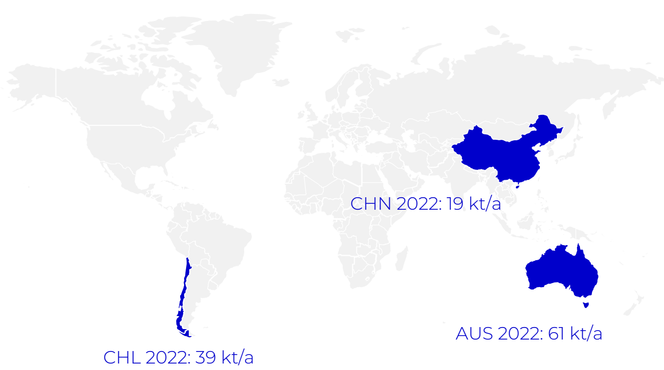
Expected fulfillment probability recycling



Major EU players with related announcements (extract):

Extraction & Processing	**Processing** of spodumene concentrate	**Recycling** of Li contents

Major countries in lithium export (2022)



Notes:
1) Extraction and processing into nickel sulphate included (based on announcements);
2) Only EU processing, extraction may also occur in non-EU countries;
3) Based on P3 estimated EU production scrap and EoL feedstock. Yield losses in recycling already included

Stated target values are estimated to be reached for extraction and processing. However, the anticipated achievement of recycling threshold values is expected to be hindered by the projected availability of this resource based on the estimated 2030 EU feedstock. Consequently, producing 25 kt/a of lithium from EoL and scrap feedstock can be assessed as highly unlikely.

Key lithium players on the European landscape can be divided into two different categories: The integrated players cover processes from geological-based material extraction until conversion in lithium hydroxide – the compound of lithium mainly required for the highnickel materials most prevalent in EU markets. Other players plan to acquire lithium spodumene concentrate or technical grade hydroxide to locally process it into battery-grade lithium hydroxide.

It is essential to state that the European lithium battery industry build-up is still in very early, primarily pilot-line stages, with technological hurdles still to overcome for mass production. Therefore, similar to AAM, it needs to be addressed that the proclaimed lithium capacities may fall short due to competition, technological developments and market consolidations.

Public announcements by local **extraction and processing** players such as Vulcan Energy, Keliber and European Metals lead to an expected capacity of over 30 kt/a for 2030, therefore covering the EU's extraction threshold of 10% (10 kt/a).

Regarding **pure processing** announcements into lithium hydroxide, the EU's goal of 40% (40 kt/a lithium equivalent) is assessed to be backed up as well. However, it is essential to mention that the stated values only refer to publicly announced production capacities. It remains to be seen whether all players will be able to secure sufficient spodumene concentrate at business-case-backed price structures.

All processing efforts combined (extraction and processing plus pure processing) are, therefore, already leading to an estimate of over 120 kt/a, surpassing the 40 kt/a threshold by factor 3.

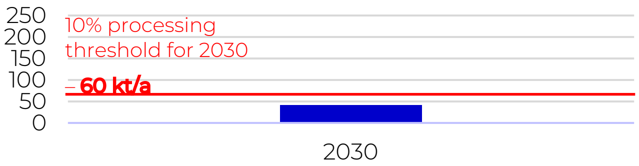
Despite the significant technical complexity accompanying lithium recycling, players like Redwood and Li-Cycle plan to expand their operations in the EU. With a focus on **recycling LIBs and cell scrap** (which accounts for over 80% of the expected feedstock), the availability of lithium produced out of recycled feedstock leads including yield losses to an anticipated volume of <10 kt/a lithium equivalent in 2030. Concerning the EU's 25 kt/a goal: The stated target value of 25 kt/a recycled lithium is assessed to be only achievable if additional production scrap and/or EoL batteries are being imported from third countries in significant volumes. That statement remains valid independent of potential sufficient recycling capacities (site capacities) in 2030.

Two developments will remain subsequently of interest towards the end of the decade: How will recycling capacities further develop, and how likely is it that despite local recycling rampups in Asia and North America, additional feedstock volumes will be imported to Europe? Countries like China have already legislated export bans on black mass (shredded battery scrap), and only recently, environmental and battery recycling organisations set up a letter to the EU stating that protective measures need to be taken from the EU as well.

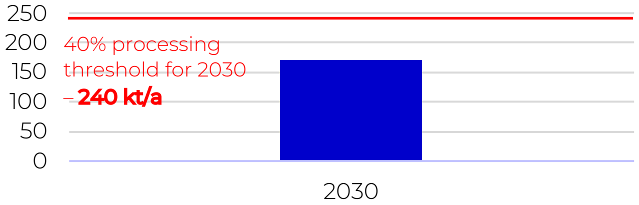
Australia and Chile are currently providing the majority of lithium. Considering the „**Third Country Criterion**", it is likely that Australia can position itself as a strategic partner. This probability is rooted in shared values and partnerships, given its status as a Western-oriented democracy with a robust European heritage and ties. That is expected to lead to increasingly attractive legislation of Australian lithium spodumene imports. Additionally, further imports can occur via Chile and China without being dependent on a single, non-strategic country. Therefore, the fulfilment of the so-called „Third Country Criterion“ can be assessed as realistic.

NICKEL

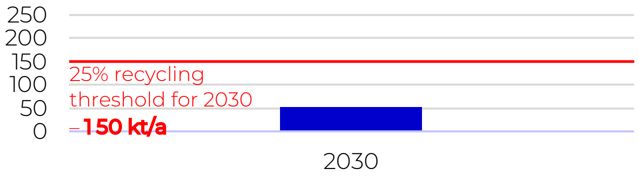
Expected extraction and processing capacity (combined processes) [kt/a][1)]



Expected processing capacity [kt/a][2)]



Expected availability of recycled nickel from EoL batteries and scrap [kt/a][3)]



Expected fulfillment probability extraction

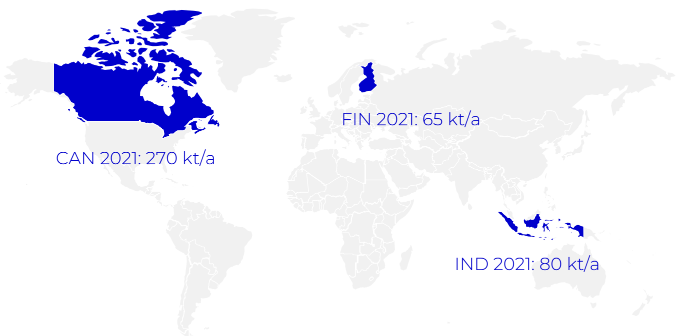
Expected fulfillment probability processing

Expected fulfillment probability recycling

Major EU players with related announcements (extract):

Extraction & Processing	Processing	Recycling of Ni contents
Terrafame	Nornickel, Umicore, Hellenic Minerals, Ege Kimya	Redwood Materials, Li-Cycle

Major countries in nickel matte export (2021)



All three target values are expected to be unmet for nickel according to announced and available capacities.

The European nickel landscape is mainly driven by two major, global-leading players, Nornickel and Terrafame. Both are fully integrated players providing both extraction and processing. However, only Terrafame pursues actual extraction efforts on European soil. Location-wise, Terrafame (owned by the Finnish Minerals Group) operates the Finnish Talvivaara nickel mine with nickel sulphate processing facilities in Sotkamo, eastern Finland and a yearly total battery-grade output of 40 kt/a of nickel equivalent in the form of nickel sulphate. Since another large-scale nickel mining project has not been announced, the threshold value of 60 kt/a for extraction will likely not be met in 2030.

Notes:
1) Extraction and processing into nickel sulphate included (based on announcements);
2) Only EU processing, extraction may also occur in non-EU countries;
3) Based on P3 estimated EU production scrap and EoL feedstock. Yield losses in recycling already included

Nornickel plays an active role in mining and processing, with mining operations in Russia and a nickel processing facility established in Harjavalta, Finland. Consequently, there is a noteworthy risk associated with nickel sourcing, given its Russian origin and the current strain in Western relations with Russia due to geopolitical conflicts. Nevertheless, an exemption from sanctions has been mandated due to the substantial reliance of the European tech and automotive sector on Nornickel's nickel supply. Anticipating a 100 kt/a output by 2030, the company is poised to maintain its position as the predominant nickel processor in Europe by a significant margin. Despite the expected combined output value of Terrafame and Nornickel surpassing 140 kt/a by 2030, the EU's targeted value of 240 kt/a appears far from realisation based on current declarations.

In the broader context, recycling enterprises like Redwood are committed to repurposing scrap batteries into materials suitable for fabricating new cells. With a focus on Nickel, two significant trends are unfolding: the rising prominence of nickel in cathode chemistries, driven by previously stated considerations of energy density and performance, and a requirement for downstream stakeholders, including cell producers and OEMs, to increase their recycled material content in line with sustainability objectives. Given the currently constrained nickel content in End-of-Life (EoL) feedstock, this dynamic presents a challenge for players engaged in circular processing, which is anticipated to expand only gradually. Furthermore, the predominant presence of lithium cobalt oxide (LCO) in additional recycling feedstock from consumer electronics restricts nickel extraction opportunities. Consequently, a notable competition for high-nickel cell scrap is foreseen throughout the decade.

If all anticipated EU feedstock for 2030 (EoL and scrap) is transformed into recycled nickel equivalent, the best-case scenario predicts a potential output of 50 kt/a. This figure falls significantly short of the CRMA target value of 150 kt/a. Given the intense global competition, particularly for nickel-containing scrap, it can be asserted that the established goal is highly likely to remain unfulfilled by 2030.

To cultivate global strategic partnerships, German Chancellor Olaf Scholz and Secretary of Economics Robert Habeck visited Canada in 2022, emphasising collaborative efforts in energy and materials. Within this diplomatic context, Volkswagen and Mercedes-Benz executed memoranda of understanding, signifying their commitment to advancing strategic collaboration with Canada, particularly in raw materials.

Furthermore, Volkswagen announced 2023 a collaborative initiative with Chinese Huayou Cobalt, Vale, Ford, and other key stakeholders to enhance the Indonesian battery ecosystem, explicitly focusing on nickel mining. Although proactive measures to diversify the supply chain are important, the potential impacts of Western-Chinese relations on this partnership network and the political implications originating from the involvement of Huayou Cobalt remain subjects of uncertainty.

Concerning the „Third Country Criterion“, the overall situation with an allied state acting as the world's leading supplier remains comparable to Lithium and principally in favour of Europe. Due to its robust economic and political ties with Europe, Canada will likely emerge as a strategic partner for the EU. Consequently, this dynamic serves to curtail the significance of the 65% target. Regardless, the collaborative efforts of Europe's domestic processing and extraction industry and the stakes held by local players in the Indonesian raw material operations are poised to establish a diversified supply structure. This strategic approach is designed to safeguard the attainment of the stated 65% target.

How does P3 assess both acts and what are the implications regarding the localisation of EU battery value chains?

NZIA & CRMA – GENERAL IMPACT ASSESSMENT

Can the envisioned acts generate a comparable transformative impact, offering robust incentives to propel the entire industry forward? What key elements might be lacking, especially when measured against the profound influence of the IRA?

Both acts share a common motivation — nurturing industry growth and reducing dependency on non-EU nations. The NZIA establishes a strategic vision, empowering decision-makers to expedite pertinent projects within the battery value chain. It signals solid political support for specific clean-tech industries due to the stated target values for 2030. Streamlining regulatory processes and establishing a single point of contact is crucial in addressing delays inherent in the intricate EU structures with varying levels of responsibilities. In terms of funding, the accelerated funding mechanism until 2025 and the potential to match aids provided by non-EU entities theoretically serve as a robust financial foundation.

The baselining concept of the act can be deemed as appropriate. However, in subsequent legislative iterations and detailing efforts of the act, it will also be imperative to address the following points. This is not merely to fortify the theoretical possibilities of the act but, more significantly, to execute industry support most effectively.

- **Ambiguous Incentive Structures**: A notable contrast with the IRA is that both the NZIA and the CRMA define target values but lack a clear depiction or elaboration on the path through concrete incentive models. In the U.S., investments benefit from significant and predictable tax credits outlined in national legislation and potential capital incentives from individual states. While substantial incentive volumes are available in the EU, crucial details such as structure, amount, and distribution over time remain unknown for potential investing companies. Moreover, lengthy application and permitting phases further contribute to the uncertainty, delaying the feasibility of initial cost assessments.

- **Refinement of Target Values and Concrete Steering Mechanisms**: The stated target values of 40% necessitate additional specifications to align them with the specific ramp-up curves of each respective sector. For instance, concerning battery cell production, the value implies that no further industry support is required until 2030. In the case of CAM and AAM, the target values appear more fitting, offering a realistic yet optimistic outlook for 2030. However, the act lacks detailed mention of steering mechanisms that would depend on the estimated probability of target fulfilment. These steering mechanisms are crucial because various measures should be implemented depending on the anticipated readiness of a particular industry to meet the targets.

- **High energy prices:** Operational costs are the foundation for every business case beyond capital expenditures. Industrial electricity prices in the U.S. are less than 0.1 € per kWh, a stark contrast to the EU average, which surpasses twice that value. Tackling the challenge of high energy prices becomes critical for businesses operating within the EU context.

- **Bureaucracy and varying legislation between member states**: Streamlining bureaucracy is imperative to eliminate reporting obligations and uncertainties for investors within the member state regulations, such as in construction, engineering, and the broader industrialisation process. Harmonising tax models facilitates the comparison of business cases, making the playing field more accessible and transparent.

- **Non-success approach**: The EU should contact players who actively decided against a European investment to develop legislation further and provide well-balanced investment environments. That measure could contribute to constantly focusing on strategic topics with significant influences.

The **CRMA, on the other hand**, considers industrialisation efforts and targets as well but emphasises more material and supply chain security. With a clear focus on bolstering the EU's self-sufficiency, the CRMA aims to reduce dependencies on foreign countries. Generally, its goals for extraction, processing, and recycling of critical materials by 2030 underscore a commitment to securing the vital supply chain. Establishing regulatory coordination bodies should further enhance governance and foster a coherent European strategy.

The previously mentioned improvement points regarding **incentive structures, target refinements and steering mechanisms** apply to the extraction, processing and recycling goals since the baselining aim is to support and strengthen local, industrialised setups. However, there are additional points that should be considered within the act:

- **Black mass protection**: As the available local feedstock for 2030 is assessed as insufficient for covering the EU's needs, it is vital to ensure export control measures to prevent unregulated loss of black mass and to secure all the available material from scrap and EoL batteries.

- **Stronger focus on planned detailing of international agreements**: The act's pursuit of an import substitution strategy falls short in addressing the fundamental challenge. Europe's predominantly indirect exposure to bottlenecks in critical raw materials through global supply chains cannot be adequately resolved mainly through domestic mining and refining efforts. The legislation lacks sufficient details regarding international partnerships and their implications for specific objectives. The specifics remain unclear, although references are made to a raw materials club and partnerships.

Generally, the legislation's primary weakness lies in the insufficient detail concerning incentive structures and mechanisms for target steering and adaptation. The final form of the act is yet to be determined, and it lacks the precise and reliable statements found in the IRA. Given the greater political power of EU member states compared to the U.S., the interplay between the Union and states introduces uncertainty regarding its impact on permitting regulations and the potential for further details in the acts.

ESTIMATED IMPLICATIONS FOR EU BATTERY VALUE CHAIN RAMP-UP

Anticipated 2030 domestic **battery** production targets are poised for attainment, driven by substantial capacity announcements from major players. Projections indicate a near doubling of the planned 2030 target capacity.

The expected production ramp-up for CAM faces challenges to meet the threshold, but new projects could bridge the gap by 2030. Concrete announcements are anticipated in 2024 and 2025. Despite numerous anticipated EU CAM capacities, challenges persist, including the EU's struggle to attract investment and address issues like high energy prices and administrative complexities.

Despite **AAM** sourcing traditionally relying on China and European production in its early stages, the ambitious entry of graphite producers is set to heighten competition. Projections for 2030 suggest that AAM capacities may meet the EU threshold by a slim margin. However, lacking AAM supply experience, most contenders will likely face challenges. The declared capacities are expected to fall short due to intense competition and market consolidations, leaving uncertainty about meeting the EU's 2030 goal.

Achieving the EU's **lithium** extraction and processing targets appears promising, with numerous announced projects, yet many involved lack industrialised production experience. However, recycling threshold values face significant challenges due to projected resource limitations, making the feasibility of producing sufficient lithium from End-of-Life and scrap feedstock highly unlikely. Australia's strategic partnership under the 'Third Country Criterion,'along with imports from Chile and China, enhances strategic diversity, making fulfilment of this criterion realistic.

The attainment of EU benchmarks for **nickel** extraction and processing faces uncertainty primarily due to existing constraints in known production capacities. A limited number of entities influence the European nickel market, introducing geopolitical risks to the landscape. Despite an increasing cumulative output, achieving the envisioned EU threshold appears doubtful. Challenges emerge in circular processing, particularly in providing sufficient nickel from feedstock. Anticipated is heightened competition for especially highnickel cell scrap.

Considering an overarching perspective of the EU market, it becomes evident that Europe is a pivotal localisation cluster, particularly within the battery value chain. Given the continent's robust automotive heritage and the escalating relevance of reducing CO2 footprints, recent years have witnessed a surge in localisation efforts propelled by both expanding Asian enterprises and companies rooted in the EU.

The trajectory of the scrutinised value chain segments demonstrates a clear upward trend, marked by various announcements and ongoing construction endeavours. As a result, the open question is not whether the EU can establish a localised value chain but rather the strength and speed of this ascending ramp-up trajectory - especially when juxtaposed with the US, which is currently in a comparable battery industrialisation phase.

In response to the IRA, the EU opted for a distinct approach, aiming to bolster local next-gen technology value creation. Emphasising its firm adherence to the World Trade Organization (WTO) principles, the EU underscored free trade as a fundamental pillar of any forthcoming legislation. Consequently, fixed rates for localised content and excluding sourcing countries were not entertained as part of the European IRA response.

With legally binding localisation requirements removed from the equation, the focal point shifts towards creating appealing investment environments. However, a notable drawback of the current drafts is the absence of specifics regarding incentive structures, overarching timelines, and application processes. Looking ahead to 2030, the window for announcements and construction starts closes by 2026, at the latest 2027.

The primary shortcoming lies in the lack of empowerment for companies to execute detailed business-case planning swiftly. P3 observes a multitude of customers across the value chain contemplating the establishment of European operations and gigafactories. When these entities draw comparisons to the US situation, they consistently highlight the intricate, timeconsuming application process, often taking years until confirmation on the magnitude of incentives is provided.

Various tools, methods, and approaches are proposed, including the prospect for companies to align aids with those granted by non-EU players. Since both acts are slated for legislation by early 2024, the question arises whether planned measures, such as establishing a predictable and simplified regulatory environment, will materialise promptly into tangible, practical actions.

Consequently, the effectiveness of the planned legislation in addressing the outlined concerns within the specified window of opportunity remains highly uncertain. It is firmly asserted that every part of the battery value chain will eventually find coverage in the EU. As mentioned, the broad EU localisation is a given and inevitable. However, the swiftness and strength with which the EU can furnish attractive investment environments are yet to be determined. The speed of execution emerges as the pivotal aspect for the near future.

The overarching motivation to foster EU industrialisation is commendable, and legislative frameworks were imperative, especially after the establishment of the IRA. While the trajectory of the value chain is expected to ascend eventually, more immediate impact and responses to pressing questions could have been expedited.

As the discussion unfolds, lingering questions will persist, providing the foundation for discourse in future years.

Localisation, foreign sourcing and environmental targets - What degree of EU localisation is practical to empower local players, meet CO2 targets, and concurrently maintain cost competitiveness?

Achieving a complete 100% coverage of all necessary upstream materials proves unrealistic due to geological raw material availabilities, environmental protection laws influencing mining practices, and the imperative need for cost sensitivities. It is crucial to remember that batteries manufactured in the EU must remain competitive on a global market scale. Navigating the equilibrium between environmental protection, raw material extraction, and competitive pricing becomes paramount. Diverse stakeholders, ranging from environmental NGOs to governments and companies across the battery value chain, must collaboratively forge a consensus on how Europe should position itself amidst the tension between local extraction, environmental protection, and foreign dependencies.

Speed of implementation – how swiftly can the EU execute the proposed measures, and how tangible will they be?

To conclude with the most critical question, it remains to be seen how fast stated action items will be transferred into reality and how detailed further elaborations and specifications of the act will be set up. How much time will it take to, e.g., shorten permitting procedures and provide clarity regarding exact funding opportunities with member states and EU level being involved? As stated, the required time window for the anticipated 2030 build-up is still open but closes in the foreseeable future.

Battery recycling – to what extent is the EU willing to break with their free trade approach to secure black mass as a baseline for all local recycling operations?

As highlighted earlier, the competition for high-nickel feedstock is anticipated to intensify among numerous industry players. A critical consideration for establishing a foundation of recycling operations by 2030 is the imperative need for measures preventing the export of black mass to the US or China and instead promoting local recycling. The extent to which the EU is prepared to advance in imposing export restrictions remains uncertain and is a crucial aspect yet to be determined.

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About P3:
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