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Policy Brief

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Reducing the carbon footprint of battery materials - a case of problem shifting?

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Summary

The scale and speed of electrification is creating pressure on selected global supply chains for battery raw materials. Nickel is one of these critical materials that are found in most battery chemistries currently on the market. Ramping up mining and refining capacities for nickel requires time and large investments. Hence, processing routes that are relatively fast to scale up are likely to be preferred over more environmentally friendly alternatives. One-sided regulations that incentivize low carbon footprint of batteries while neglecting to address other nickel applications are likely to have a negligible impact on overall carbon emissions because they result in problem shifts to other industrial sectors such as stainless steel production.

Rise in battery demand triggers rapid rise in nickel demand

The European Union will in the course of 2023 ratify its new and comprehensive Battery Regulation. European battery production is also set to expand significantly. From 2027, the Battery Regulation will set maximum threshold levels of carbon emissions (and all batteries placed on the European market will be classified into higher or lower carbon emission performance categories. The carbon footprint of batteries will be calculated for the full life cycle – meaning emission levels at mining and refining stages will form part of the calculation. One likely effect of this regulation will be increased scrutiny placed on battery materials that cause high CO2 emissions.

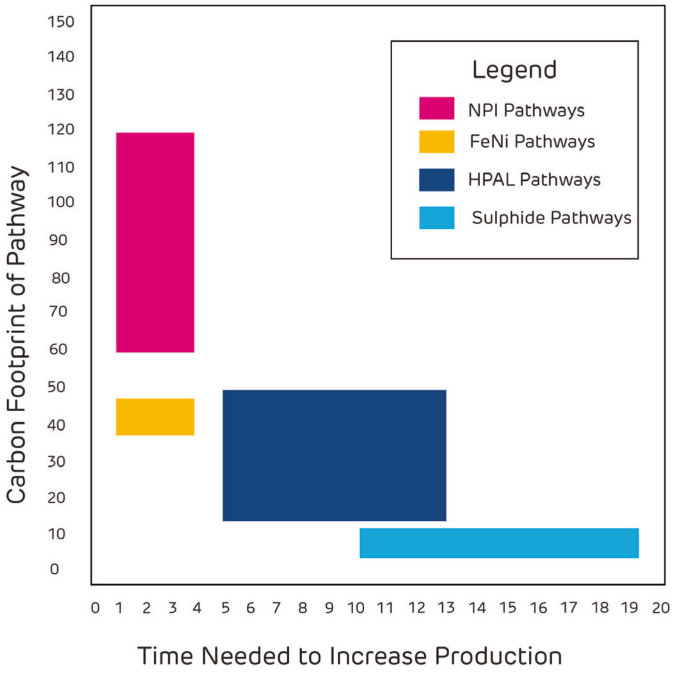
Nickel is one key battery material that has high emission levels at both mining and refining stages. The processing routes for nickel are very diverse and depend largely on the type of ore (sulphidic or lateritic) that is processed. There are several ways to obtain battery-grade nickel sulphate needed for lithium-ion (Li-ion) batteries. The sulphidic processing routes tend to have significantly lower carbon emissions, especially compared to the lateritic route that smelts nickel pig iron (NPI), which emits about ten times more CO2 per ton of nickel. However, expanding capacity for NPI smelting is faster and easier – it is less capital intensive and uses simpler technology – than sulphide ore processing routes, which require large investments and are slower to build up.

European and global battery production will include a range of battery chemistries, but high nickel content batteries are likely to be key. Nickel can in some battery chemistries help to reduce the need for cobalt and has the advantage of increasing the driving ranges of EVs. Given the stringent carbon footprint requirement for batteries that are to be placed on the European market, we will likely see a preference for nickel from sulphidic processing routes in the production of nickel-containing batteries. We expect that the fast increase in demand of battery-grade nickel will require a quick upscaling of production capacity. Still, due to the advantages that NPI smelting has over sulphide ore processing, there is a danger that a rapid expansion in nickel production primarily comes through NPI – causing overly high CO2 emissions. European manufacturers may be forced to use "clean" nickel while the increasing amounts of "dirty" nickel are likely to be channelled to less regulated sectors such as stainless steel or used for the production of EV batteries sold outside of the EU.

Nickel production patways

Figure 1 illustrates this challenge by comparing the typical carbon footprint and time needed to develop new production capacities for different battery-grade nickel production pathways. NPI smelting pathways have the highest carbon footprint but are also among the fastest to deploy, while sulphide pathways have the lowest carbon footprint but typically require more than 10 years for building new capacities. Ferro-nickel (FeNi) pathways could be a lower footprint alternative to NPI smelting as their production can also be ramped up quickly. However, the properties of FeNi make it more suited to produce stainless steel, so using FeNi to produce nickel sulphate for batteries is not ideal in a systemic perspective.

Figure 1



Can problem shifts be avoided?

Overall, our analysis indicates that ideally, the scope of regulations should encompass entire material cycles and not just one particular value chain, such as batteries. Targeted policies, even if ambitious, risk triggering problem shifts of the kind illustrated above.

Reducing overall carbon emissions could be achieved more effectively through other interventions:

- Encourage the rapid development of sulphide nickel mining. Sulphidic ore deposits are mostly located in Northern countries, where social acceptance of mining is a major issue slowing down new projects. This is an opportunity to develop a framework for responsible mining that limits future impacts on the local environment and populations.
- Collaborate with countries where problem shifts may be a key issue. Indonesia or the Philippines are key countries that may see a relative expansion of NPI production processes as the global demand for nickel increases. These are countries that have well-established relations with actors such as the EU and Norway. Targeted collaboration on NPI smelting through technology transfers or investments in green electricity production could be one important measure that could bolster relations as well as help reach important climate targets.
- Recognise that the case for further developing access to renewable energy in areas where we may see an expansion of NPI smelting should be seen as exceptionally strong.
- Work towards further advancement of techniques for carbon capture and storage (CCS) in NPI smelting. Increased research funding, including funding from European sources, could be earmarked for these purposes

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This policy brief draws on insights generated by the three-year research project BATMAN (Lithium ion BATteries - Norwegian opportunities within sustainable end-of-life MANagement, reuse and new material streams) which has been jointly conducted by NTNU, IFE, UiA, TØI, Hydro, Elkem, Eyde Cluster, Glencore Nikkelverk, Agder Energi, and Fiven. These research partners have mapped emerging battery chemistries and the evolution of the European EV-fleet. They have assessed issues such as how we may balance reuse vs recycling of batteries, bottlenecks in supply of battery materials and possible increases in carbon emissions. The project has also analysed how new regulatory and policy directions may shape the sector, for example through carbon leakage, technology lock-ins, or other problem shifts.

Sources

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