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Policy Brief

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Lithium in the EV battery expansion: How bad is the supply constraint?

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Summary

Our model of the global lithium supply and demand has shown that the expansion of lithium mining will likely not be able to keep up with the rise in demand in the coming decade. This supply constraint could limit the speed and scale of the electric mobility transition in the coming years and therefore threaten climate targets. This policy brief suggests that during this temporal supply bottleneck, climate targets may be addressed effectively with more forceful demand-side interventions – a mobility transition based on fewer or smaller cars and with smaller batteries including non-lithium-based technologies. In the longer term, the electric transition will require breakthroughs in battery research and recycling practices. Mining also needs to be expanded, but this will necessitate much higher levels of social acceptance of mining in both high- and low-income countries.

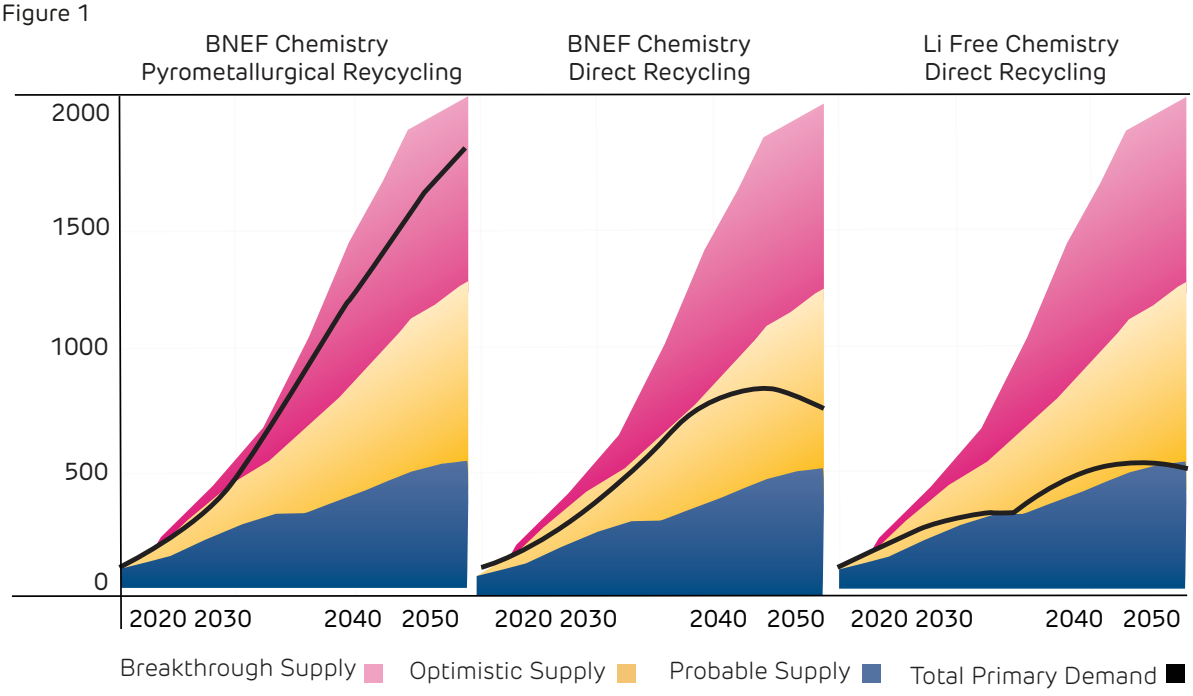
A foretold supply crunch

The BATMAN project has calculated a range of probable supply scenarios based on an assessment of known deposits and projects. These supply scenarios were then compared with future scenarios for lithium demand and recycling. In the first scenario in figure 1, we see that a continuation of current demand trends and recycling practices will lead to a demand for lithium that can only be met in highly optimistic supply scenarios, requiring major technological breakthroughs and unprecedented social acceptance for new mining projects.

In the second scenario, we map out a situation where current recycling processes (which do not recover lithium) are replaced by direct recycling. The increased recovery of lithium reduces the primary lithium demand in the long term. However, due to the fast increase in demand and the relatively long lifetimes of cars and batteries, there will not be enough recycled lithium to cover a significant share of the demand in the coming period.

In the third scenario, we model a progressive replacement of current lithium-ion (Li-ion) batteries by lithium free chemistries, such as sodium-based batteries or hydrogen fuel cells, making up 50% of the market by 2035. The resulting decrease in lithium demand makes it more compatible with realistic long-term levels of supply. However, lithium is expected to remain the dominant technology for at least the next 10 years. Furthermore, other promising new battery technologies such as lithium-air (Li-air) and lithium-sulfur (Li-S) will lead to an even higher increase of lithium demand compared to current technologies as they contain more lithium per kWh.

Figure 1



Policy implications

The transition to electric vehicles currently depends on a stable and affordable supply of lithium. Next generation technologies such as solid-state batteries not only fail to address potential supply bottlenecks of lithium but may worsen the situation since they often have a higher lithium content. Moreover, from a European perspective, China, and to some extent the US, have a more privileged position in lithium supply chain due to more extensive ownership of mining and refining capacities.

Moving forward, policymakers may consider the following options:

- Facilitate and finance more battery research, with innovations geared towards breakthroughs in battery chemistries and recycling practices. We need a broader range of alternative chemistries to avoid future shortages.
- Recognise that supporting sodium-ion batteries and hydrogen fuel cell vehicles may also play a key role in ensuring the electrification of vehicle fleets.
- Step up the development of new mining initiatives in Europe and beyond. This needs to be accompanied by a greatly expanded ambition for sustainable mining. Currently, the social acceptance of mining in both high- and low-income countries remains a profound challenge.
- Initiate more forceful demand-side interventions – envision a mobility transition based on fewer or smaller cars and with smaller batteries.

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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.

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