



# SHAPING THE CIRCULAR FUTURE OF E-MOBILITY

Electric mobility – powered by renewable energy and in combination with circular economy concepts – plays a decisive role in the transition to a climate-friendly society. Cathode active materials (CAM) are key to making e-mobility a practical reality for everyone. By 2025, BASF's innovations in battery materials aim to double the driving range of midsize cars, from 300 to 600 km, on a single charge and reduce the charging time to 15 minutes. At the same time, BASF is contributing to a circular value chain by providing efficient recycling technologies to regain valuable metals used in batteries for electric vehicles (EVs).

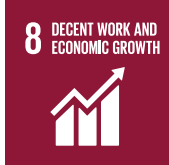


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In 2018, BASF announced the construction of a battery materials precursor plant in Harjavalta, Finland. The plant is being constructed adjacent to the nickel and cobalt refinery owned by Norilsk Nickel (Nornickel), with whom BASF has a long-

term supply agreement for nickel and cobalt feedstocks. It will utilize locally generated renewable energy sources, including hydro-, wind-, and biomass-based power. The precursors of the cathode active materials (PCAM) from the Harjavalta

plant will be used in BASF's new battery materials production site in Schwarzhede, Germany. The new plant is part of a multi-step investment plan to support the European EV value chain. This state-of-the-art plant will produce CAM



with an initial capacity that enables the supply of around 400,000 full EVs per year with BASF battery materials stemming exclusively from European sources. The Schwarzheide plant's modular design and infrastructure will allow for the rapid scale-up of manufacturing capacities, enabling BASF to meet increasing customer demand for the European EV market. The start-up dates for the two plants in Finland and Germany are planned for 2022. These European plants will complement existing facilities in Asia and North America, making BASF the first CAM producer with a local presence that serves customers in three key regions.

BASF's sustainability strategy and targeted investments are aligned with the objectives of the European Green Deal. We will contribute to a competitive circular value chain for e-mobility and, in particular, batteries. The New Circular Action Plan – with sound implementation of the “strategy for a sustainable and smart mobility,” including battery regulation – is key for a regulatory environment that fosters European economic growth and balances the environmental footprint.

As a producer of CAM for electric vehicles, BASF is already looking into the use of recycled raw materials in its production, thereby closing the loop in the battery value chain. We provide proprietary recycling technology to significantly increase extraction efficiency, which complements our CAM portfolio for lithium-ion batteries. Our innovations in recycling processes enable high-efficiency lithium extraction. Due to the relatively high scrap rates in the manufacturing processes along the battery value chain for EVs, sizable quantities of recyclable materials are available even today. We expect a scale-up of the global EV market in the coming years when large amounts of batteries reach the end of their lifecycles, making recycling an important market requirement. In this context, one major advantage of battery materials recycling is that it complements the sourcing of virgin metals from mining. A closed loop for battery materials keeps them in the

use phase for a longer period and reduces the waste of precious resources at the end of the battery's life. What is most important in terms of climate protection: Recycled batteries have a lower carbon footprint compared to those made of primary raw materials.

Together with its partners, BASF has taken concrete steps toward developing innovative and sustainable battery recycling. One step is the development of new lithium-ion battery recycling capabilities. This will make it possible to respond to the strong growth in this global market over the coming years and to secure the supply of raw materials required for this energy transition. In early 2020, BASF signed a cooperation agreement with the partners Fortum and Nornickel to plan a battery recycling cluster in Harjavalta, Finland. This would enable a successful closed loop cycle to reuse the critical metals present in used batteries. BASF is focused on bringing solutions concerning high-efficiency lithium extraction for battery recycling within this cooperation. It intends to use recycled materials from the processes developed by the companies in its planned battery materials precursor plant in Harjavalta. Using metals from recycled batteries to produce battery materials offers significant reductions in CO<sub>2</sub> during the production of EVs. Additional CO<sub>2</sub> reductions can be achieved by using electricity from renewable sources in Finland for the recycling process. The establishment of a circular value chain further contributes to BASF's ambitious sustainability target to achieve CO<sub>2</sub>-neutral growth until 2030.

In addition, BASF is partnering with Eramet and SUEZ in the “Recycling Li-ion batteries for electric Vehicles” (ReLieVe) project, which will receive substantial funding of €4.7 million from EIT Raw Materials (European Institute of Innovation and Technology), a consortium initiated and funded by the European Union, and the three members. The objective is to develop an innovative, closed-loop process to recycle lithium-ion batteries from EVs and to enable the

production of new lithium-ion batteries in Europe. As of January 2020, and over a two-year period, the ReLieVe project will carry out a series of activities for the large-scale development of this innovative process and the structuring of an integrated industrial sector: from the collection and dismantling of end-of-life batteries going into recycling, all the way to the manufacturing of new electrode materials. BASF will contribute to the project with expertise in cathode material production. The virtuous recycling process meets the essential challenges of sustainable performance through its savings on raw materials.

BASF and its partners are preparing for the battery materials recycling market scale-up by increasing recycling yields and building an integrated value circle.

BASF is also actively involved in the World Economic Forum's Global Battery Alliance (GBA), which it cofounded in 2017. The GBA has around 70 members, all of whom are committed to creating a socially responsible, ecological, economically sustainable, and innovative value chain for batteries. The GBA is committed to fostering a circular approach to batteries, including their design and the use of recycled materials to drive greenhouse gas reductions. This commitment would be based on a wide range of considerations, including performance safety, longevity, material efficiency, safe and easy disassembly, a design based on lifecycle analysis, and on state-of-the-art technologies. It also embraces the use of recycled materials to drive market support for economically viable circular material flows, when available and appropriate. ■

