Scaling up battery production drives down carbon emissions significantly

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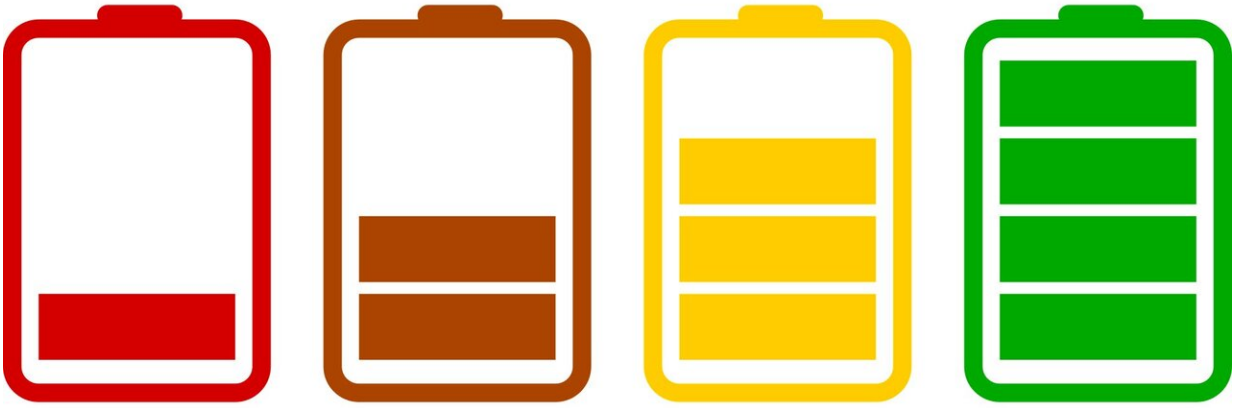

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A common criticism of electric vehicle production is the high carbon emissions from battery production. But new research from Chalmers University of Technology in Sweden shows how scaling up production through enormous "gigafactories" can cut the environmental impact significantly, compared to small-scale industrial production. And when the energy used to power the factories comes from green sources, the emissions can be reduced to roughly one quarter of emissions in results

presented a few years back.

The largest environmental impacts in electric vehicle manufacturing usually result from the production of batteries. Over the last decade, substantial research has been dedicated to analyzing battery production processes to identify the steps with the highest impacts. But earlier data for such analysis has usually been derived from small-scale production facilities, or even pilot projects.

"Today, however, global battery production capacity is scaling up massively, with gigawatt facilities being commissioned and constructed—and there is little research or data that analyzes how this will affect emissions. A lot of research is still published that relies on older data sources stemming mostly from small-scale battery production, thereby skewing the understanding of the environmental impacts," explains Mudit Chordia, doctoral student at the Department of Technology Management and Economics at Chalmers University of Technology, and lead author of the new study.

To rectify this, the researchers used a life cycle assessment to remodel a commonly cited study relating to small scale production and combined it with updated data more representative of the most modern and state-of-the-art upcoming production facilities.

"Our results revealed how upscaling battery production from megawatt to the gigawatt level yields significant reductions in energy usage per kilowatt hour of battery-storage capacity produced—up to 58%. The efficiency gains of large-scale production are highly significant," continues Chordia.

When adjusting for different scenarios relating to the energy supply for such factories, even in the most carbon-intensive case (based on South Korea) the researchers observe an emissions reduction of nearly 45%. In

addition, if the energy is supplied from low carbon-intensity sources, the emissions reduce by a further 55%. If regions with low carbon electricity supplies—such as northern Sweden, where construction of Europe's largest battery factory is currently underway—are selected for the launch of battery production at giga-scale, the potential is very good for producing batteries with lowest possible environmental footprint.

Access to data a challenge

Another important observation from the study is that with large-scale production, a greater proportion of the impacts shift further up the supply chain, to the raw material extraction and processing phases. A challenge to the researchers' work was getting access to the relevant data to model the processes and accurately analyze the impacts.

"In the course of our work, we found that life cycle assessment datasets often used for some of the battery raw materials lack the coverage and precision necessary for modeling the high grade of material quality required in battery production. The supply chains for manufacturing are usually considered trade secrets, making it very challenging to collect data and to conduct a full analysis representative for all types of actors," explains Anders Nordelöf, researcher at Chalmers University of Technology and co-author of the study.

"For further reductions of the environmental impacts from battery production, the manufacturers and wider battery industry need to make a focused effort on procuring raw materials from low-carbon intensity mineral extraction. But in such a competitive industry, this will remain a challenge for many actors."

More information: Mudit Chordia et al, Environmental life cycle implications of upscaling lithium-ion battery production, *The International Journal of Life Cycle Assessment* (2021). DOI:

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