



Charging Ahead: Moving Toward the Net-zero Mine

To decarbonize the production of minerals and metals, collaborative efforts around mine electrification must extend beyond the big players to include smaller mine and quarry operators too

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There is a growing sense of urgency around the need to decarbonize mining operations, and the conversation is now at the forefront of C-suite concerns.

According to McKinsey & Co., mining accounts for up to 7% of global scope 1 and 2 greenhouse gas (GHG) emissions and a reduction of 50% from 2010 levels until 2050 is necessary to stay on track for a global 2°C scenario. For a 1.5°C scenario, these levels need to be reduced by at least 85%¹. These targets are ambitious and require decisive and collaborative action across the industry and along the value chain.

With diesel-powered vehicles accounting for anywhere between 30% and 80% of direct emissions², varying with site geography, commodity, and mine design, switching to electric-powered mobile equipment constitutes an attractive option, and seemingly low-hanging fruit for decarbonisation.

It's not surprising then that a large focus for major mining companies has been and is to replace diesel-powered mobile machines with electric and battery-electric vehicles (BEVs). For example, BHP recently announced it will replace 160 haul trucks with those equipped with Caterpillar's new electric drive technology and other low/zero-emission powertrain trucks at its Escondida mine in Chile by 2023. Scandinavian mid-tier miner, Boliden, has installed trolley assist technology at two of its operations and is targeting the installation of 27 diesel-electric trolley-assisted haul trucks by 2023. In addition, initiatives such as the Blu-Vein project or Volvo's TARA solution are looking into advancing the efficiency of BEVs as well as overcoming the challenges around frequent battery charging.

While the public eye is often focused on the actions of large multinational mining companies and, while these companies do have a large share in the

global production of many critical minerals, the decarbonization of metals and minerals also requires solutions for medium and smaller sized operators, as well as those in the quarrying sector.

In Germany alone, 550 million tons (Mt) of sand, gravel and natural stones were extracted by around 2,700 medium-sized and small enterprises in 2018. Currently, a significant portion of the energy input is attributed to internal transport, mostly realized by diesel-powered vehicles. However, as is the case for larger operations, it's usually insufficient or impossible to simply replace these machines with electrified or battery electric models as the operational processes and infrastructure must be adapted as well.

Piloting Solutions for SMEs: The ELMAR Project

In order to support medium and small-sized operations with their transition towards electrification and decarbonization, the ELMAR project, bringing together a consortium of OEMs, mine operators, technology providers and academia and being funded by the German Federal Ministry of Economy and Climate Action, was launched in summer 2022.

The ELMAR consortium comprises two institutes of RWTH Aachen University - the Institute for Advanced Mining Technologies (AMT) and the Institute for Power Electronics and Electrical Drives (ISEA). Volvo Group Trucks Central Europe GmbH, Volvo Construction Equipment Germany GmbH, Volvo Autonomous Solutions AB (commissioned by VCE Germany GmbH) are providing their expertise as equipment and vehicle manufacturers and automation providers. Meanwhile, Mineral Baustoffe GmbH and Knauf Gips KG represent mine operators, PSI Fuzzy Logik & Neuro Systeme GmbH, PSI Software AG as cloud solution providers, and TITUS Research GmbH as a developer of autonomous monitoring systems.

Taking a holistic approach, the project will not only include BEVs and the transformation of two very different SME operations, but also consider energy demand and energy supply as well as the optimization on both sides in combination with production constraints.

With respect to implementing BEVs, the consortium targets their autonomous operation, opening



ELMAR will not only consider the implementation of battery-electric vehicles and the transformation of two small-mid sized mining operations, but also energy demand, supply and optimization alongside production constraints. (Photo: Martin Braun Photography)

¹ www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-decarbonization-what-every-mining-ceo-needs-to-know.

² www.icmm.com/en-gb/case-studies/2022/innovation/accelerating-implementation-of-zero-emission-vehicles.



As part of ELMAR's scope of work, the mine plans will be optimized for energy utilization based on connecting an operation-specific deposit model with the energy demand forecast. (Photo: Martin Braun Photography)

the opportunity to use more, but smaller BEVs with a better ratio between the tare weight and payload to increase efficiency. Consequently, as part of the project, novel mobile machines that are smaller, lighter (and thus more energy efficient and better suited to electrification) will be integrated and demonstrated to improve the business case of electric vehicles.

As Dr. Tobias Hartmann of the AMT at RWTH Aachen University and coordinator of the ELMAR project, explains: "We will retrofit the transport approach at operations, rather than retrofitting batteries into existing machines."

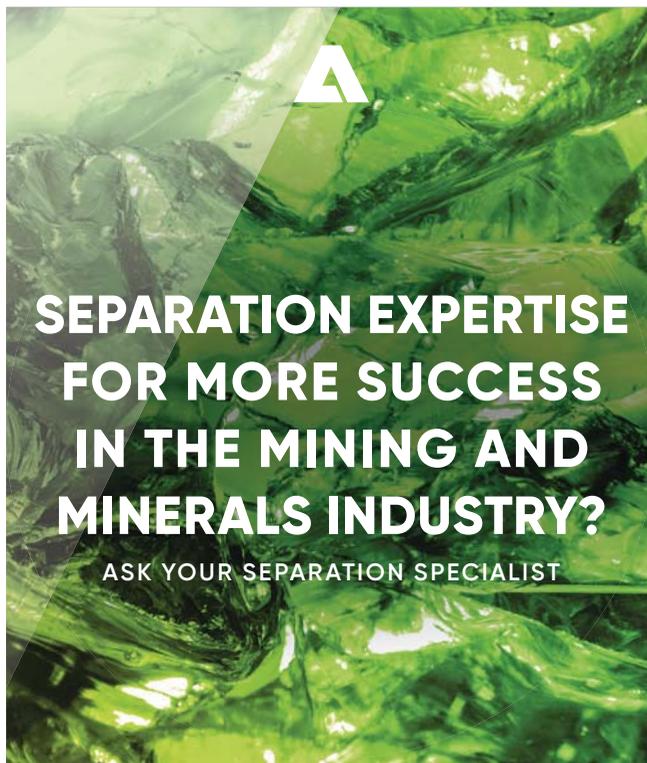
Furthermore, the mine plan will then be optimized for energy utilization based on connecting an operation-specific deposit model with the energy demand forecast. Options for integrating renewable energy sources will be evaluated and included in the mine redesign. The development of appropriate modelling approaches constitutes an important part of the project. These models will be data driven and include a cloud solution for data processing and storage as well as an interface to plan and run production based on the optimization.

It's this coupling of energy and data and its integration into the process, which makes the ELMAR project unique and a potential landmark in pushing electrification and decarbonisation in the SME mining sector.

Over the course of the project, demonstrations of automated BEVs are envisioned at brownfield operations across Germany. Lessons learned will result in a transformational concept for decisions around the transition to BEVs, along with recommendations for small to medium-sized mine sites which will also be adapted to a greenfield project.

There is a clear ambition across the industry to realize the zero-emission mine. Multinational mining corporations are focusing on the implementation of BEVs as a first and important step. While the technology challenges are still being addressed and solutions tested and piloted, the need for a holistic approach to energy sourcing and management is becoming center stage in decarbonization efforts.

To learn more visit: www.amt.rwth-aachen.de/en/elmar.html.



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