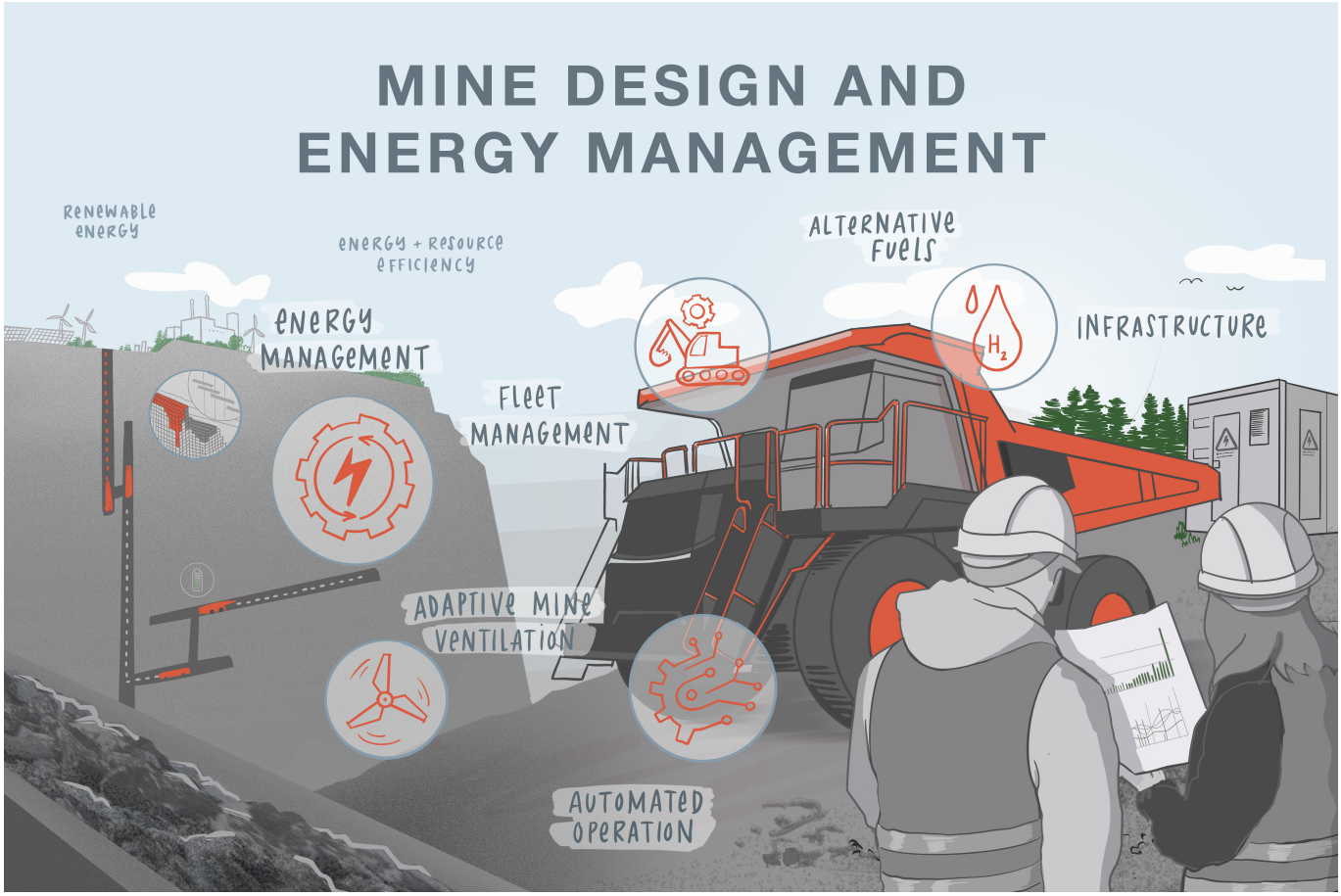
Mine Design and Energy Management



Mining operations are crucial for the energy transition and the achievement of climate targets. Many of the raw materials are urgently needed for key technologies, such as battery technology and robotics. The resulting increase in the global demand for raw materials cannot be satisfied by secondary raw materials, meaning that primary raw material extraction is becoming increasingly important. For a more sustainable world the energy transition must also be implemented in mining operations. Our research area 'Mine Design and Energy Management' focuses on the transition to a low carbon and autonomous mine with safe, energy- and resource-efficient processes by leveraging new technology and integration of renewables.

In our research area we rethink mining operations across all processes holistically and develop new approaches in operational planning and control along with the associated infrastructure and mine ventilation. Specific topics currently addressed in the field of 'Mine Design and Energy Management' are:

- The formulation of operational transformation concepts for switching from mainly diesel-powered to electric and/or autonomous mining operations. This is done considering the preservation of operational safety in production and ensuring a secure electrical supply, along with integrating renewable energies. The developed solutions are demonstrated and validated in different application scenarios at mine sites. As part of the 'Living Lab' the AMT is conducting on the premises provided by Nivelsteiner Sandwerke und Sandsteinbrüche GmbH the transition to electric-autonomous internal transport, along with all associated operational and process-related measures.
- The development of a mining energy model and optimised route planning for electrified transport. For this purpose, the energetic properties of the vehicles, geometric and energetic characteristics of the routes and the mass flow of the transported material are analysed.

- The development of concepts for safe, autonomous mixed operation.
- The investigation of CO^2-saving potentials compared to diesel-powered vehicles, while considering the availability of renewable energies, the used energy mix as well as the operational size and fleet composition.
- The creation of a physical and a digital pilot plant for sand processing. Energy and process data are recorded during operation and key parameters for the processing process are defined. Due to its flexible design, it is possible to react to the requirements of the local energy grid by adapting the operating mode to the energy supply situation, thereby contributing to a stable and efficient energy supply.

Provide tailored adaptive and energy-efficient mine ventilation concepts for safer underground mining, such as the extraction of rare earth elements (REE) that often contain amounts of radioactive elements. Here we use hybrid simulation and modeling approaches to tackle this challenge.

Related projects:

- AREA.AI: Development of concepts for safe, autonomous mixed operation
- ELMAR: Elaboration of transformation concepts for electric-autonomous in-house transportation development of a mining energy model and optimized route planning

Completed projects:

- NEXGENSIMS: Sensor-based measurement of gas concentrations and weather velocities underground

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