

## Current Research Projects

Here you will find an overview of our current publicly funded research projects, grouped alphabetically. In addition, the AMT implements projects on a private contract basis together with industrial companies, which, however, cannot be listed here for reasons of confidentiality of the research subject.

### AKUSTAHL

The aim of the AKUSTAHL project is to develop a monitoring system using acoustic emission analysis (AE analysis) for the micro and initial crack prediction of steel structures subject to fatigue loading, such as bridges, cranes, offshore or industrial structures. Existing systems for acoustic emission analysis are thus to be expanded to include the measurement and detection of microcracks for the earliest possible detection of damage events.

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### AREA.AI

The AREA.AI project explores opportunities to enhance the safety and sustainability of resource extraction through the development of a robust, low-emission, and autonomous transport system. The AMT focuses on ensuring safety in both autonomous operations and mixed traffic scenarios by investigating regulatory and operational requirements. It researches and develops necessary collision avoidance systems and Human-Machine Interfaces to ensure operational safety. Additionally, it evaluates communication technologies in mining, including optimizing wireless networks and developing simulation

approaches. Furthermore, the AMT conducts an ecological analysis to assess the CO<sub>2</sub> reduction potential of electrified mining machinery and to develop implementation scenarios for these technologies.

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## ELMAR

The objective of the ELMAR (Integration and Demonstration of the Use of Electric Heavy-Duty Transport Machines in the Raw Materials production) project is to investigate the fundamental effects of the use of electric automated transport vehicles in the raw materials production on the entire operation.

Furthermore, technologies and solutions for the utilization of electric mobile machines will be developed and their integration into existing and planned operational environments will be developed and tested in real-world mining environments.

The overall objective of the contribution AMT is making to the project is to investigate the electrification of raw materials extraction in order to generate a detailed understanding of the upcoming transformation of mine operations. For this purpose, a mine plan for optimized energy deployment, a holistic concept of energy design for raw material operations, and an IIoT gateway for decentralized machine communication will be developed within this project.

To achieve these respective goals, model-based applications for mapping raw materials extractions will be (further) developed and transferred into methods and procedures that enable optimized long-term and short-term planning and control of operational processes with respect to energy and resource use.

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## EPH

The "Energiepark Herzogenrath" (EPH) project aims to achieve CO<sub>2</sub>-neutral energy supply through a central energy management system integrating local industrial enterprises. Digital twins and intelligent forecasting techniques enable precise mapping of energy demands and optimal utilization of renewable energy sources. In collaboration with the AMR institute, a flexible pilot plant for sand processing is being developed, continuously collecting energy and process data while dynamically adapting to the local energy

grid. By integrating into Demand Site Management (DSM), the plant actively contributes to grid stability, while a comprehensive energy measurement system supports the optimization of energy consumption. The project serves as a model for innovative energy transition approaches and is funded by the BMWK.

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## REESOURCE

### **Welcome to Project REESOURCE: “UNLOCKING THE SUPPLY OF RARE EARTH ELEMENTS IN EUROPE THROUGH RESPONSIBLE, SUSTAINABLE AND DECARBONISED INNOVATIVE TECHNOLOGIES”**

Project REESOURCE aims to revolutionise the mining of Rare Earth Elements (REEs) in Europe, leveraging a world-class deposit in Norway with a multi-generational lifespan. This initiative focuses on ensuring a stable and sustainable supply of REEs, critical for green technologies, while adhering to principles of responsibility, sustainability, and reduced carbon emissions. Central to this endeavour is the innovative “Raise Mining” method, enabling "Invisible Mining" by minimising socio-environmental impacts.

A key challenge in this project lies in managing the safety hazards posed by radioactive minerals often associated with REE deposits. Effective mine ventilation is essential to mitigate these hazards by diluting radioactive isotopes and maintaining safe occupational conditions. The Advanced Mining Technologies (AMT) team is tasked with developing ventilation guidelines and a hybrid simulation model combining VentSim and CFD/Ansys. This approach will provide a digital design framework to optimise ventilation parameters, ensuring energy efficiency and adherence to regulatory safety standards.

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