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Roadmap for a competitive fossil-free mining and minerals industry in Sweden

Mining and minerals – an important part of the solution

The Swedish mining and minerals sector will play an important part in a fossil-free future. The simultaneous transitions towards fossil-free energy and transport systems, a climate-smart built environment and increased recycling are all dependent on sustainably produced, high-quality metals and minerals, not least due to the demand for the metals and minerals required by modern batteries and infrastructure. The Swedish mining sector already generates benefits for the global fight against climate change via the export of climate- and environmentally smart products and equipment.

In order to seriously address the challenge of transitioning to fossil-free production, the mining and metals sector is taking a structured approach, producing a roadmap for sustainable, competitive and fossil-free mining and minerals over the course of 2018, within the framework of the Fossil-Free Sweden initiative.

The view from 2018 – taking stock of the situation today

Today the mining and minerals sector generates about 8% of Sweden's total CO₂ emissions. Fossil fuels are used in multiple parts of the industry's value chain, and greenhouse gas emissions arise from transport and mining operations and in part from the processing of iron ore, metal ores, limestone and cement. Most of the industry's emissions come from production of iron ore pellets, smelting of ore into metals, and limestone and cement production, though emissions from the Swedish sector are low relative to global competitors. At the same time, many of the industry's processes and technologies are already fossil-free, especially in mining operations, and the transition towards fossil-free alternatives is already underway. The sector has made significant progress in switching from diesel- to electricity-powered technologies, and digitalization continues to drive optimization and efficiency, reducing overall energy and fuel requirements.

Processing of ore will require more to become fossil-free, and especially to deal with the process emissions that arise regardless of which fuel is used, for example when limestone is processed to lime and cement. Here development of existing technologies as well as a shift to new, currently undeployed technologies will be required. Biomass can replace some of the fossil fuels used today, but both fuel properties and supplies need development. Electric heating options can be a long-term solution but are immature technologically today. The iron- and steel industry is investing in hydrogen as a reducing agent in its HYBRIT project; research and development is likewise needed to identify process routes and system configurations for fossil-free production of other metals and minerals. Cementa has launched the



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initiative CemZero to investigate the conditions for electrifying cement production and eliminate CO₂ emissions. Process emissions, however, will require a strategy for and development of technologies for CO₂ separation and sequestration, geological storage of CO₂ (CCS) and industrial re-use of CO₂ (CCU).

Roadmap 2045 – this is what the journey looks like

In 2045 modern mining of ores and minerals is a sustainable complement to recycling in meeting global demand. Improved product designs and value chains for reuse and recycling have made it possible to recycle much of the metals and minerals in use. Yet recycling is not sufficient to meet demand from a growing global population and increased living standards. Primary production of metals and minerals is needed even beyond 2045, and global competitiveness remains essential for the Swedish industry, since only profitable firms are able to make the necessary investments.

One of the most important paths to fossil-free production is electrification. With help from biofuels in cases where electricity cannot be used operation of machines and internal transport in the mining sector become fossil-free as early as 2035. The transition to electricity has been driven primarily by technological progress and has mostly taken place via phasing out of old equipment and normal investment cycles. Competitive biofuels and/or hydrogen-based solutions have played a complementary role where mine geography or shorter lifetimes and smaller-scale operations hinder deployment of electricity-based solutions. Automation and digitalization have decreased energy requirements by optimizing production and making vehicles more efficient. Infrastructure for charging and hydrogen fueling is in place and necessary investments in the electricity grid have been completed.

Sweden has established a unique, world-class CO₂ -free system for processing iron ore. In part ore is processed by direct reduction using hydrogen. Pellets production continues as well, with process heat from CO₂ -free energy, either biomass or indirect heating via electricity. Hydrogen gas production, direct reduction and pellets production have been co-located for optimal energy use. Processing of other metals is also CO₂ -free. Lime and cement production likewise uses indirect heat from electricity and/or biomass, and process emissions are handled via CO₂ separation and geological storage (CCS) or reuse (CCU), for example in methanol production or algae production. These investments have been expensive and have not been borne by individual companies – public and private investments in technological progress have been essential. New pricing models have been introduced.

Critical conditions and barriers

The mining and minerals sector is optimistic that the transition will be a successful one. Yet the necessary development will require time and capital. Farsighted political decisions that promote the industry's global competitiveness will be central to achieving success, as will effective and reliable approval processes for new investments.

The industry is prepared to invest but barriers along the way need to be cleared. Here politics has a clear responsibility to maintain a long-term and holistic view.

The most important conditions where politics can make a difference are:

- Effective and reliable permitting so that new, necessary and climate-smart investments are possible
- A holistic view in political decisions that avoids (for example) policies that sub-optimize and harm the industry's competitiveness and ability to invest in fossil-free production
- Investment in research and development within fossil-free production processes and CCS, including test sites and upscaling
- Conditions for access to fossil-free electricity with a low total system cost and high reliability
- Strategic allocation of biomass and access to biofuels at competitive prices

The industry, the public sector and other actors need to work together to bear the cost of the transition, drive technological development and support the achievement of global and national climate goals.

This is Svemin

Svemin is a national branch organization for mining, mineral, and metal producers in Sweden with more than 40 member companies active throughout Sweden. Members included mining companies, prospecting and exploration companies, limestone and cement companies and various equipment and service providers.

