Fossil-free steel in Sweden

Steel is used widely, with increasing global demand. At the same time, iron and steel production are responsible for approximately a quarter of global industrial CO_2 emissions. Following the adoption of the EU's 2050 climate neutrality target, the steel industry is under intense pressure to improve energy efficiency, recycle more and switch to low carbon production processes. In a capital-intensive industry characterised by path dependency and technological lock-ins, sustainability transitions are not straightforward. However, modelling shows that hydrogen-based production in conjunction with a move towards the recycling of scrap steel enables the industry to continue to produce high-quality steel as well as reduce emissions and maintain jobs in the sector.

Overview

Sweden's steel production accounts for 3 per cent of total European steel production[103] and around 2 per cent of Sweden's GDP.[104, 105] In 2018, the steel sector in Sweden employed 15,700 workers directly and 26,500 indirectly, and accounted for 4 per cent of Sweden's total exports of goods.[106] In response to foreign competitive pressures, Sweden has developed expertise in highly processed steel grades and niche-oriented products made of environmentally friendly steel.[106]

The Swedish government has committed to two major climate targets: 100 per cent renewable electricity generation by 2040 and a net zero carbon economy by 2045. These ambitious goals, together with the Fossil Free Sweden initiative, put pressure on all Swedish industries to decarbonise.

The commitment to develop fossil-free steel production is supported by both government and the industry, as demonstrated by the long-term plans of the country's largest incumbent iron and steel producers, LKAB (a state-owned mining company) and SSAB. SSAB operates Sweden's two remaining plants that use blast-iron furnaces[107] and are leading entrepreneurial activity and experimentation to decarbonise virgin steel production using hydrogen-based production methods, with the help of substantial financial support from the Swedish Energy Agency. For these companies, investing in innovation makes economic sense. At present, SSAB relies on imported coal to operate its blast furnaces, instead of using readily available, domestically generated, fossil-free electricity. Also, by taking the lead in the development and implementation of new technology, SSAB aims to enhance its competitiveness in the long term.[107]

Interactions with megatrends

Technological innovation will be essential for the competitiveness of the steel sector. The EU steel sector cannot compete globally on labour costs, and therefore needs to base its competitiveness on innovation, technology, quality and the abilities of a highly skilled workforce.[108]

Iron (from which steel is made) causes the highest climate impact among metals, due to the large volumes of steel produced yearly, its energy-intensive nature and the use of highly polluting coal in the blast furnaces for iron ore reduction to produce virgin steel. In 2017, the iron and steel industry produced about 6 per cent of global CO_2 emissions.[109] To address requires a number of strategies. On the demand side steel can be used more efficiently or alternatives can replace it. On the production side greater use of recycled steel and innovative production processes will be key. Recycling steel allows savings in terms of CO_2 emissions in the range of 62 per cent to 90 per cent compared to primary production.[110] However there will still be a need for new technologies for innovative steel production with significant reduced emissions. Alternative production methods are varied and include using hydrogen, biomass or electrolysis to reduce iron ore, changing the process to reduce the use of carbon and capturing the emissions generated.[108]

Implications for jobs and skills

The steel sector is often perceived by younger generations as involving low-skill, low-pay and less safe occupations.[111] However, the reality of the modern steel industry is different, with salaries comparable to other industrial jobs and highly automated, high-tech workplaces. There is a high demand for science, technology, engineering and maths (STEM) graduates in the sector, especially as the average age of workers in the steel industry is relatively high.

The ageing steel sector workforce has consequences in the flexibility of the workforce, and ease of adoption of new skills, such as digital skills. Older workers seem to be more resistant to change and to adopting more flexible approaches to tasks and responsibilities, although this attitude changes based on the roles covered.[111] The ageing

workforce also makes knowledge transfer more difficult. The low number of young entrants and the increasing age of steel workers creates a gap in knowledge transfer, with expert older workers retiring without being able to pass on their knowledge.[111]

Jobs linked with administrative functions will be the ones at greatest risk of automation. Production workers will still make up the majority of hiring in the steel sector but will perform different tasks and will require a varied and flexible skillset. Specialised technical skills and advanced technology skills will remain in demand. The knowledge of steelmaking processes and materials will remain fundamental, but the importance of digital skills will rise substantially, implying that workers will still need in-depth knowledge of tasks but won't be performing them. Green skills, such as understanding of environmental management and knowledge to support circular business models, are projected to become increasingly important. R&D expertise will be needed to lead research in sustainable steel and new production processes, while floor workers will need competences in resource efficiency, material reutilisation and recycling.[111]

For Sweden's and the EU's climate targets to be met, the steel industry needs to decarbonise. This means that the future jobs in the steel industry will be either in recycling-based steel or in new forms of steel production that are still exploratory, such as hydrogen-based technologies. Modelling by Cambridge Econometrics (E3ME, FTT:steel) indicates that a shift towards more hydrogen-based steel production in Sweden would enable a Swedish steel production increase without a negative impact on employment levels. This result is linked to the labour intensity of various production technologies and the availability of scrap steel: although hydrogen-based production is slightly less labour intensive than current fossil-based production, it is more labour intensive than recycling-based production and does not rely on the availability of scrap steel.

Case Study
Fossil-free steelmaking in Sweden

Under the HYBRIT joint venture, the Swedish firms SSAB, Vattenfall and LKAB are collaborating to develop a fossil-free hydrogen-based steelmaking process as an alternative to coal-based steelmaking by 2035. While the main objective is to reduce the environmental impact of steelmaking, the economic impacts are also important. With this new method of producing steel, CO_2 emissions generated from the steel industry could be eliminated, thus contributing to Sweden's goal of net zero emissions by 2045.[112] Construction of a pilot plant began in 2018, with EUR 52 million of assistance from the Swedish Energy Agency. The pilot phase should last until 2024, with a subsequent demonstration phase from 2025 to 2035.[113]

Credit: HYBRIT