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# Decarbonising steel production: a 21st century challenge

Developing economically viable hydrogen-based steelmaking technology is one of the steel industry's overriding priorities in the coming decades.

The industry has already had some success in its search for both production and financial opportunities to decarbonise – or reduce the carbon footprint of – the steel production process. So far, the steel industry remains among the three largest global carbon dioxide producers.

## Carbon neutrality

Five years ago, 190 UN member states signed the Paris Agreement, the first global agreement in the organisation's history, under which the signatories pledged to regulate volumes of atmospheric carbon dioxide ($CO_2$) emissions from 2020.

The central aim of the Paris Agreement is to limit the global average temperature rise to at least 1.5 degrees Celsius by the end of this century (the member states agreed that human activities are the main cause of warming).

At the Climate Action Summit 2019, more than 60 countries, including the EU and the UK, committed to full carbon neutrality by 2050. Carbon neutrality means that carbon dioxide emissions will be reduced altogether or fully offset by production industries. In fact, as will be discussed below, European steelmakers were the first to implement innovative decarbonisation methods in the steel production process.

Interestingly, the US, China and India – the main "sources" of atmospheric greenhouse gas emissions – have not ratified plans to achieve carbon neutrality. However, some European countries promised to fully eliminate CO2 emissions in a shorter time span.

Decarbonisation is the most pressing issue facing the steel industry. A simple example: every tonne of steel produced emits on average 1.85 tonnes of carbon dioxide into the atmosphere. Due to the specifics of the production process, steel producers account for around 8% of global carbon dioxide emissions.

Steel producers are not only facing pressure to decarbonise from environmental activists and anti-climate change campaigners. Major automobile producers (the automotive industry is one of the main consumers of steel products) such as Volkswagen and Toyota have declared their intention to eliminate carbon dioxide emissions completely from their production cycle, including raw materials. In other words, automobile manufacturers will soon require only carbon-neutral steel.

Aside from this, investment funds have begun to show increasing interest in the sustainability projects that are being developed by environmentally responsible enterprises.

Finally, many countries' regulatory policies are continuously tightening carbon emission standards and increasing the cost of emission quotas (under the Kyoto Protocol), further contributing to this issue. Taken together, these factors demonstrate the growing pressure on the steel industry, pushing the industry toward carbon neutrality.

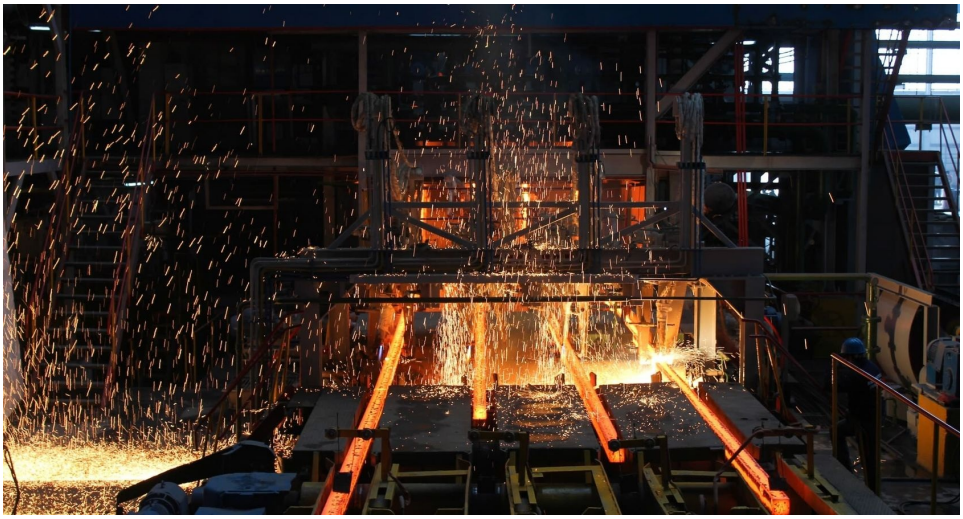
## First green hydrogen-based plant

The efforts of politicians, investors and activists have already begun to bear fruit. In late summer 2020, the

world's first fossil-free steel plant that runs on green hydrogen and without $CO_2$ emissions was launched in Sweden. The Hydrogen Breakthrough Ironmaking Technology (HYBRIT) project was invented and implemented by three Swedish companies: the steel manufacturer SSAB, the energy company Vattenfall and the mining company LKAB. Their idea is in many ways similar to the environmental aspirations of automobile manufacturers. The creators of HYBRIT aim to achieve a carbon-neutral production cycle, from raw materials to finished steel products. Green hydrogen will be used to reduce the oxygen content of iron ore raw materials, replacing traditional coal and coke. As a result, the production process will emit ordinary $H_2O$ instead of environmentally hazardous $CO_2$.

However, at HYBRIT, they do not hide the fact that they faced two serious challenges during the implementation of the project. First, the Swedes have yet to figure out how to use 100% hydrogen efficiently on an industrial scale. Second, there is still no answer to the question about energy-efficient hydrogen production, since it must be economically viable.

Therefore, the plant will run in test mode during the next four years. They will start using natural gas, then switch to hydrogen, and compare the results. Ultimately, the initiators of HYBRIT aim to reduce carbon dioxide emissions in Sweden by 10% as their contribution to the decarbonisation of the European steel industry. It should be noted that the Swedish Energy Agency provided financial assistance to the project, investing US$52 million in HYBRIT.



### Other decarbonisation projects

Other European enterprises are not sitting on the side-lines of the initiative to decarbonise the steel production process. The global steel producer ArcelorMittal is beginning to study the use of hydrogen for iron ore reduction: in cooperation with Freiberg Mining Academy, they are starting to test the relevant equipment at the company's steelworks in Hamburg. At the end of the pilot tests, ArcelorMittal expects to receive 110,000 tonnes of steel produced using hydrogen. In total, the steel giant has already invested EUR250 million in decarbonisation projects.

German's Thyssenkrupp Group has taken a similar path. After receiving a grant from the local government's climate initiative, Thyssenkrupp Group will be also ramping up the use of hydrogen in production processes, planning to reduce CO2 emissions by 20%. One of the company's long-term goals is to reduce its carbon footprint by at least 80% over the next 30 years.

Salzgitter Flachstahl GmbH (SZFG) also appears to be on track to soon catch up with the new green steel trend. A year ago, the company signed a contract with Siemens Gas and Power . The latter committed to build a 2.2 MW electrolysis plant that will produce green hydrogen using wind power. In the future, this plant will become part of the hydrogen-based steel production project at SZFG. The new capacity is expected to be launched in the coming months.

Another global player in the field of innovation in steel, Primetals Technologies Limited, is now developing its own technology for hydrogen-based iron ore reduction. A pilot plant will be built at Voestalpine steelworks in Austria. The design capacity of the plant is expected to reach 250,000 tonnes of green steel per year.

### Ukraine's green path

Ukrainian steel giants have been keenly following the latest steel industry decarbonisation trends. For example, Metinvest closely monitors the development of relevant technologies to choose the best solution in the existing production environment.

Ukrainian politicians seem interested in decarbonisation as well. In mid-October, the country's Ministry of Energy announced that it was beginning to prepare a national "Hydrogen Economy Strategy". The acting minister of energy, Olga Buslavets, spoke about this after visiting a steel plant of Germany's Thyssenkrupp Steel, whose

hydrogen projects were discussed above. Officials also plan to prepare the legislative framework necessary to launch a hydrogen market in Ukraine.

Notably, the pioneers of green hydrogen-based steel production themselves admit that these new technologies need very substantial subsidies from the state. Hydrogen-based steel production is more expensive than conventional processes by nearly one-third. Decarbonising the steel production process is not currently projected to become economically viable for another 10 years . By then, politicians are striving to make the price of $CO_2$ emissions prohibitive for the industry (both through the Kyoto Protocol mechanisms and by raising environmental taxes). At the same time, green energy is likely to become significantly less costly. Meanwhile, European steelmakers insist that the green steel industry has as great a need for government subsidies as alternative energy.

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