Summary

Climate policy challenges of the steel industry in Germany

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Climate policy challenges of the steel industry

The steel industry is one of the core sectors of the German economy. It is integrated into numerous value chains and its products are just as indispensable in vehicle production and mechanical engineering as they are in the construction industry or the electrical industry. Due to the technology involved, steel production in the existing processes is associated with the emission of considerable amounts of carbon dioxide (CO_2), which must be gradually reduced over the next few years in view of the targets set by the EU and the German government for reducing greenhouse gas emissions (GHG emissions). With the help of model-based scenarios, the study examines the challenges this poses to the steel industry in Germany and quantifies the possible consequences of an internationally uncoordinated approach to climate protection for the steel industry and the economy as a whole.

This overview summarises the most important results and conclusions of the study. The study was published in December 2020.

How can GHG emissions from the steel industry be reduced?

Currently, steel is produced using two different processes:

- In the blast furnace-converter route (primary steel production), iron ore is reduced with the help of carbon-containing reducing agents such as coke and processed into crude steel in further work steps. In Germany, this process produces just under 2 t of CO_2 per tonne of produced steel. In 2018, this process was used to produce just under 30 million tonnes (around 70 per cent of the total steel production in Germany (42.4 million tonnes)).

- In the electric steel route, steel scrap is melted down in an electric arc and reprocessed (secondary steel production). The resulting emissions per tonne of steel produced are around 0.1 t CO_2. In 2018, just under 13 million tonnes (around 30 %) of steel were produced via the electric steel route.

One theoretical way to reduce the GHG emissions associated with steel production while keeping total production unchanged is to increase the share of low-CO_2 electric steel significantly. However, the limited amount of steel scrap and the different product portfolios of the two process routes stand in the way of this.

Another method is the use of hydrogen-rich gases and pure hydrogen instead of carbon carriers such as coke in primary steel production, as well as the further use and recycling of CO_2 in the industrial value chain. This could reduce process-related CO_2 emissions significantly. The technology causes considerable additional costs compared to the traditional process. In addition, the CO_2-free production of hydrogen requires large amounts of renewable electricity.

As far as the available options – such as increasing the share of electric steel and replacing coke with hydrogen as a reducing agent – do not come to fruition in the short and medium term, the only option for reducing GHG emissions would be to reduce steel production in Germany.

What does this mean for the steel industry in Germany?

Scenario calculations were used to examine what a reduction in production caused by higher GHG emission costs would mean for the steel industry and for the economy as a whole in Germany. For the scenario calculations, an economic model was used that reflects both individual company decisions and the integration of the German economy into international economic relations.

In order to achieve the targeted CO_2 reduction, increasingly higher specific GHG emission costs are required. In real prices, these will reach a level of 105 EUR/t CO_2 from 2032. This makes steel production in the blast furnace route in Germany increasingly expensive. Since the intense competition on the world markets largely prevents the increased costs from being passed on in product prices, the profitability of primary steel production deteriorates. For steel producers, this raises the question of whether it still makes sense to renew (reline) the existing blast furnaces. The costs of a relining for the typified blast furnaces in the model are on average just under 230 million euros per relining. In view of an assumed average lifespan of a "furnace journey" of 16 years and against the background of the age structure of the plants in Germany, the first plant will already reach its age limit in 2024. By 2030, half of the plants will have to be relined and by 2034 all plants will have to be relined.

The basis for the decision on decommissioning or lining and continued operation of a plant is a profitability review. In this process, the expected net profits over the lifetime of the plant are compared with the capital expenditure required for the delivery (net present value method). If the profitability test is positive, the company acquires the corresponding capital goods before reaching the technical age limit, carries out the delivery and can continue production. If the profitability test is negative, the plant is shut down at the end of its service life without being relined.

As a result of the rising specific GHG emission costs and the intense competition on the steel market, the profit margin of the companies is decreasing noticeably, which means that the lining and subsequent continued operation of the blast furnaces is usually no longer profitable. When the plants reach their technical lifetime, they are shut down. At the end of the period under consideration, only around 40 percent of the blast furnace capacities installed in 2018 are still in operation, and steel production in Germany also falls by around 40 percent compared to a reference development. The steel production lost in Germany as a result of the GHG pricing is compensated for by imports. Since the imports are also associated with CO_2 emissions (abroad), these do not show any significant change in a global view compared to the reference scenario, i.e. CO_2 emissions are shifted from Germany to abroad (carbon leakage).

Macroeconomic consequences

The German steel industry is closely interlinked with other sectors from which it obtains inputs and to which it supplies its products for further processing. This is reflected in a comparatively high value added multiplier of 2.7. If the value added in the steel sector falls by one euro, the economy as a whole (including the steel sector) "misses out" on 2.7 euros of value added. A weakening of the steel industry therefore also has consequences for the upstream industries.

If one also takes into account that production restrictions have negative consequences for income, consumption, profits and investments, the loss of value added towards the end of the period under consideration is about four times greater than that in the steel sector alone. In the end, the total economic value added in Germany in 2035 is just under 20 billion euros (-0.5%) below the corresponding value in the reference scenario. Cumulated over the entire period from 2020 to 2035, the overall economic value creation losses amount to 114 billion euros (-0.2% of the reference value).

The number of employees in 2035 is 200 thousand lower than in the reference period, including 43 thousand jobs lost in the steel industry.

The overall economic GHG abatement costs - defined as the loss of overall economic value added per tonne of GHG saved in Germany - amount on average to approx. 600 euros per tonne and are thus many times higher than the additional costs of a hydrogen-based production process.

Conclusion

The results of the model-based scenario comparison show that a unilateral increase in the CO_2 price for German steel producers would lead to the death of the blast furnace route in German steel production over the next 15 years. This would have considerable negative consequences for value creation and employment in the steel industry and the economy as a whole. For total industries, gross value added in 2035 would be about 20 billion euros lower than in the reference scenario. If these losses are put in relation to the GHG emissions saved in Germany as a result, specific GHG avoidance costs of around 600 euros per tonne on average result. In addition, macroeconomic employment losses of about 200 thousand people would have to be expected.

At the level of the steel-demanding sectors, the effects depend strongly on the steel qualities used and the time horizon of the observation. If the relatively more expensive products of German steel producers can be substituted by those of foreign producers, the subsequent economic effects in the downstream industries will be small. For part of the steel sector's product portfolio, however, the procurement of steel of the same or higher quality abroad can be associated with temporary frictions. In these cases, at least temporary losses in quality and turnover on the part of the steel-demanding companies can be the result.

On the other hand, the economic consequences would not have a positive impact on global GHG emissions. Due to the increase in the cost of steel production in Germany, the relocation of production volumes to existing or new blast furnace routes abroad is to be expected, which is why the national production cut would not be accompanied by a GHG reduction on a global scale (carbon leakage). It is likely that these would even increase, as steel production in Germany and Europe is associated with lower emissions than competitors from China, India or Russia, for example.

If the German steel industry is to achieve the defined GHG reduction targets, there are only two options within the framework of national or European unilateral action: They receive sufficient support for a transformation towards low-GHG production processes or they leave the market. Since the GHG targets cannot be achieved with the existing technology, it is irrelevant whether policymakers choose the CO_2 price assumed here or another instrument.

From a business point of view, the switch to low-GHG processes is not profitable for steel producers today or in the foreseeable future. In the special market constellation in which the steel industry finds itself – extreme cost differences between the two technologies, no level-playing field, danger of carbon leakage – it seems justified not only in terms of industrial policy but also in terms of regulatory policy to support the steel industry in its transformation.

Considering the spectrum of possible scenarios, it becomes clear that only with government support for the transformation to hydrogen technology – including the creation of a uniform level-playing field - both the climate policy goal of GHG reduction and the economic policy goal of maintaining value creation and employment in and through the steel industry in Germany can be achieved. Under these conditions, the steel industry can retain its important role in industrial value creation networks in the coming decades.