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Green Industrialisation: Rethinking African-German Cooperation for Sustainable Steel Value Chains

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Germany's commitment to climate neutrality by 2045 faces significant challenges due to the high carbon emissions from its industrial sector, particularly steel production. Current policies focusing on domestic hydrogen (H2) compatibility and imports from African countries risk economic insufficiency and overlook the scope and ambitions for green industrialisation and climate-positive growth on the African continent. This brief looks at the limitations of this approach and the potential for sourcing energy-intensive iron or steel directly from African countries, that have the potential of significantly higher generation capacities of renewable electricity in the future.

Keywords: Decarbonisation, Energy Intensive Industries, Iron and Steel Industry, Renewable Energy, Green Steel Supply, Energy Partnerships, Bilateral Cooperation

Background and problem statement

The European Green Deal targets for climate neutrality by 2050, as well as Germany's own climate protection law with more precise reduction targets for 2030 and 2040, have committed the country to substantial transformation efforts (Umweltbundesamt 2023). Although Germany has already greatly expanded its generation capacity of renewable electricity, it is not yet able to source sufficient green energy for the necessary decarbonisation of its energy-intensive industries. Germany's current dependency on fossil fuels as predominant energy source in its industrial sector represents both an obstacle to achieving the country's decarbonisation targets and a risk that its energy-intensive industries may become economically unsustainable as EU CO2 pricing is expected to expand over the coming decades.

The industrial sector is responsible for more than 20% of Germany's greenhouse gas emissions, amounting to approximately 200 million tonnes of CO2 equivalent per year. The iron and steel industry is the largest contributor to these emissions (Umweltbundesamt 2024). Simultaneously, several sectors of the energy-intensive industry in Germany are already experiencing a recession, not least due to high energy prices. This also holds true for the steel industry, where production has shrunk by around 20% since 2011, resulting in nearly 10,000 job losses by 2023 (Wirtschaftsvereinigung Stahl 2023). At the same time, steel has a pivotal role to play in sustainable transformation across sectors, e.g. for transportation infrastructure, buildings and energy networks. Moreover, steel is indispensable for large parts of the rest of German industry (such as car manufacturing). Almost 70% of German exports are steel-intensive products (ibid.). The decarbonisation of the German steel supply is therefore of high priority. To decarbonise this sector in the long term, Germany plans to replace fossil fuels, currently the main energy carrier in steel production, with green hydrogen (H2).

Large and untapped potentials for high renewables production capacities such as wind, solar and hydropower in several African countries have put the continent at the centre of the climate strategy policy debate in Europe and Germany. This matches the political directional decisions taken at the African Climate Summit (ACS) 2023 (Africa Climate Summit 2023). The member states of the African Union set out ambitious industrial development objectives under the principle of "climate-positive growth". In particular, to significantly expand renewable energy production capacity and develop the continent into a cost-competitive industrial hub that can help other regions decarbonise (Nairobi Declaration 2023). This is to be accompanied by a prioritisation of energy-intensive industries to benefit economically from the use of renewable energy and to add value to Africa's natural endowment.

While in Germany there is much interest in importing green H2 from African countries to decarbonise domestic steel production, the debate does not yet reflect the potential

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for green industrialisation within African countries, not only by supplying green H2, but also by taking on wider parts of the value chain. This brief therefore addresses the following questions: How is Germany currently pursuing sustainable steel production? What is the potential role of African countries and can they become players in green steel supply?

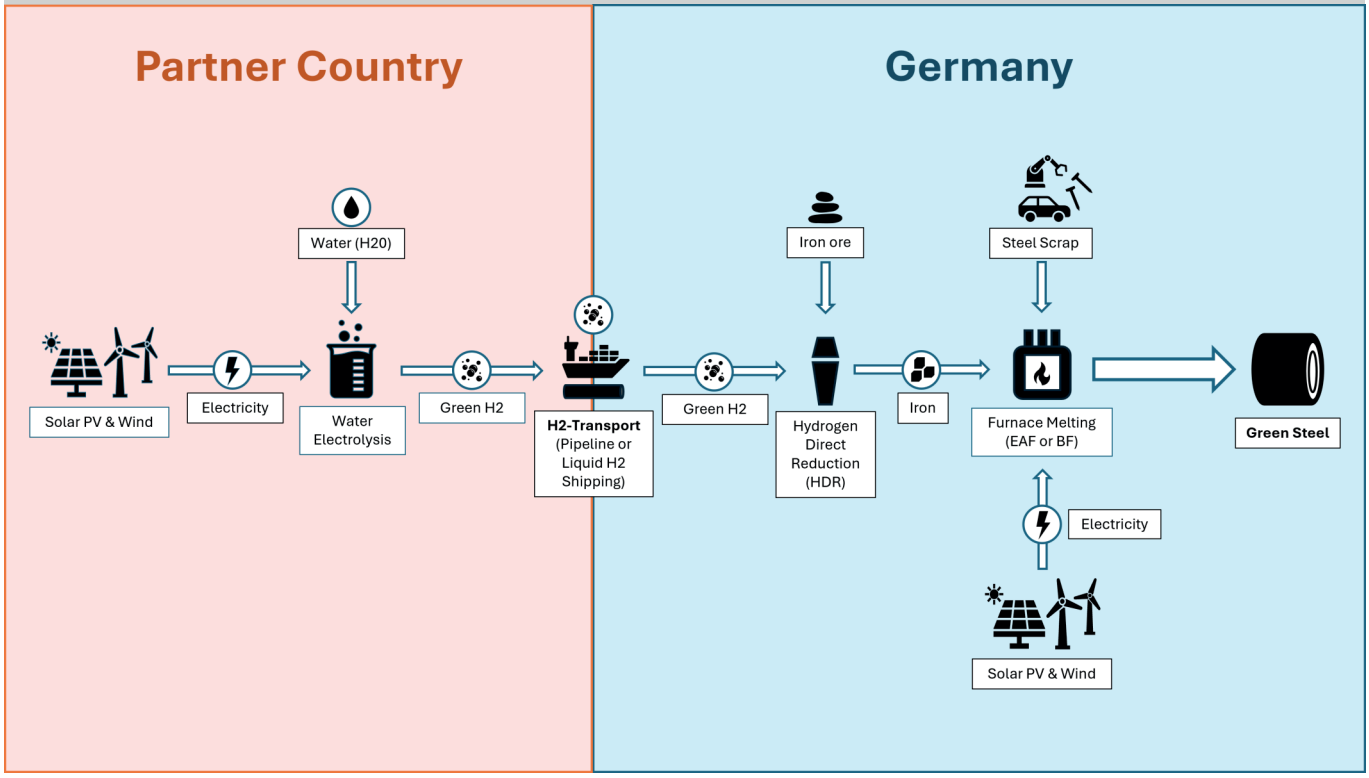
Current state of German steel supply

Germany is the largest steel producer in the EU, producing a total of 35.4 million tonnes of crude steel in 2023 (Wirtschaftsvereinigung Stahl 2023). Its primary steel market is dominated by three major producers (ThyssenKrupp, ArcelorMittal and Salzgitter). The majority of steel in Germany (around 70%) is produced as "primary steel" using fossil-based blast furnaces (BFs). The remaining 30% is produced as "secondary steel" by recycling steel scrap in electric arc furnaces (EAFs). Although electric arc furnaces are more widely distributed throughout Germany, they represent a smaller proportion of production (Lopez et al. 2023; Wirtschaftsvereinigung Stahl 2023). The electricity-based production route (via EAFs) can be more easily made carbon neutral through the usage of renewable electricity (and green H2 as a pre-heating fuel). To neutralise the CO2 emissions of the much larger blast furnaces based primary steel production would require a considerably greater availability of green H2, in addition to a substantial technological transition to H2-based direct reduction of iron ore (H-DR) (Lopez et al. 2023). Without this shift in the production of steel supply, the German emission targets by 2030 will not be achieved (Arens et al. 2017). However, the question of where production capacities for green steel should be established remains controversial among economists (Rubröder and Wermke 2024).

Thus far, policies at the German and EU level have been aimed at keeping the steel industry within the domestic economy. In 2020, the German government presented its steel action plan ("Handlungskonzept Stahl") for an internationally competitive and climate-neutral steel industry within Germany (BMWK 2020). The same year, the EU strategy on H2 was adopted with the aim of making large quantities of green H2 available for its own industries through domestic production and imports on a large scale (European Commission 2020). In the following years, this strategy was further concretised through several EU policies including investment incentives and project funding schemes for the creation of H2 infrastructure and H2 markets.

Looking solely at Germany, two strategic orientations are clearly recognisable so far. Firstly, driving forward the technological transformation of domestic steel production towards H2 compatibility. And secondly, securing a reliable H2 supply from African countries. The German government is currently using large-scaled subsidies to support a number of steel companies in converting their production facilities to be H2-compatible. Last year alone, this included 1.3 billion euros to AcelorMittal, 1 billion euros to Salzgitter, around 2 billion euros to ThyssenKrupp and 2.6 billion euros to Stahl-Holding-Saar. The German government has furthermore begun to mobilise its bilateral energy partner-

Box 1 | Supply chain of green steel under the condition of import of green hydrogen to Germany. (Source: Own illustration)



ships with several African countries that are considered to have favourable conditions for renewable electricity generation in order to establish them as future import sources for green H2 (Giz 2024). These include the establishment of green H2 agreements with Algeria (2024), South Africa (2023), Namibia (2021), and Morocco (2020). Numerous other bilateral partnerships are currently being considered by the German government (BMBF 2023). Box 1 (see previous page) illustrates the supply chain for green steel, assuming the import of green H2 from a partner country to carry out the complete steel production process within Germany. However, there is reason to assume that this exclusive focus on supplying the domestic industry with green H2 will not be sufficient to decarbonise the German steel industry in keeping with the climate targets set and in an economically efficient manner.

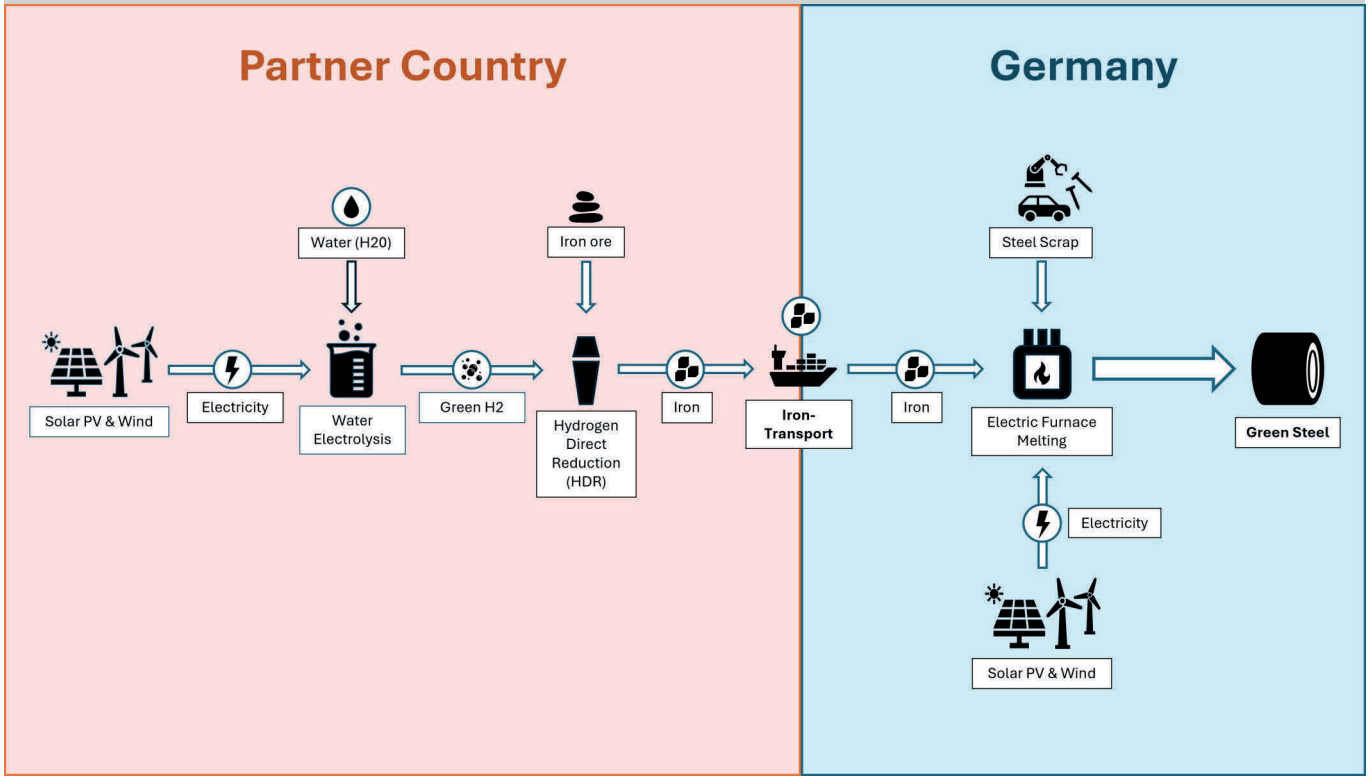
Limitations of the current approach of sourcing green hydrogen for domestic steel production

Still, there is controversy among economists as to whether this currently high domestic steel production capacity in Germany will still be economically reasonable in the future and whether part of the iron requirement could also be purchased on the newly emerging market for green primary products outside Europe or even, in principle, whether green steel could be imported from countries that are expanding their capacities for its carbon neutral production (Rubröder and Wermke 2024).

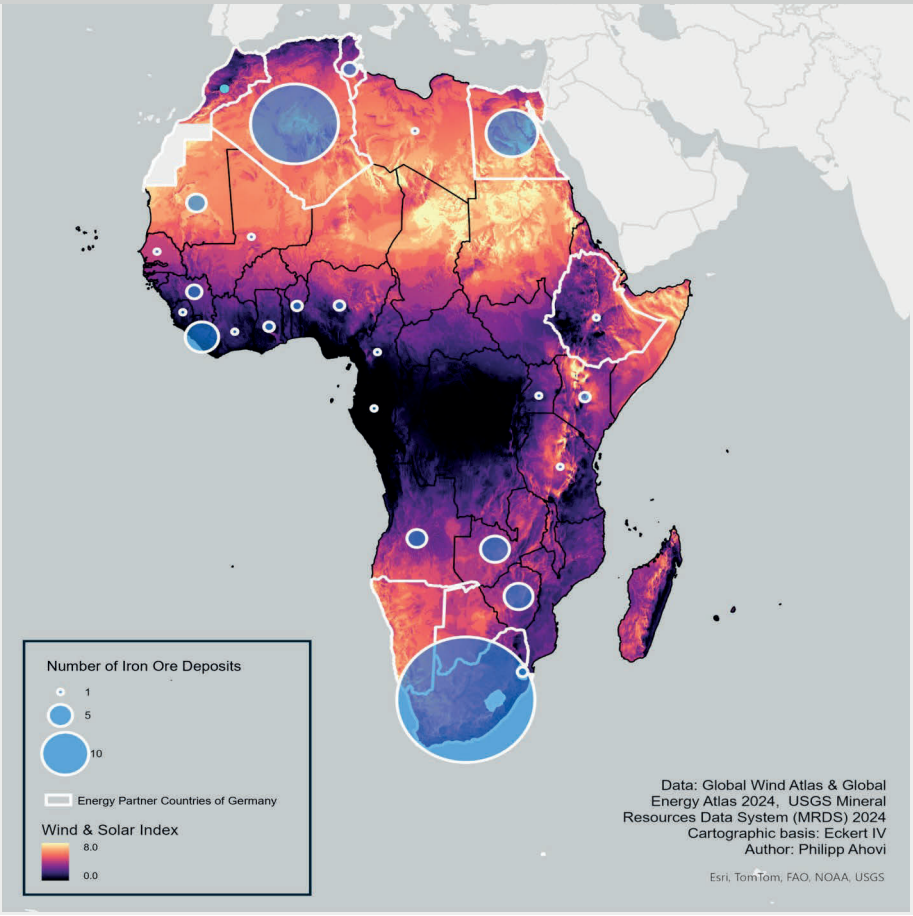
There are a number of serious problems caused by global overcapacity in the global steel industry, such as creating damaging trade distortions and regional imbalances and destabilising world trade relations (GFSEC 2024). Since 2016 the G20 countries have set out to reduce existing production capacity worldwide through the OECD-moderated Global Forum on Steel Excess Capacity (ibid.). This would include reducing subsidies, which are at least partly responsible for the creation of excess capacity. The billions, that are currently being channelled into Germany's domestic steel industry stand in stark contrast with these aims.

Furthermore, positioning African countries solely as H2 suppliers not only reproduces unequal trading partnerships, but also overlooks their productive capability and fails to support them in developing their economies according to the principle of climate-positive growth. The AU member states are explicitly calling for climate-positive investments that are anchored in their industries (Nairobi Declaration 2023). Among other things, due to the challenges surrounding H2 transport that economic discussions in recent years have partly shifted from the import of H2 to the import of green H2 products into Germany. Therefore, increased focus has been placed on importing on intermediate hot briquetted iron (HBI) to be used in Germany's existing electric arc furnaces (EAF's) (Lopez et al. 2023). Box 2 illustrates how this would change the supply chain for green steel. The energy-intensive iron reduction process using green hydrogen is carried out in the partner country. This means that iron is now being transported to Germany instead of green H2.

Box 2 | Supply chain of green steel under the condition of import of hot briquetted iron (HBI) to Germany. (Source: Own illustration)



Box 3 | Combined index of wind speed and solar radiation on terrestrial surfaces overlapped with the number of iron deposits aggregated at national level. (Source: Own illustration)



The potential of African countries to supply green iron

Box 3 provides an overview of African countries that, in principle, present the natural prerequisites for the supply of green iron. These involve, among others, a: 1) high capacity potential for the production of renewable electricity (e.g. from wind and solar radiation) and 2) natural deposits of iron ore. Displayed in colour is a combined index calculated from high-resolution raster data on wind speeds and solar radiation (Data: Global Solar Atlas 2023; Global Wind Atlas 2023). The blue circles represent the number of documented iron deposits in a country proportionally (Data: USGS 2024). South Africa has the largest number of iron deposits (30), but Algeria (19) and Egypt (11) also stand out as countries with large iron deposits and high renewable energy potential. All three of these countries already have an energy partnership with Germany, as implied by the white outlines around their national borders. Given their natural preconditions, serious consideration should be given to developing these existing energy partnerships into wider industrial partnerships that promote green iron production infrastructures in their domestic industries.

The case description in box 4 (see next page) provides an example of how bilateral agreements on H2 can revolutionise a sector, both on site and Germany.

The political and economic implications of a reorganisation of the steel value chain

An approach of outsourcing part of the steel production chain from the domestic industry to other countries is likely to meet with political resentment in Germany as well as in the EU. To this day, manufacturing jobs, including in steel production, are regarded as the backbone of Germany's economic stability. Policy debates often centre on the preservation of employment and security of steel supply. Another reason for German and EU policymakers' neglect of the green steel production potential of the Global South may be their interest in maintaining the nature of the traditional preferential trade relations, which focus on importing raw materials and keeping most of the value added in Germany (Lopez et al. 2023). With Germany's high iron reduction capacities in the form of the numerous CO2-intensive blast furnaces, a considerable amount of industrial infrastructure could be made superfluous more immediately by importing green iron (ibid.). However, these narratives miss the reality of today's global steel production and, as frames of a de facto protectionist industrial policy, risk harming the German (steel) industry rather than protecting it.

Firstly, it must be pointed out that in Germany far fewer

Box 4 | Case-Study: German-Namibian cooperation agreement on green hydrogen

In June, Germany and Namibia signed three cooperation agreements which are to be implemented from April 2025. One of them focuses on Namibia's green hydrogen sector: Namibia's energy sources enable the production of green H2 which, as set out in the cooperation agreement, is also to be used locally at the production site in Lüderitz for the production of green ammonia (BMBF 2024; German Embassy in Namibia 2024).

Green ammonia plays a significant role in the production of fertilisers and in the chemical industry. Currently, Germany and the Netherlands have the largest ammonia production capacities within the European Union (Bonnet-Cantalloube et al. 2023), whereas Germany is also the largest consumer (BMWK 2022). In the EU, ammonia production is still largely dependent on fossil fuels, which are estimated to account for about 14 percent of total emissions from chemical production facilities in Germany (Wehrmann 2024).

The relocation of ammonia production to Namibia could have significant implications for a range of stakeholders. For Namibia, this agreement represents an opportunity to diversify its economy, create jobs and become an actor in the global green energy market (BMWK 2022). Moreover, the production of green hydrogen and green ammonia could facilitate economic growth and infrastructure development in the region through the promotion of electrification and income generation. For German producers, the agreement ensures a steady supply of green ammonia through imports, without having to rely on fossil fuels (ibid.).

jobs are dependent on iron ore reduction than on the rest of the steel value chain (Trollip et al. 2022). In addition, as already mentioned, the global steel market is characterised by overproduction, with India and China as large steel exporters already posing a long-term threat to the German steel industry (IG Metall 2024). If preliminary products such as green iron can be imported cheaply, the end products produced by German (steel-)industry will be more price competitive on the global market. This may be necessary in order to keep the domestic steel industry in Germany alive in the long term.

An existing case study on Morocco estimates hot briquetted iron (HBI) imports to be a more cost competitive option for green steel supply than H2 imports due to Morocco's expected sharp decline in levelised cost of electricity (Lopez et al. 2023). In the long term, the latter is also likely to occur in other African countries. Furthermore, with the import of iron German EAFs would continue to remain operational and potentially expand in capacity as primary steelmaking transitions from BOFs to EAFs (ibid.).

At the other end of the equation, however, are the high costs of capital in many relevant African countries, often characterised by high interest rates (OECD 2023). This is an obstacle to investments, and therefore to the development of industrial infrastructure, and also requires effective policy action by national and local governments to overcome. In addition to a possible lack of adequate infrastructure and financial barriers, a number of other factors must be taken into account that determine the feasibility of local and green iron reduction or steel production, such as technological capacity, difficulties in securing consistent raw materials, the regulatory environment (bureaucracy, corruption, export regulations, quality standards, etc.), political and economic stability, and social and environmental concerns (safety standards, labour rights, environmental regulations).

Conclusion

Looking forward, the scope of the German government's current policy strategy could be expanded beyond the import of H2 in the upcoming mandate, as high investment potential in the dynamic African partner countries and industrial decarbonisation capacities for Germany will depend on this in the future. This represents a strategic move towards sustainable industrialisation. By providing financial resources, facilitating technology transfer, and supporting infrastructure development, Germany could support the respective partner countries to build a resilient and sustainable industrial base. This would not only benefit African partner countries through technology transfer, job creation and economic development while accelerating their energy transition, but also ensure and diversify a steady supply of green steel for Germany, aligning with its climate targets as well as its economic and geostrategic interests. In this context, it should be emphasised that the strongest increase in demand for steel is occurring in countries of the Global South, another major consideration for enabling the development of production capacities for green steel on site (Lopez et al. 2023).

This strategic alignment represents a crucial step towards achieving climate-positive industrialisation both in Germany and across its African partner countries.

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