POLICY BRIEF

Lead markets for a resilient and climate-neutral steel industry

The Low Emission Steel Standard: a path to future-proof steel?

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GERMANWATCH

Summary

The steel industry has embarked on a demanding transformation. Politicians are supporting the sector with large subsidy packages and the development of the necessary energy infrastructure. In addition to making hydrogen and renewable energy available in sufficient quantities and at affordable prices, work is also needed to establish the climate-friendly lead markets of the future.

To address the temporary price difference, lead markets must be artificially segmented to separate climate-friendly products from conventional fossil steel grades. To make these lead markets transparent and fair, a universal standard is required, as proposed by the German Steel Association in its Low Emission Steel Standard (LESS). The Federal Ministry for Economic Affairs and Climate Action has incorporated the initiative from the steel industry into its concept 'Lead markets for climate-friendly basic materials'. This position paper evaluates the LESS and the Federal Government's concept paper from a climate and development policy perspective, and makes policy proposals for the concrete implementation of future-proof lead markets in the steel industry.

Imprint

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Cover image:
Shutterstock / D. Alimkin

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08/2024

Suggested citation:
Berlepsch, T., 2024, Lead markets for a resilient and climate-neutral steel industry.

Download this document at: https://www.germanwatch.org/en/91328

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1 Introduction: State of transformation of the steel industry

The German steel industry is undergoing a process of radical change that is historically unprecedented. Coal-fired steel production is no longer fit for purpose in view of the challenges posed by the climate crisis. Following the Paris Agreement and the introduction of emissions trading, the phase-out of fossil steel has begun. German steel producers have set out to restructure their value chains to become climate-neutral. The challenges of integrating and testing new technologies in operational steelworks to gradually decarbonise production[1] are immense. In addition, the transformation is taking place under the looming threat of tough competitive conditions and global overcapacity of non-decarbonised steel, leading to a decline in demand for relatively expensive German steel. Given the complexity of this mammoth task, political support for redesigning the steel industry to align with climate goals and the workforce, whilst recognising the importance of the steel industry for the broader societal transition, is crucial.[2]

Among the most climate-damaging industrial plants in Germany, the steel and iron industry occupies the top 13 places.[3] German steel production emits around 55 million tonnes of CO_2 per year. This is around a third of total emissions in Germany. However, the good news is: Steel does not have a fundamental climate problem, but a coal problem.[4] The technology for fossil-free pig iron and steel production is available, and its widespread use could make steel a very environmentally and climate-friendly basic material due to its durability and reusability. However, a major commitment from society is needed, as plants that have evolved over time, shaping entire regions and allowing them to flourish, will have to be converted in one to two decades. But the timing is favourable: 71% of blast furnaces worldwide and 74% in the EU will have to be replaced by the end of the 2020s anyway. At the same time, this conversion also offers an opportunity to boost production and utilisation of scrap steel. Not only must the primary route be climate-friendly, but the secondary route must also be upgraded.[5]

Transforming the steel industry is like open-heart surgery. While blast furnace operations continue, the major German steel producers are building more climate-friendly direct reduction plants, which are intended to replace the use of coal in steel production in the medium term. The funding decisions for this have been ratified and issued. The current strategy provides for investment in the decarbonisation of around 60 percent of current production capacity. This strategy enjoys broad consensus among the Federal Government, leading German steel manufacturers and trade unions. Through European state aid exemptions under the Important Projects of Common European Interest (IPCEI), a good seven billion euros have been mobilised from federal, state and EU funds to gradually convert steel production from coal to hydrogen during ongoing operations. The Carbon Contracts for Difference[6] introduced in Germany could also finance the conversion of other production capacities if sufficient funds are provided in the forthcoming auction rounds. At the same time, the hydrogen economy, including infrastructure and production

[1] As the use of carbon, that is, carbon molecules, is physically and technically inevitable in iron and steel production, the term 'defossilisation' should in fact be used when referring to the avoidance of fossil molecule emissions. However, as the term 'decarbonisation' has become established in the debate, we will use it here.

[2] See Schreck, S., Kobiela, G., Wolf, S., 2023, Klimaneutrale Stahlindustrie. Rahmenbedingungen für die Transformation in Deutschland (last accessed: 8 August 2024).

[3] Hermann, H., Emele, L., 2023, Dirty Thirty – Industrial sector emissions in Germany (last accessed: 8 August 2024).

[4] See ACCR, 2024, Forging pathways: insights for the green steel transformation (last accessed: 8 August 2024).

[5] See Witeck, W. K. et al., 2024, Low-carbon technologies for the global steel transformation. A guide to the most effective ways to cut emissions in steelmaking (last accessed: 8 August 2024).

[6] BMWK website: https://www.klimaschutzvertraege.info/en/home (last accessed: 8 August 2024).

capacities, must be ramped up. The steel industry can be a major initial customer and thus a driver of the phase-in. Yet it will also have to rely on the planned expansion in order to secure the supply of climate-friendly energy sources to replace coal.

To drive investment decisions in favour of the transformation, it is now important to stimulate demand for clean, but more expensive, steel. This requires so-called (green) lead markets.

2 Lead markets for the steel industry

At present, without political support, climate-friendly products do not have a competitive edge over fossil-based products due to the higher costs. In the long term, climate-friendly steel is expected to become cheaper than fossil steel, at least in the EU. This is because, from the mid-2030s, emissions trading is likely to make coal use in steel production unprofitable, and there will be sufficient, relatively cheap renewable energy available. The quantity of reusable steel scrap is also constantly increasing, thereby enhancing the potential for recycled steel from scrap. Unlike primary steel, recycled steel has advantages in terms of energy, cost, and resource consumption. Consequently, its share of total production capacity will rise, favourably impacting the price.

In order for the more climate-friendly but initially more expensive production methods to prevail, temporary artificial market segmentation is necessary.[7] Quota-based lead markets can ensure a market-based distribution of investment costs. Primarily, lead markets create a notional market segmentation. Green (climate-friendly) steel is indistinguishable from black (coal-produced) steel in terms of its performance characteristics. However, lead markets can artificially differentiate the two submarkets.

The first step requires clear and independent certification and labelling of these products to distinguish them from conventional production methods and products. Clear certification criteria and independent verification make it more difficult for market participants to engage in fraud, and prevent greenwashing.[8] A certified technology standard can thus serve as a benchmark for other producers.[9]

The aim of creating lead markets is firstly to enforce a certain price difference, a green premium for the more climate-friendly product. The green premium reflects the additional costs incurred when purchasing the more sustainable product. Secondly, state or private sales guarantees can send clear market signals that boost demand and encourage investment in these markets. This protects frontrunners, or companies that are early adopters of new climate-friendly technologies, from the pricing power of conventionally manufactured products. The price difference will also reflect the cost difference between conventional and climate-friendly products. The green premium is established solely by the market, without the need for state actors to predict the cost difference.[10] Consequently, producers' revenues will increase. If producers pass the green premium on to their customers, this instrument, unlike other subsidy programmes, can function without direct additional government expenditure.[11] It therefore serves as an intelligent complement to the Carbon Contracts for Difference and IPCEI project funding, which are initially needed to enable early investments in green steel.

[7] Wolf, A., 2023, Klimaschutzverträge als Patenrezept für die Dekarbonisierung? (last accessed: 8 August 2024).

[8] Hamilton, S., Zilberman, D., 2006, Green markets, eco-certification, and equilibrium fraud (last accessed: 8 August 2024).

[9] Joas, F. et al., 2020, Klimaneutrale Industrie. Schlüsseltechnologien und Politikoptionen für Stahl, Chemie und Zement (last accessed: 8 August 2024).

[10] BMWK, 2023, Transformation zu einer klimaneutralen Industrie: Grüne Leitmärkte und Klimaschutzverträge (last accessed: 8 August 2024).

[11] ibid.

3 Low Emission Steel Standard (LESS): greenwashing or new European benchmark?

In April 2024, the German Steel Association and Federal Minister for Economic Affairs Robert Habeck jointly introduced the LESS labelling system at the Hannover industrial trade fair. This followed a year-long stakeholder process involving industry, science and civil society (including Germanwatch). The aim was to develop a labelling concept for CO_2-reduced steel, as well as the basic material cement and the chemical substances ammonia and ethylene. With LESS, the steel sector is now forging ahead and is working to ensure that the voluntary labelling system is also adopted at the EU level.

Low Emission Steel Standard (LESS)

The LESS classification considers both the quantity of CO_2 emitted per tonne of steel and the percentage of scrap steel used, on a scale from level A to D. This has two simultaneous aims: incentivising the conversion of primary steel production and pricing in the demand for scrap steel. There is a split level system for quality steel (mainly primary steel) and structural steel (mainly secondary steel) with different threshold values (see Figure 1). In addition to the A-D or 'near zero' classification, the percentage of scrap share and the Product Carbon Footprint (PCF) or Global Warming Potential (GWP) according to an Environmental Product Declaration (EPD) will be indicated in kilograms of CO_2 equivalent per tonne of steel.

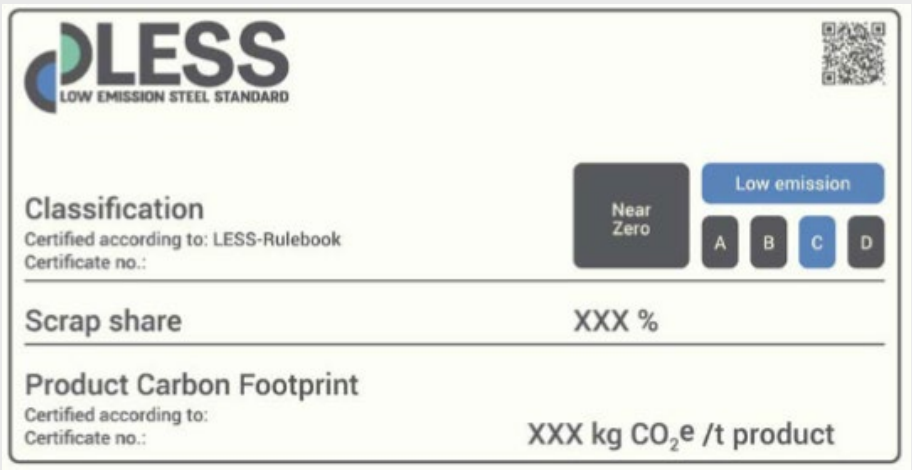

Figure 1: LESS label (source: Wirtschaftsvereinigung Stahl (German Steel Association))

The German Steel Association has published the classification system and the rulebook to be followed for certification (see Bibliography). Independent certification organisations such as TÜV Nord and others will certify the steel production routes on site. Initially, two German plants from the primary and secondary routes will be certified. The non-profit certification organisation is based in Belgium and certification is also open to international companies.

3.1 Sliding scale: hot stuff or scrap?

The Low Emission Steel Standard is based on a proposal by the International Energy Agency (IEA),[12] which presented the initial concept for a classification system for climate-friendly steel on behalf of the G7 states under the German Presidency. The result was the so-called sliding scale, which displays the scrap share on the X-axis and the greenhouse gas emissions on the Y-axis, as illustrated in Figure 2. The IEA proposal sparked intense international debate. Ultimately, five levels were established, from very good A to particularly emissions-intensive steel E.

Sandbag (2024) has identified a problem with a simplified classification according to the sliding scale: 'Penalising the use of scrap, as the sliding scale approach would do, could hinder the development of more efficient secondary markets and the closing of material loops in the steel sector.' The criticism mainly stems from the fact that the sliding scale considers the technological state of the production route and lowers the threshold values for the classes in a 'sliding' fashion towards increasing scrap utilisation. This disadvantages steel with a higher scrap share and therefore a lower climate footprint. For example, steel produced using an electric arc furnace (EAF) from 100% steel scrap and renewable electricity will achieve class B with 500 kilograms of CO_2 equivalent per tonne (CO_2e/t). In contrast, steel made from sponge iron produced using green hydrogen from a direct reduction (DR) plant with the same emissions intensity will receive a better rating of class A.

This reflects the two aims in decarbonising the steel sector, which are not easy to reconcile. From a raw materials and circular economy perspective, the use of secondary material is always preferable to production from iron ore. This is because, in terms of energy efficiency, the direct use of electricity is superior to conversion losses in the production of green hydrogen. From this perspective, the incentive for scrap steel should be maximised.

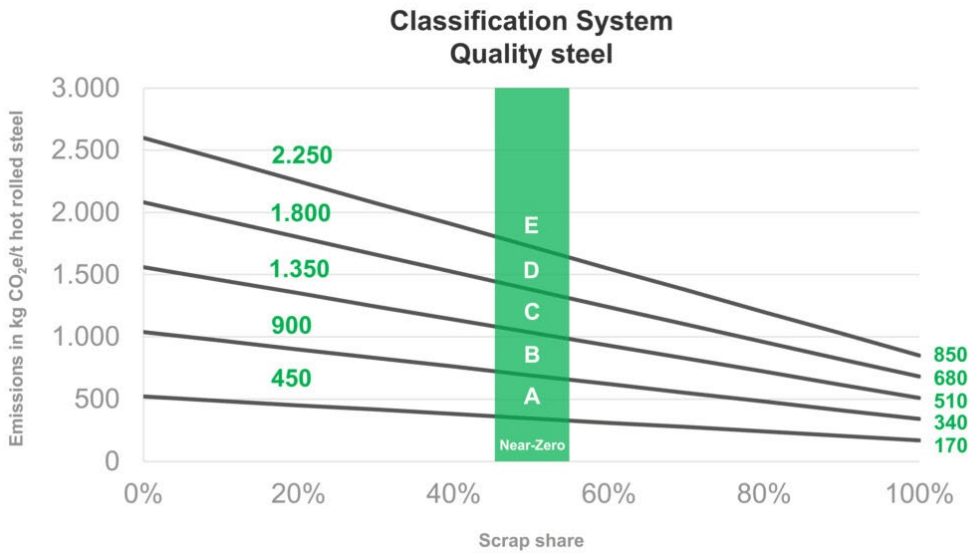

Figure 2: Threshold values for quality steel with sliding scale (source: Wirtschaftsvereinigung Stahl (German Steel Association))

However, the limited availability of scrap underscores the urgency of decarbonising primary steel production, which is more expensive, at least for the time being. LESS takes this into account.

[12] IEA, 2022, Achieving Net Zero Heavy Industry Sectors in G7 Members (last accessed: 8 August 2024).

Furthermore, various production routes with different technologies and scrap shares are feasible, and different scrap shares may be appropriate depending on the use of the end product. Using a single label with fixed emission values would be impractical, as it would be very easy to obtain for recycled steel and virtually impossible for primary steel. LESS addresses the alternative of using two different labels by setting different threshold values for quality steel and for structural and reinforcing steel. The threshold values for structural and reinforcing steel are higher, ranging from 50 to 250 kg CO_2e/t, but otherwise have the same properties.

Using two completely different labels for primary and secondary steel would not account for any intermediate steps in scrap use. It would therefore also not incentivise an increase in scrap share in primary production. In this respect, the sliding scale is truly technology-neutral and can also include future scrap utilisation methods still in development. For example, the scrap share in the basic oxygen furnace (BOF), where steel scrap has mainly been used as a coolant to date, could in future exceed the current 20%. Alternatively, quality requirements could change, creating new applications for secondary steel with higher scrap rates.

Moreover, it is clear that the amount of scrap available is not infinite. The collection rates for steel are already around 90%.[13] The potential to increase collection rates and scrap use must be exploited, but it is limited. 97% of CO_2 emissions come from the primary route. The key climate lever is therefore the decarbonisation of primary steel production.

LESS also requires information on the product carbon footprint (PCF) and global warming potential (GWP) according to the environmental product declaration (EPD) of the delivered steel product. German scrap steel producers therefore also support LESS. Their argument is that they will sell their scrap steel anyway, as end products are evaluated mainly according to the overall footprint, and their production method is the lower-emission one for purely technological reasons.

3.2 Evaluation

In order to evaluate the LESS system, Germanwatch considers whether the German Steel Association's proposal is ambitious and consistent from a climate action standpoint. Additionally, different starting conditions for emissions reduction in the various technological production routes must be considered. The use of scrap for steel production, which is advantageous from a circular economy perspective, must also be analysed in global terms, recognising scrap as a limited resource.

How ambitious is LESS?

The LESS scale stipulates that, based on the current state of technology, all primary steel plants can only achieve a maximum D certification. Better classification is only achievable through new, potentially fossil-free plants, such as direct reduction combined with electric arc furnaces (DRI-EAF). Using natural gas (NG) would likely achieve a maximum rating of class C (NG-DRI-EAF). For a B rating, hydrogen (H_2) would have to be used (H_2-DRI-EAF). This production route could only be awarded an A if the hydrogen used is green and the electricity comes from 100% renewable energy. For the best 'near zero' label, additional reduction of upstream emissions (Scope 3.1) from iron ore mining and

[13] For alloyed recyclable steel, the end-of-life recycling rate is even higher at 95%. See worldstainless, 2023, The Global Life Cycle of Stainless Steels (last accessed: 8 August 2024).

other alloying metals is necessary.[14] The ambition of the near zero target set by LESS becomes clear considering the investments required to enable the technology.[15]

The LESS scaling takes into account the steps required for transformation in the correct sequence. Step 1: plant renewal; step 2: fuel renewal.[16] This largely eliminates 'greenwashing'. Only in the transition phase, when old and new routes are combined in the accounting terms, is the system susceptible to embellishment. From an economic point of view, it may be advisable to maximise the service life of blast furnaces. However, a balance must be found between the swift shutdown mandated by climate policy and the technically and economically feasible gradual scaling of climate-friendly capacities. This would ensure sufficient business flexibility in the transition phase and make the transformation economically sustainable.

Does LESS balance primary steel incentives and scrap use?

The availability of scrap is limited. By gradually favouring the primary route, LESS protects scrap steel producers from scrap price inflation. A decarbonisation pathway based exclusively on electric arc furnaces (EAF), using scrap or imported iron pellets, is neither consistently sustainable nor equitable at the global level. If the production step of iron ore reduction in blast furnaces or in direct reduction plants upstream of the EAF is simply imported from abroad, this only results in climate-damaging emissions being shifted geographically ('carbon leakage'). Globally, emissions would then remain a zero-sum game. However, if steel manufacturers rely exclusively on steel scrap, significant protectionist intervention in the functioning international scrap market would be necessary. Countries with developing economies, like Turkey[17] and India, rely on scrap imports to meet their steel demand. Restricting scrap exports from developed Western states would cause severe friction. The opportunity cost of scrap protectionism is that less scrap would be available where it is needed for decarbonisation. Scrap protectionism is therefore not a globally just transformation strategy. Instead, states such as Germany should use their financial and technological resources to help decarbonise the primary route and make it market-ready.

Although increased regionalisation of the scrap market is desirable, reducing transport emissions would hardly justify the efficiency losses that would occur if the international scrap trade were restricted. Moreover, existing steel scrap is already largely collected and processed.[18] The technology for this is mature and fully developed. Although efficiency improvements and further increases in collection rates are desirable, the potential is limited. Criticism of 'downcycling' holds little weight in the steel sector. Given existing demand, little is gained if more secondary material is used in the automotive industry. The recycled steel used there would then no longer be available in other sectors, such as construction, where more primary steel would be required. As long as overall steel

[14] This also distinguishes LESS from alternative certification systems, which for the most part do not take alloys and upstream emissions into account. See Burmeister, H., Sartor, O., Reimann, K., 2023, Labels for climate-friendly basic materials: A guide to the debate (last accessed: 8 August 2024).

[15] During the stakeholder process, a 100 kilogram addition in emissions was included in LESS compared to the IEA proposal. This accounts for the product lifecycle demands by requiring LESS to also cover the supply chains of upstream products (Scope 3.1) and reduce these emissions by 50% for the near zero class.

[16] Blast furnaces should be replaced by direct reduction plants as quickly as possible. These offer a distinct flexibility advantage, as they can initially operate with high natural gas shares while hydrogen availability is still low. The shares can then be gradually switched to hydrogen as availability increases. See Joas, F. et al., 2020, Klimaneutrale Industrie. Schlüsseltechnologien und Politikoptionen für Stahl, Chemie und Zement (last accessed: 8 August 2024).

[17] Turkey alone imports 25% of the global scrap volume. Scrap protectionism would devastate the Turkish steel sector, which is restricted in its ability to decarbonise its industry with subsidies due to an agreement with the EU on accession negotiations.

[18] Recyclers could potentially benefit from better information sharing about product contents through a digital product passport, as currently planned by the EU. This could be particularly helpful for small and technical products. For large steel components (bridges, building beams, etc.), there are already good methods for determining alloy composition.

consumption does not fall, the sector remains a zero-sum game and focusing solely on secondary steel as a decarbonisation strategy is futile.

Conclusion

The potential to reduce CO_2 emissions in steel production through recycling and a circular economy must be exploited to the full.[19] However, as over 90% of the steel industry's emissions come from coal combustion in the blast furnace and basic oxygen furnace on the primary route, it is appropriate to reward efforts to decarbonise this route in particular. The sliding scale of LESS does just that.

The LESS is highly ambitious, even if ever lower threshold values are desirable from a climate action perspective. 500 kg CO_2e/t, as specified as the threshold value for near zero in the case of scrap-free quality steel, is certainly far from zero. However, it is also clear that there will likely always be unavoidable residual emissions in steel production.[20] Since LESS also includes supplier emissions, the efforts to also make mining emission-free would have to be enormous to achieve completely climate-neutral steel. Cutting emissions by more than two tonnes of CO_2 equivalent per tonne of steel and nearly eliminating process emissions through direct reduction using green hydrogen is a significant advance and would dramatically reduce the industry's share of total emissions.

Another aspect to be reviewed is the data collection methodology. The independent certification organisations will now conduct the first measurements using the LESS rulebook and certify the first voluntary production routes. How well the individual production steps in integrated steelworks are separated must be analysed in detail. Simply calculating the mass balance of the entire production process is inadequate for transparent certification. Moreover, LESS does not consider emissions of other pollutants and particulate matter besides CO_2 equivalents. 'Low emission' only refers to gases that are harmful to the climate. Health issues in steel production are not considered. Another factor not taken into account is the human rights 'footprint', which is especially substantial in mining regions due to the large amount of iron ore required for primary steel production. LESS-certified steel is therefore not automatically 'responsible steel', which also considers human rights and the rights of indigenous peoples, as well as labour and environmental conditions in mining.

Nevertheless, Germanwatch views the Low Emission Steel Standard as a consistent and transparent classification system for more climate-friendly steel, achieving a balance between climate protection and economic efficiency. It is therefore a first step towards creating green lead markets, but only a first step. For LESS to be a success, additional policy instruments are needed to boost demand for LESS-certified steel.

[19] One idea to increase the amount of steel scrap available in Europe is to dismantle ships at the end of their lives in shipyards in northern Germany. The employment potential this would create for coastal locations has been examined by the Leibniz Centre for Tropical Marine Research (ZMT) in Bremen. See ZMT, 2023, Potenzialstudie Schiffsrecycling.

[20] Depending on the route, between 0.4 and 2% compared to the coal blast furnace route. See Witeck, W. K. et al., 2024, Low-carbon technologies for the global steel transformation. A guide to the most effective ways to cut emissions in steelmaking (last accessed: 8 August 2024).

4 Instruments for implementing lead markets

The Low Emission Steel Standard lays the foundations for creating lead markets in the steel sector. The labelling of a green product, the definition, and clear rules for certification are the first steps, a necessary but not sufficient condition. A certification system alone does not create lead markets; it must be brought to life. It is vital to continuously raise ambitions, while keeping in mind the ability of steel manufacturers to decarbonise. This requires carefully balanced instruments. Depending on the availability of green hydrogen, class B and A steel could be available from 2030.

Germanwatch calls for instruments to establish lead markets for quality and structural steel at European and German federal level using LESS and with increasing ambition from 2026. To successfully transform the steel industry, policy instruments must be used that help phase in climate-friendly steel production and accelerate the phase-out of fossil steel production. To make space for a sales market for climate-friendly steel, the production capacities for fossil coal steel from blast furnaces must be reduced simultaneously, given the overcapacity. Only a policy mix that both promotes and demands action is capable of initiating a transition phase that ensures sustainability and hence climate-friendly employment and value creation during ongoing operations.[21]

4.1 Incentivising the various dimensions of the green steel transformation

Our concrete proposal for introducing green lead markets, a combination of **increasing minimum standards** and **public procurement**, is based on the various dimensions of the green steel transformation. In order to comply with the Paris climate goal and the European Fit for 55 package, coal must be completely phased out from the steel industry. To achieve this, the phase-out of the fossil blast furnace route from **primary steel production** must be implemented gradually as soon as direct reduction plants are ready for operation as alternatives. This is expected to be the case from 2026, or 2027 for some plants. From then on, fossil steel capacity can be reduced in the same way. Even if natural gas is initially used as a reducing agent, this will also significantly lower the carbon footprint.[22] The use of green hydrogen can then be gradually phased in as quickly as possible as availability increases.

Secondary steel, produced from recycled scrap in electric arc furnaces, has a significantly lower CO_2 footprint purely from a process perspective and is superior to primary steel from a climate action perspective. Increasing the share of scrap steel in overall capacity should therefore be an integral part of a transition strategy.[23] However, as the demand for scrap is high and the supply of scrap fluctuates with the economy and is naturally limited, its share in total steel production can only increase to a limited extent. From the mid-2030s, however, an increase in scrap availability should be

[21] Algers, J., Åhman, M., 2024, Phase-in and phase-out policies in the global steel transition (last accessed: 8 August 2024).

[22] Using natural gas in direct reduction plants (NG-DRI) would already reduce climate gas emissions by about 57% compared to the coal blast furnace converter route (BF-BOF). See Lüngen, H. B., 2021, Wege zur Minderung von CO_2-Emissionen in der Eisen- und Stahlindustrie in Europa (last accessed: 8 August 2024). Whether blue hydrogen can be used temporarily and viably in the decarbonisation of industry depends on many preconditions and prerequisite framework conditions. See Schreck, S., 2024, Blauer Wasserstoff: Katalysator oder Stolperstein für eine klimaneutrale Wasserstoffwirtschaft? (last accessed: 8 August 2024).

[23] In addition, import substitution is increasingly being discussed as a resilience strategy for the transformation. Raw material security can be achieved much more easily through the circular economy and recycling than through a reliable supply of primary raw materials in mining. Raising scrap rates will therefore increasingly become a goal of security policy.

expected as steel-based infrastructure and industrial plants are replaced and decommissioned, and the total volume of steel in circulation rises. When the price of steel scrap rises, the incentives to increase collection rates and realise the potential of scrap use will also increase.

Another factor in a sustainable transition strategy is sufficiency. **Sufficiency** aims to reduce the production and consumption of goods with a harmful environmental impact. The steel industry operates with economies of scale due to the size of investments in plants and their strategic importance. The result is enormous structural overcapacity of around 24% in a tough global market. Reducing global overcapacity would significantly help to curb the steel industry's excessive emissions.[24] However, it is also clear that steel and other metals will be needed to modernise energy systems and transform the economy. The total iron demand per megawatt hour is lower for renewable energy than for fossil energy systems, which means that the demand for steel will fall in the long term.[25] However, the pace of transformation and especially the high steel demand for wind turbines[26] may mean that primary steel production in direct reduction plants will temporarily have to be higher than the level at which it will stabilise at the end of the transition phase. The Institute for Energy and Environmental Research sees enormous potential for saving primary raw materials for steel and iron products by 2050 through the use of secondary raw materials.[27]

To reduce overall steel consumption, it is advisable to use steel as long as possible, thus slowing down the cycle. Wherever applicable, finishing solutions such as galvanising or other electroplating or alloying processes should therefore be used to extend the service life of steel and non-ferrous metals, thereby reducing resource and energy consumption.

Ecological criteria in public procurement can stimulate early demand for green steel and other materials. However, the use of public funds to establish new sales markets for climate-friendly products can only serve as a bridge. In the medium term, private markets must also increasingly demand climate-friendly products. Regulation and gradually increasing **minimum standards** with emissions intensity requirements must therefore be the objective. EU standards for the maximum CO_2 emissions per product are needed.

This transition phase is expected to reach a turning point in the mid-2030s. After this point, the 'brown premium' will surpass the 'green premium', as climate-friendly steel becomes cheaper (thus the green premium shrinks) and emissions trading (ETS) makes climate-damaging steel more expensive (and thus the 'brown premium' grows). The Office of Technology Assessment at the German Bundestag expects cost parity between conventional and low-CO_2 steel by 2035 under these conditions.[28] At that point, no additional public costs will arise. Once fossil steel production becomes unprofitable and is phased out, it will no longer be necessary to support lead markets through public procurement. Until then, a healthy mix of instruments consisting of increasing **minimum standards** and **public procurement** is needed.[29]

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[24] See WVS, 2023, Überkapazitäten im Stahlbereich gefährden die Klimaziele. Fünf Aussagen zur Strukturkrise der globalen Stahlindustrie (last accessed: 8 August 2024).

[25] Chardayre, T. I., Reckordt, M., Schnittker, H., 2022, Metalle für die Energiewende. Warum wir die Rohstoffwende und die Energiewende zusammendenken sollten (last accessed: 8 August 2024).

[26] Given that the steel used accounts for the majority of a wind turbine's emissions, green steel is the main lever for eliminating a large part of the climate footprint of wind energy. See Voigt, N. et al., 2022, Transforming the Steel Industry May Be the Ultimate Challenge (last accessed: 8 August 2024).

[27] Dittrich, M. et al., 2024, Nutzung und Reduktionspotentiale von Basismetallen in Deutschland und der EU (last accessed: 8 August 2024).

[28] Caviezel, C., Achternbosch, M., Grünwald, R., 2024, Alternative Technologiepfade für die Emissionsreduktion in der Grundstoffindustrie (last accessed: 8 August 2024).

[29] Burmeister, H., Sartor, O., Reimann, K., 2023, Labels for climate-friendly basic materials: A guide to the debate (last accessed: 8 August 2024).

4.2 Gradually increasing minimum standards

Binding minimum requirements for the emissions intensity of steel as a basic material are required. These will ensure that low-emission steel gradually becomes the new standard despite the initially limited demand due to price differences. As with other basic materials and product groups, the Ecodesign Regulation (ESPR) adopted by the EU in May 2024 sets product-specific requirements for climate and resource protection and consumer protection in steel production.[30] These product-specific legal acts offer the chance to embed the transformation of the steel industry into the decarbonisation pathway prescribed by the ETS, concretise the phase-out of fossil steel through emission guardrails, and support the industry in its transformation efforts. These minimum standards will then apply to all products of this type placed on the market, including imports. The latter is vital to ensure equal competitive conditions in the EU internal market and prevent carbon leakage.

The Federal Ministry for Economic Affairs and Climate Action has presented interesting proposals for implementing green lead markets. Germanwatch supports the concept presented, particularly the increasingly ambitious requirements for emissions intensity.[31] We also propose setting the minimum requirements in the delegated act of the Ecodesign Regulation for the steel sector. It is essential that the EU minimum requirements for emissions intensity increase gradually, setting out the transformation pathway in an ambitious and predictable manner. At the same time, they must be balanced and achievable. Early announcement and predictable specifications are particularly important because they provide sufficient orientation for investment decisions and prevent disruptive production bottlenecks.

Gradually increasing minimum standards

	2030	2035	2040	2045
LESS classification	D	C	A	near zero
Emission threshold value for quality steel made from 20% scrap in kg (CO_2e/t)	2250	1800	900	450
Emission threshold value for structural steel made from 100% scrap in kg (CO_2e/t)	600	480	240	120

Table 1: Gradually increasing minimum standards[32]

[30] The new EU Ecodesign Regulation (ESPR) came into force in May 2024. It establishes the framework for setting specific requirements for the design and production of goods for various product groups in delegated acts. Steel and iron products are to be prioritised. A 'Steel Regulation' ('Delegated Act Steel') under the ESPR is expected from 2026. Stakeholder discussions involving Germanwatch are currently being held by the Joint Research Centre of the EU Commission.

[31] BMWK, 2024, Leitmärkte für klimafreundliche Grundstoffe. Konzept des Bundesministeriums für Wirtschaft und Klimaschutz (BMWK), pp. 35 et seq. (last accessed: 8 August 2024).

[32] Figures from: BMWK, 2024, Lead markets for climate-friendly basic materials. Concept proposed by the Federal Ministry for Economic Affairs and Climate Action (BMWK); Theuringer, M. et al., 2024, Rulebook for the classification system of the Low Emission Steel Standard (LESS) (last accessed: 8 August 2024).

Germanwatch proposes implementing the Federal Government's lead market concept for EU minimum standards for the emissions intensity of steel products, aligning with the limit values of the LESS. Achievable maximum emission values should be introduced from 2030, with near zero targeted for 2045. Different threshold values are specified for quality steel and structural steel. Based on the goal of climate neutrality by mid-century, the following stages and threshold values for minimum emissions intensity requirements are derived from LESS and the Federal Government's concept (see Table 1).

Gradually increasing minimum standards based on the proposed threshold values would allow steel producers sufficient time to adapt, as neither the timing of introduction nor the required emission level should be too technically demanding. In the middle of the transition phase, the pace must be stepped up (the curve has to rise more steeply) and the level of ambition should double within a decade to achieve the climate goals (Figure 3). The phase-in of climate-friendly steel during this period makes sense in purely economic terms, as the price parity of green and conventional steel is likely to be reached in this phase. To meet the EU goal of climate neutrality by 2050, near zero emission levels should be achieved by 2045 at the latest.

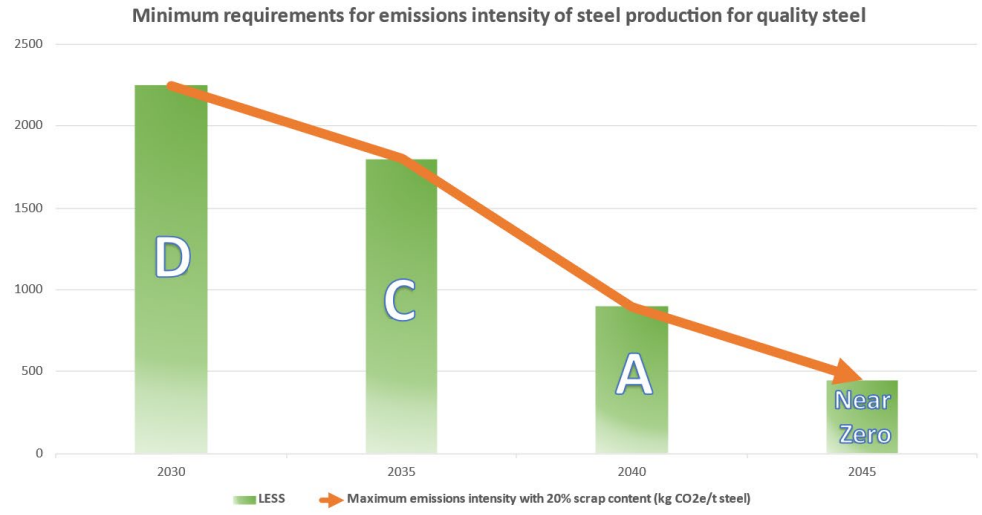

Figure 3: Minimum requirements for emissions intensity (source: own illustration)

The middle transition phase presents a challenge. Firstly, due to the long investment cycle, facilities must be set up quickly and with minimal red tape. Secondly, regulatory framework and infrastructure for renewable energy and hydrogen must be in place. The groundwork must be laid now to ensure that the steel industry's transformation becomes a success story. Introducing a minimum standard with LESS level C, as proposed by the Ministry for Economic Affairs, would result in the extensive shutdown of the blast furnace route from 2035 and is therefore to be welcomed for climate action reasons. At the same time, it is crucial to meet the steel demand necessary for the transition to a low-carbon society, ensuring that there is no 'phase-out gap'. To achieve this, direct reduction plants and electric arc furnaces must be built and phased in quickly enough for the transition to take place without interrupting operations. The gradual transition from natural gas to green hydrogen (and from grey to green electricity) will then be comparatively easier, provided the necessary infrastructure is in place. A further increase in the level of ambition by 2040 will ensure that the transformation pathway continues without a 'lock-in' to blue hydrogen. During this 'hot' phase of the transformation, the public sector should become a driver for the emergence of the new market. The use of a steel certificate for public procurement can close this gap (see box).

Accelerated phase-out through minimum standards

With weaker lead market instruments such as minimum quota or production quota regulations, the only change would be to companies' balance sheets. This is because specific products would be sold in specific markets to meet quotas, without changing the composition of the total production volume. Non-European manufacturers could simply bring to the European market the climate-friendly part of their production which they need to meet the quota. They would then have an advantage, and the level playing field would not be maintained. Production-only specifications, which only impose requirements on production and not on the placing of products on the market, would also put European companies at a disadvantage. To prevent this, Germanwatch proposes a combination of slowly increasing EU-wide minimum standards for all steel products placed on the market, which gradually push the most CO_2-intensive technologies out of circulation. At the same time, public procurement creates incentives to produce substantial volumes of particularly climate-friendly steel early on, as these are purchased reliably and at a fair price. This combination of robust lead market instruments has the potential to phase out coal-based steel and simultaneously phase in climate-friendly steel (as illustrated in Figure 4).

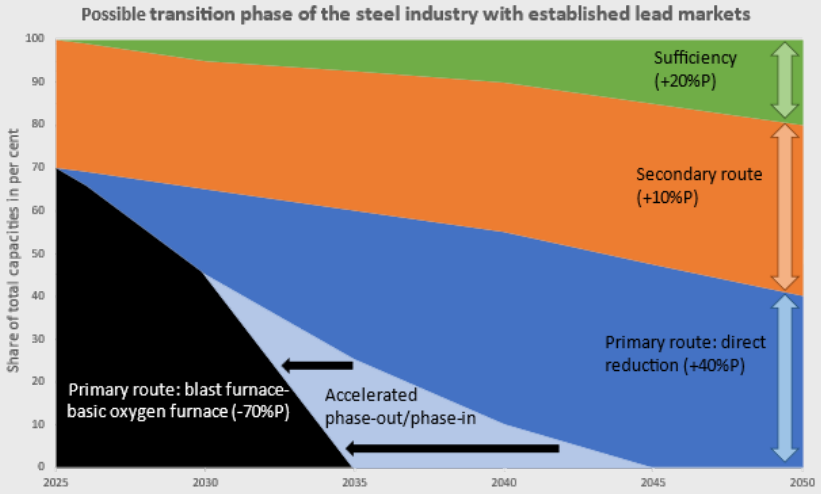

Figure 4: Transition phase of the steel industry (source: own illustration)

4.3 Public procurement and tenders

As the existence of certification alone will not stimulate demand to a level sufficient to cover the high investment costs, additional push and pull factors must also come into play. State-assured sales guarantees through quotas in public procurement and contract awarding are instruments envisaged by the Federal Government to create green lead markets.[33] The Federal Government's Steel Action Concept has already established the state-led increase in demand for climate-friendly products as a pillar of the transformation.[34] The concept paper 'Lead markets for climate-friendly basic materials' recently presented by the responsible ministry attempts to bridge the gap between the announcement and concrete steps towards the actual creation of lead markets. For the steel sector in particular, the certification issue is now clearly answered, and a pathway for gradually increasing minimum requirements is outlined. This is a clear specification of the pathway for phasing out fossil steel production and is therefore very welcome. The concept is less advanced in the areas of cement and chemicals. However, we will focus on evaluating the concept in the steel sector below.

Noticeable are appeals to the private sector to adopt and use voluntary labelling for low-carbon steel, and to steel consumers to then demand the green steel. With this strong focus on voluntary action, the Federal Government is falling behind previously announced plans to stimulate public sector demand. Germanwatch is of the opinion that concrete guidelines are now needed for public tendering and procurement law. In Germany and the EU, the public sector is responsible for 15% of gross domestic product and therefore has considerable power to shape the market.[35]

The announced procurement reform package is not expected to address any specific products, but will create guardrails for green procurement. However, all of this is on a voluntary basis. Price will continue to win out over sustainability. In order to change this, a paradigm shift in procurement is necessary. The frequently asked question in procurement offices is: 'How much green steel is available and how do we recognise it?' The LESS has now answered this. It is now time to start taking action.

Since the 2014 EU Directive on public procurement, implemented in Germany in 2016 through the Act for the Modernisation of Public Procurement Law, it has been possible to consider sustainability criteria in procurement. The United Nations has also formulated environmentally friendly procurement as a target of the Sustainable Development Goals (SDG 12.7). However, higher procurement costs for environmentally friendly products and the lack of resources in administration are obstacles. These stand in the way of the genuine application of public procurement as a decarbonisation measure if sustainability criteria are considered on a purely voluntary basis.[36]

Germanwatch therefore calls for public procurement and contract awarding in Germany relating to steel to be reformed so that a substantial portion of the more climate-friendly steel produced is purchased by the public sector. This would give planning certainty, with the state actively participating in creating the market for these products and rewarding providers who have decided at an early stage to invest in the transformation. Even if a reform of the General Administrative Regulation on the Procurement of Climate-Friendly Services (AVV Klima) is not directly based on a voluntary

[33] Bündnis 90/Die Grünen, FDP, SPD, 2021, Mehr Fortschritt wagen. Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit – Koalitionsvertrag zwischen SPD, Bündnis 90/Die Grünen und FDP [Coalition agreement between SPD, Bündnis 90/Die Grünen and FDP]; BMWK, 2023, Transformation zu einer klimaneutralen Industrie: Grüne Leitmärkte und Klimaschutzverträge (last accessed: 8 August 2024).

[34] BMWi, 2020, For a strong steel industry in Germany and Europe. The Steel Action Concept (last accessed: 8 August 2024).

[35] For building materials such as cement, the share of public procurement is even higher, at around 31% (BSoG 2024: *Public procurement of cement and steel for construction*, Brussels School of Governance).

[36] Chiappinelli, O., Zipperer, V., 2017, Öffentliche Beschaffung als Dekarbonisierungsmaßnahme: Ein Blick auf Deutschland (last accessed: 8 August 2024).

label such as LESS through a procurement reform package, the defined emission limits could be aligned with LESS. This would make procurement as uncomplicated and bureaucracy-free as possible. In the building and construction sector in particular, the Federal Government could adopt the LESS limits for structural steel on behalf of the federal states and local authorities. By incorporating these limits into part of their procurement, they could achieve a significant climate impact while substantially advancing the creation of green lead markets. LESS or a standard based on LESS should be incorporated into the Assessment System for Sustainable Building (BNB) at federal level and into the EU Construction Products Regulation.

The public sector vehicle fleet includes vehicles used in local public transport, fire brigades, police and emergency services, municipal waste disposal, maintenance companies and other public services. An amendment to the Act on the Procurement of Clean Road Vehicles (SaubFahrzeugBeschG) could now consider not only operational emissions but also production emissions.[37] Priority in procurement should not only be given to battery electric vehicles but also to vehicles produced in a more climate-friendly way.

The length of investment cycles delays the response of market participants to green lead market signals. The quotas for public procurement must therefore be carefully aligned with the technological capabilities of market participants while being ambitious enough to genuinely accelerate the technological transition.

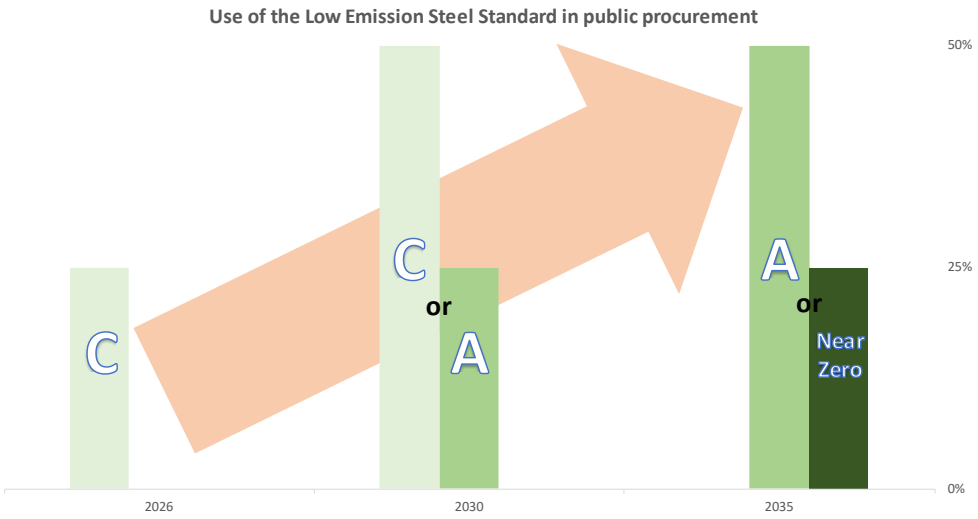

Figure 5: Use of the LESS in public procurement (source: own illustration)

From 2026, when the first climate-friendly steel is expected to come onto the market in Germany, the public sector should choose at least LESS level C or better for 25% of the purchased steel (see Figure 5). According to the German steel industry association, this is very easy to achieve by replacing coal with natural gas. At the same time, the industry's frontrunners would be rewarded and federal, state and local government procurement offices would be prepared for the new procurement policies. The system could thus be tested without overburdening industry and the public sector.

[37] It is estimated that the current stock of publicly procured vehicles is about nine million. Many of these are large, steel-intensive vehicles.

The next phase is aimed at boosting the phase-in of green steel production, even though it will still be more expensive than the conventional steel production. Therefore, from 2030, a significantly larger portion of the more climate-friendly steel produced should be purchased by the public sector. This can reward the transformation of the steel industry through volume purchases while also advancing the phase-in of the hydrogen industry. To stimulate demand for climate-friendly steel, at least half of the publicly procured and used steel should be classified as at least LESS level C from 2030. To give steel producers some flexibility during the phase-in, it could be appropriate to allow them the option to offer 25% of steel classified as A instead of 50% C. This would mean producing only half the quantity, but with almost twice the climate action measures. This option would accommodate the challenges of the phase-in and strike a balance between attainable and ambitious requirements in a technology-neutral way.

A similar option could be considered for the next stage. From 2035, at least 50% of publicly procured steel should achieve at least level A. The requirements could also be met if 25% is classified as near zero instead. Again, it is important to reward additional efforts required for near zero, such as the Scope 3 emission reductions from mining. From the mid-2030s, the additional costs of climate-friendly steel compared to conventional steel will fall as renewable energy becomes cheaper and fossil fuels more expensive. As a result, creating lead markets through public procurement will gradually cease to be necessary. Once climate-friendly products become cheaper, the lead market will take over the entire market and artificial market segmentation will no longer be needed. The bridging measures can then be discontinued. However, binding and comprehensive product standards are needed to ensure that green production in the EU does not come under price pressure from imports from regions with less stringent CO_2 regulations.

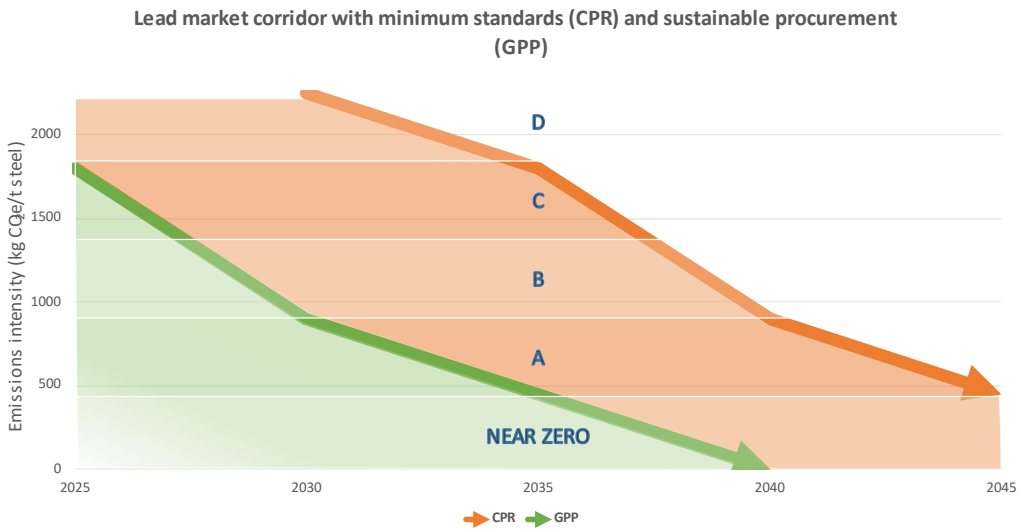

Figure 6: Lead market corridor with minimum standards (CPR) and sustainable procurement (GPP) (source: own illustration)

A combination of minimum emission standards (Carbon Product Requirements[38]/CPR) and sustainable procurement (Green Public Procurement/GPP) can create a lead market corridor. This allows steel producers to choose the best transformation pathway for them without being restricted to any particular technology. Figure 6 shows what the proposed LESS threshold values for emissions intensity could look like as the guardrails of the corridor. European harmonised minimum standards (CPR) would gradually remove the worst performers from the game and prescribe a clear phase-out of the most emission-intensive production routes. This process would be budget-neutral and market-transparent. At the same time, sustainable public procurement (GPP) would create an incentive to lead the way in order to secure a portion of the higher-priced market share purchased by the public sector. This ensures that the minimum standards only specify the slowest transformation, but frontrunners and early movers are rewarded. The lead market instruments proposed here thus form the guardrails for the green steel transformation.

Better than LESS steel is simply *less* steel!

If public procurement purchases a substantial portion of climate-friendly steel with ambitious specifications, it also helps to significantly strengthen the circular economy. This is because it is easier to achieve the standard using recycled steel than via the primary steel route. In addition, consideration should be given to how sufficiency strategies such as lightweight construction or steel substitution could be rewarded and promoted through public procurement. For instance, the tender criteria could incentivise material savings by treating a 25% reduction in steel consumption as equivalent to 25% lower-emission steel. To ensure this provision results in actual material sufficiency or substitution with climate-friendlier options, safeguards must prevent a rebound effect where more climate-damaging cement is used instead.

Germanwatch asserts that for LESS to succeed in public procurement, the federal government must financially support local authorities, rather than passing on to them the additional climate action costs. To simplify the awarding and procurement process for the responsible authorities, incorporating a proportion of climate-friendly basic materials should be mandatory, not merely one of several tender criteria.

4.4 Private initiatives to increase demand

Private demand for climate-friendlier steel needs to rise alongside public demand. For example, car buyers could be offered the option of selecting parts made from green steel, encouraging voluntary demand that supports lead markets. This would firstly require car manufacturers and suppliers to clearly signal their commitment to purchasing and offering green steel. Secondly, customers and consumers would need to willingly pay the green premium for climate action. A Transport & Environment study found that the additional cost of green steel is just 57 euros, which is less than the price of a tyre change.[39] Yet this could cut CO_2 emissions from European car production by 6.9 million tonnes by 2030. A small price for a major benefit.

Of course, original equipment manufacturers (OEMs) in the automotive industry could also shift their purchasing policies towards climate-friendlier primary products and publicly commit to this change. The Climate Group's SteelZero initiative is an attempt by civil society to persuade private steel-consuming companies to make voluntary commitments to set and publicly announce goals

[38] See Shawkat, A., Cosbey, A., forthcoming, A vision for international trade in CO2-intensive materials: the role of carbon product requirements (Agora Industrie).

[39] T&E, 2024, Green steel can cut climate impact of car production for just €57 a vehicle (last accessed: 25/07/2024).

for reducing emissions in steel purchasing.[40] Over 40 companies from seven sectors have pledged to buy only net-emission-free steel by 2050 at the latest. The sole German company among them so far, wind turbine manufacturer Siemens Gamesa, aims to use 50% low-emission steel by 2030 and only net zero-emission steel by 2040. Given the patient nature of voluntary commitments, one approach to increasing green steel use in the automotive sector could be to set a minimum of 40% green steel in new cars in the EU by 2030, as per the EU End-of-Life Vehicles (ELV) Regulation, and increase this to 100% by 2040, as proposed by Transport & Environment.[41]

Tax incentives could be introduced for the large fleets of the 17,000 German taxi companies, Uber and similar services, and company car fleets, not just for climate-friendly drivetrains but also for climate-friendly steel and other materials. This would require an overdue reform of the privileged status of company cars.

Initiatives in the steel-intensive rail sector could prioritise or stipulate the use of climate-friendly steel in rail and bridge construction, and for the production of locomotives, wagons, railcars, and goods trains. In particular, the companies belonging to Deutsche Bahn AG, which are publicly owned and promote climate-friendly mobility, could gain an additional climate edge over road transport by committing to buying climate-friendly steel. A joint purchasing policy between the railway companies would also be feasible due to the highly interconnected European rail system. Even if this does not yet cover the entire European network, a Weimar Triangle with the major railway nations of Germany, France and Poland could lead the way, following their announcement of closer cooperation on climate protection.[42]

Finding the right balance between private and public demand is critical and depends on how the price gap between climate-friendly and conventional steel changes. Public demand, supported by binding quotas for specific product classes, will be crucial in the early stages of developing the lead market. This is necessary before the private sector can demand a substantial proportion of green steel capacity based solely on price. Forecasting price developments is challenging, as it depends on various factors like energy and hydrogen infrastructure, the global economy, and emissions certificates. Therefore, minimum emission requirements serve as a critical transition tool, acting as a lower guardrail for the transformation pathway. Initially, minimum standards for emissions intensity (in CO_2 per tonne of steel) should be established at the European level and, ideally, harmonised internationally over time within frameworks like the Climate Club.[43]

4.5 European and international level

In a globalised world, and even more so in the European single market, lead markets cannot be established at national level. The EU Ecodesign Regulation provides the right framework for initiating product-specific lead markets. Companies, politicians, and civil society are well advised to engage in developing product-specific delegated acts at European level, where the framework conditions for lead markets are defined under the leadership of the EU Commission. Germanwatch believes that the German venture can serve as a blueprint for further developing concepts suited to the needs of the European internal market. This applies both to the LESS classification system developed by the German Steel Association and the 'Lead markets for climate-friendly basic materials' concept of the Federal Ministry for Economic Affairs and Climate Action. It makes sense to base the

[40] Climate Group, Building demand for net zero steel (last accessed: 25/07/2024).

[41] T&E, 2024, Green steel can cut climate impact of car production for just €57 a vehicle (retrieved on: 25/07/2024).

[42] Hermwille, L., Dellatte, J., Śniegocki, A., 2024, Das Weimarer Dreieck als Motor der EU-Industriepolitik (last accessed: 8 August 2024).

[43] See Shawkat, A., Cosbey, A., forthcoming, A vision for international trade in CO2-intensive materials: the role of carbon product requirements (Agora Industrie).

emission limits on the LESS levels because they are ambitious and provide sufficient technological flexibility for incentivisation and the use of recycled steel. The German steel industry and the Federal Government's leadership with their proposals and concepts benefit the European debate. The LESS certification system can now be tested on a voluntary basis; any issues can be addressed when the European steel regulation is drafted. Adopting a modified European LESS or a lead market concept based on LESS would mark significant progress over the current diverse approaches to decarbonising the steel industry. By following the German initiative, the EU and other European players have an established system to expand and enhance. Germany has the chance to set an international standard with this committed approach, providing German industry a valuable head start.[44]

Steel production accounts for around 11% of global CO_2 emissions. Simply closing German or European blast furnaces and importing the required steel instead is not a sustainable strategy for the climate, nor does it future-proof the German economy. The EU's approach of using a Carbon Border Adjustment Mechanism (CBAM) to protect European industry from carbon leakage is a timid yet understandable step. However, in the highly internationalised steel market, a European solution alone is insufficient in the long term. Discussions with various countries on whether to establish their own frameworks for the steel sector to remain competitive in the medium term, prompted by the CBAM, should definitely be pursued further. The UN's Industrial Deep Decarbonisation Initiative (IDDI) and Germany's Climate Club are important initiatives that help embed an internationally recognised and established decarbonisation pathway for the steel industry through clear emission reduction targets and standards. This is where climate diplomacy can play an important role. Both the North American and Asian markets are developing definitions and standards for climate-friendly steel. It is more likely that these standards will be mutually recognised by the Climate Club or the IDDI than one standard prevailing globally. However, such harmonisation or at least convergence would be a major step towards the long-term goal of a global emission-free steel industry. An important interim step at European level is a climate-friendly, socially responsible, and resilient steel regulation.[45] The next crucial step is an agreement with the USA as part of the Global Arrangement for Sustainable Steel and Aluminium (GASSA), which would set clear emission reduction targets, address overcapacity, and establish equal competitive rights for trading partners on both sides of the Atlantic. However, these negotiations have stalled and a breakthrough is not expected soon. The EU's steel trade balance has been negative since 2016, making a reversal seem unlikely. For Europe, moving forward is the only way to prevent the impending loss of relevance[46] (see 'Renewables pull' information box).

[44] See Waagsaether, K., Waliszewska, A., Lehne, J., 2024, Raising Ambition on Steel Decarbonisation. 2023 Steel Policy Scorecard (last accessed: 25/07/2024).

[45] The regulation must also ensure that the use of technologies such as carbon capture and storage (CCS) and synthetic natural gas (SNG) for steel production is ruled out, as they are economically unviable and risk a fossil lock-in. See Carels, F. et al., 2023, Hydrogen import options for Germany. Analysis with an in-depth look at synthetic natural gas (SNG) (last accessed: 8 August 2024).

[46] See Koch, M. et al., 2024, Wasserstoffimporte Deutschlands – Welchen Beitrag können Pipelineimporte in den 2030er Jahren leisten? (accessed on: 8 August 2024).

Renewables pull

The possibility of a 'renewables pull', whereby part of the upstream value chain of the climate-friendly steel industry could migrate away from Germany and Europe, has been the subject of ongoing discussion. This is mainly due to less favourable climatic and geographic conditions for producing green hydrogen, as well as its high transport costs. Countries developing their own hydrogen production might take further steps along the value chain by building their own direct reduction plants, supplying both the fuel and the sponge iron However, this contradicts the EU's strategic interest in maintaining sufficient steel capacity locally for geopolitical and resilience reasons. The existing network of primary production, regional suppliers, consumers, and exceptional research collaborations bolster the role of established European steel locations.

Besides opportunity to utilise technical expertise in plant construction and expanding the business sector, cheaper procurement of sponge iron as a primary product can make steel production in Germany and Europe more cost-effective and therefore more competitive. Even though some value creation might be lost, a win-win situation could still emerge, benefiting sponge iron exporters and steel producers alike.

Shifting a particularly cost-intensive part of production can create price advantages that preserve jobs in the remaining capacities. Subsidising steel production to a certain extent may also be politically opportune. Germany and the EU must strike a balance between cost-efficient production and competitiveness on the one hand and maintaining strategic sovereignty on the other.

5 Looking ahead

With a balanced approach that rewards efforts while clearly setting the direction of travel towards climate-friendly steel, the chicken-and-egg problem of whether production or demand should be ramped up first can be resolved simultaneously and gradually. The proposed European minimum emission standards, combined with national public procurement, act as guardrails for a transformation pathway within which lead markets can develop. Within this lead market corridor, steel companies can weigh up their transformation options and make their investment decisions with planning certainty. Industry-recognised thresholds aligned with the LESS should provide a balanced transformation pathway within the scope of the EU Ecodesign Regulation. Alongside gradually increasing minimum requirements for the emissions intensity of steel production for the EU internal market, public procurement plays a key role in establishing lead markets.

Lead markets complement other instruments such as the IPCEI, Carbon Contracts for Difference and other subsidy programmes, and are by no means intended to replace them. They do, however, reduce the overall need for subsidies while enhancing the impact of CO_2 pricing by making climate-friendly products more profitable and non-climate-friendly products less profitable. In addition, they contribute to uniform standards that gradually replace conventional production processes with modern ones, ensuring the long-term existence and competitiveness of economic sectors.

There is no blueprint for the green steel transformation. Transforming an industry of this scale while maintaining ongoing operations on site is historically unprecedented. All stakeholders should deal constructively with uncertainties and dilemmas, muster courage and establish a new culture of learning from mistakes. Among all the technical details, we must not forget one thing: people make steel. From the outset, social security, training, and retraining must be integrated to support the socio-political aspects of the transformation. Companies and their workforces, regions and local authorities as well as civil society must actively participate in the transformation project for it to succeed.

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