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SCRAP BONUS CONCRETE

Instruments for fair competition in the global value chains involved in steel production

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Instruments for fair competition in the global value chains involved in steel production

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Executive summary

As a raw material, scrap already makes substantial contributions to climate protection in steel production today. Every ton of carbon steel scrap used saves 1.67 t of CO_2 compared with steel production from ores and coke. Recycling a ton of stainless steel scrap prevents the production of 4.3 t CO_2. In 2018, about 94 million tons of scrap were melted down in Europe, helping prevent approx. 157 million tons in CO_2 emissions — the equivalent of the annual emissions of every car in France and Great Britain.

The use of scrap combines both economic advantages and more positive environmental effects. Every ton of CO_2 that is not produced leads to milder climate change and reduces its impact for today's population, but especially for future generations. The social benefits associated with every ton of steel scrap used are referred to as the »scrap bonus". It ranges from 80 to 213 euros per ton of steel scrap, and from 158 to 502 euros for stainless steel scrap.

In order to ensure fair competition between the raw materials involved in steel production, but also on the steel market, market prices have to reflect the advantages and disadvantages the raw materials pose for society. The scrap bonus should therefore be »internalized« within the pricing system. This study examines the extent to which European climate policy integrates the scrap bonus into its pricing mechanism and where gaps or flaws remain that stand in the way of fair competition. It proposes measures to resolve these flaws and to encourage efficient and climate-friendly steel production.

The European Emissions Trading System (EU ETS) is the central instrument of European climate policy, especially for energy-intensive industries and power generation. The EU ETS follows the »polluter pays« principle: Companies have to obtain emission allowances for the greenhouse gases they release. The number of these emission allowances is capped, which ensures that an upper limit of emissions is observed. The emission allowances can be traded in order to reduce CO_2 emissions in those areas where it costs the least to prevent them. Two instruments are designed to prevent carbon leakage, i.e. the migration of energy-intensive industries and their emissions abroad: The free allocation of emission allowances to trade exposed industries that involve a high amount of electricity and compensation for the costs of emission allowances in the price of electricity.

With the European Green Deal, the European Commission has adopted a new growth strategy geared toward a modern, resource-efficient and competitive industry sector. This strategy goes hand in hand with a more ambitious climate policy: Europe must reduce its greenhouse gas emissions by 55 percent by 2030 compared with the level in 1990. In order to achieve this objective, the European Commission proposed the Fit for 55 package in July 2021.

The Fit for 55 package includes a revision of the emissions trading system. The reduction targets of the EU ETS are to be made even more stringent and other industry sectors, such as shipping, will be integrated. In order to avoid carbon leakage, the European Commission is proposing a Carbon Border Adjustment Mechanism (CBAM), which is intended to extend the pricing mechanism for greenhouse gas emissions to selected imported products and replace the free allocation of emission allowances in the medium term.

The European Emissions Trading System is helping to internalize the scrap bonus into the prices of raw materials and steel. However, there are gaps in the EU ETS that stand in the way of the complete internalization of the scrap bonus and are not fully resolved by the reforms proposed by the European Commission.

Mining is not part of the European Emissions Trading System. Therefore, emissions from ore or coal extraction are not subject to CO_2 pricing. Emissions from mining in Europe account for a smaller share of CO_2 emissions in the steel production value chain. Nevertheless, the integration of mining into the EU ETS would contribute to achieving fairer competition between the raw materials involved in steel production.

Europe imports a large proportion of its metal ores from third countries. In order to avoid distortions in competition between raw materials, the raw materials and intermediate products involved in steel manufacturing should also fall under the CBAM. This would fully integrate the climate costs of mining outside Europe into the pricing system. In addition, the exceptions for ferroalloys provided for in the European Commission’s proposal for the CBAM should be removed.

The carbon border adjustment mechanism would determine a price for direct emissions from the production of imported steel. This would contribute to fairer competition between European and imported steel and reward the use of scrap in steel production outside Europe. Climate-friendly, scrap-based steel could be imported into Europe at a lower cost than CO_2-intensive steel.

The majority of the reforms in the Fit for 55 package are expected to be implemented by the middle of the decade. The CBAM is set to be launched in 2026. Further gaps in the internalization of the scrap bonus may remain in the longer term: Indirect emissions from the use of electricity or from intermediate products are not covered by the CBAM. In addition, the scrap bonus for scrap exported from Europe is not reimbursed. The extension of the CBAM to indirect emissions and exports will only appear plausible once a successful pilot phase has been completed.

A temporary solution could internalize the positive environmental effects of scrap and create additional incentives for creating closed-loop material life cycles. For this purpose, the free allocation of emission allowances could be linked to the use of scrap. This would create a monetary advantage for using scrap, the amount of which would be tied to the price of CO_2. Linking the free allocation of emission allowances to scrap could serve as a transitional instrument until the carbon border adjustment mechanism is fully in effect.

Alternatively, incentives for using scrap could be generated by stipulating a mandatory scrap utilization quota. Compared with a positive incentive for the use of scrap, this would constitute a greater intervention on the market, could place strain on the European steel sector and open up the question of whether a mandatory scrap utilization quota would also apply to imported steel.

It is not advisable to restrict international trade in scrap. This instrument would lead to lower scrap prices within Europe, but at the same time reduce the use of scrap outside Europe. As such, restrictions in cross-border scrap trade would lead to increased CO_2 emissions and undermine efforts to protect the environment when it comes to steel production.

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1 Introduction

The use of scrap as a raw material for steel production reduces greenhouse gas emissions, saves natural resources and prevents the release of substances that cause air pollution. These ecological benefits generate quantifiable economic prosperity gains. For example, preventing CO_2 emissions helps reduce the greenhouse effect and thus lessens the impact of climate change. Not only the present population, but above all future generations, will benefit from the use of scrap in steel production. The »scrap bonus« indicator quantifies the environmental costs prevented by the use of one ton of scrap in steel production in euros (Fraunhofer IMWS 2019). It thus measures the environmental benefits of using scrap in monetary units.

The scrap bonus is calculated in two steps. The first step is to quantify the environmental damage that is avoided by the use of one ton of scrap in steel production. In the second step, this damage is evaluated in economic terms, i.e. converted into euros. The use of one ton of carbon steel scrap prevents greenhouse gas emissions of 1.67 t of CO_2 compared with production from ore and coke. The use of one ton of stainless steel scrap leads to savings of 4.3 t CO_2. In 2018, steel mills in the European Union reduced CO_2 emissions by about 157 million tons through their use of scrap — the equivalent of the annual emissions of every car in France and Great Britain combined (Fraunhofer IMWS 2019). The monetary value of these benefits for society, also known as the scrap bonus, is between 79 and 213 euros per ton of recycled carbon steel scrap. In the case of stainless steel scrap, the scrap bonus is between 158 and 502 euros per ton. This takes into account not only the reduction in greenhouse gas emissions, but also the local environmental damage that is prevented. In 2018, the European steel industry avoided environmental costs of between 7.4 billion and 20.0 billion euros through its use of scrap (Fraunhofer IMWS 2019).

From an economic point of view, the scrap bonus is a positive external effect. Without corrections to the pricing mechanism via policy, the environmental benefits of the use of scrap will not be reimbursed. This reduces the incentives to use scrap, influences the decisions made in relation to consumption and production and distorts in competition between raw materials and products.

The study »Scrap bonus concrete« examines to what extent the ecological benefits of scrap use in Europe are internalized or reflected in the pricing system. It focuses on the effects that using scrap has in terms of helping protect the environment. The primary focus is the European Emissions Trading System (EU ETS) as the central instrument of European climate policy. It analyzes whether the main sources of emissions from steel production are covered by the EU ETS. Important gaps, which contribute to insufficient internalization of the scrap bonus, are identified. The current reform options under the European Green Deal are taken into account in the study. Practical proposals for resolving the flaws are developed.

2
Technical principles

2.1
Definition of steel

The standard DIN EN 10020 defines steel as a raw material, »whose mass fraction of iron is greater than that of any other element, whose carbon content is generally less than 2 percent and which contains other elements«. Steel is one of the most important and versatile materials on the world market. Its applications range from transport to mechanical engineering, bridge and steelwork construction, energy and environmental technology and the packaging industry. Its versatility is reflected in its diversity: The list of steel and iron grades published by the Steel Institute VDEh and the European Steel Registration Office comprises some 2400 varieties of steel (VDEh 2015, p. 2).

Stainless steel is defined as steel that has a mass fraction of at least 10.5 percent chromium and a maximum of 1.5 percent carbon (ISO 15510:2014). Chromium is the decisive component for the special corrosion resistance of stainless steel. The transition metal reacts with the oxygen in the air and forms a thin passive layer that is just few nanometers thick and protects the underlying stainless steel from corrosion. Corrosion resistance can be further increased by adding nickel. Other types of steel are summarized under the term carbon steel.

In 2018, 1 826 million tons of crude steel were produced worldwide. Despite the COVID-19 pandemic, worldwide production rose to 1 878 million tons by 2020, of which China accounted for 1 065 million tons. At 139 million tons, the EU was the second largest steel producer, ahead of India, Japan and the US (World Steel Association 2021). In Germany, 42.4 million tons of steel were produced in 2018. In 2020, that figure was 35.7 million tons — a decrease of 15.8 percent from 2018 (WV Stahl 2021).

2.2
Scrap as a raw material

Scrap is an essential raw material in the production of (stainless) steel (Fraunhofer UMSICHT 2016). Its use reduces greenhouse gas emissions from steel production and also avoids the pollution of air, soil and water (Fraunhofer IMWS 2019). Scrap is divided into three types, depending on the point in the life cycle of a product at which it is produced. Home scrap is scrap that is produced in the steel industry itself and is completely recycled there. New scrap is scrap that is produced in steel processing. It is almost completely recycled. Old scrap consists of products at the end of their life cycle. In the case of old scrap, high recycling rates are achieved in some cases, for example, around 88 percent is recycled in the construction sector (Helmus and Randel 2015). The figure rises to more than 91 percent in the case of tinplate packaging (GVM 2020). At the same time, empirical studies show that the supply of old scrap in particular responds to price signals (Damuth 2011).

Carbon steel scrap and stainless steel scrap are internationally traded commodities that are collected, processed and made available to steel producers by the steel recycling industry (Fraunhofer UMSICHT 2016). Figure 01 shows the use of scrap in steel production in 2018 for selected countries. The bars correspond to the respective use in millions of tons (left-hand axis). The dots represent the scrap utilization quota, i.e. the ratio of scrap use to crude steel production as a percentage (right-hand axis). The Bureau of International Recycling (BIR) quantifies the use of scrap in seven key regions[1] at 469 million tons. In absolute terms, China has the world's largest use of scrap at 187.8 million tons. Its use of scrap more than doubled compared with 2015. The BIR puts this increase primarily down to stricter environmental standards in the People's Republic of China, which would have led to higher scrap utilization rates in the blast furnace route and new capacity in the electric arc furnace route (BIR 2019). By 2020, the use of scrap in China had grown to 220.3 million tons (BIR 2021). The scrap utilization rate in China was 20.2 percent in 2018 — significantly lower than in Europe or the USA. In the EU, it reached 55.9 percent (Germany: 43.6 percent), and in the USA it was 69.4 percent (BIR 2019). Regional differences can be traced back to factors such as the availability of scrap or historical developments in the steel industry in individual countries. Turkey's high scrap utilization rate can be explained, for example, by the availability of European scrap and lower investment costs involved in electric arc furnace plants.

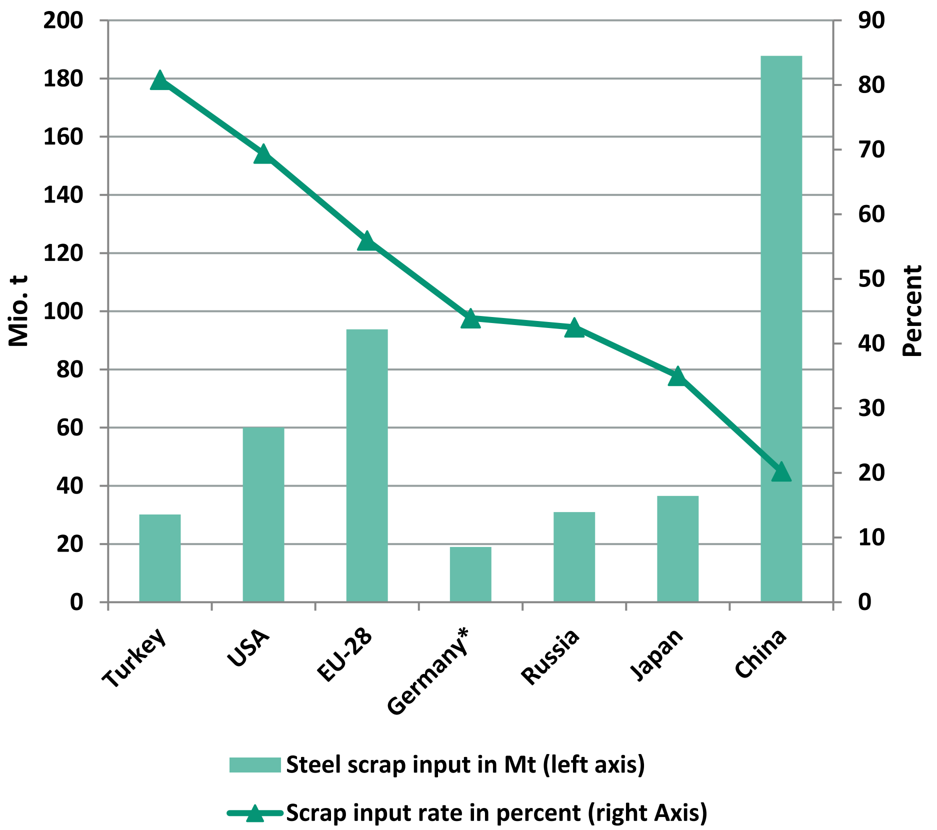


Fig. 01: Scrap use in steel production by country. Figures for 2018, except Germany (2017).
Source: Own diagram based on information from the BIR (2019)

Scrap metal is an internationally traded commodity. Figure 02 shows exports of steel scrap from the EU to third countries (countries outside the European Union) and imports from third countries in millions of tons between 2011 and 2019. Imports of steel scrap into the European Union during this period were relatively stable at around 3 million tons, while a rising trend in exports was evident from 2015 onwards. In 2018, some 21.7 million tons of steel scrap were exported from the EU.

[1] These regions are China, the EU, the USA, Japan, Russia, India and South Korea, which together account for 81 percent of global steel production.

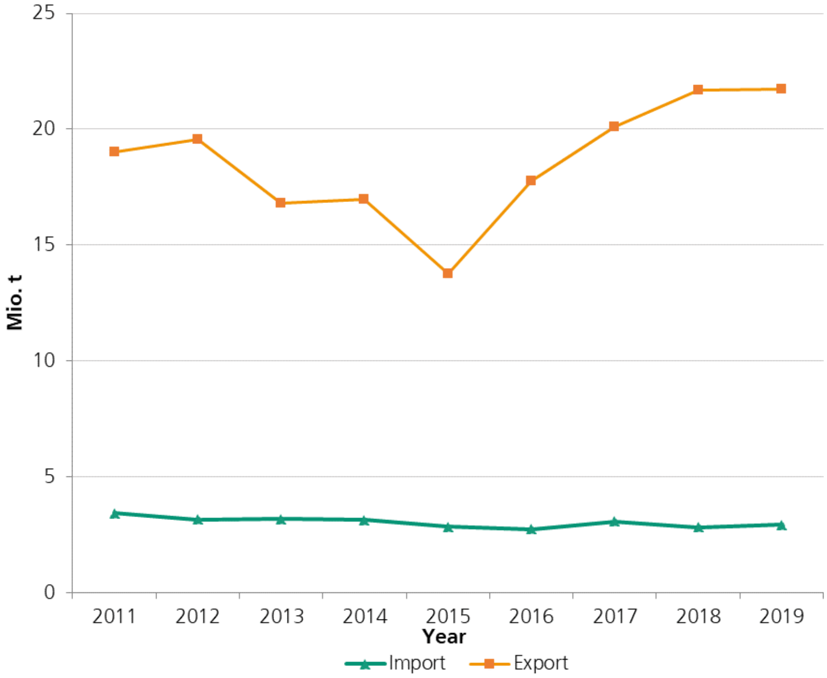


Fig. 02: European Union trade in steel scrap with third countries between 2011 and 2019 in millions of tons.
Source: Own diagram based on information from Eurostat (2021)

Figure 03 shows exports of stainless steel scrap from the EU and imports into the EU in thousands of tons for 2011 to 2019. During this period, export and import figures were close, with similar quantities were entering and leaving the EU. From 2016 onwards, a significantly increasing trend in exports became apparent. In 2019, 255 000 tons more stainless steel scrap was exported than imported. This is due to a decline in stainless steel production in Europe of 8.5 percent between 2018 and 2019. Worldwide production of stainless steel grew by 2.8 percent in the same period (ISSF 2021). Together, figures 02 and 03 show that Europe contributes to climate-friendly steel production in third countries by exporting scrap.

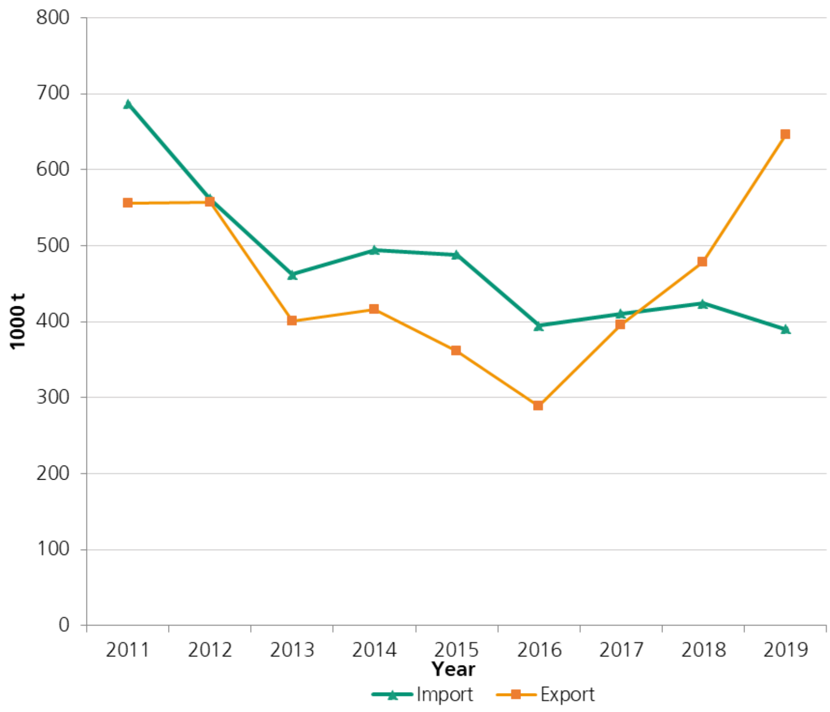


Fig. 03: European Union trade in stainless steel scrap with third countries between 2011 and 2019 in thousands of tons. Source: Own diagram based on information from Eurostat (2021)

2.3 Production routes for steel

Carbon and stainless steel are currently produced almost exclusively via two routes: the blast furnace route and the electric arc furnace route. In the blast furnace route, the intermediate product pig iron is produced from iron ore and coke in the blast furnace that gives the route its name. The pig iron is processed together with steel scrap in the basic oxygen furnace to form steel. Scrap is the primary material used in the electric arc furnace route. It is melted by means of electrical energy and processed into new steel. In the EU, 58.5 percent of steel was produced in the blast furnace route and 41.5 percent in the electric arc furnace route in 2018. In Germany, those figures were 70.1 percent and 29.9 percent respectively. In Europe, stainless steel is produced exclusively via the electric arc furnace route.

2.3.1 Carbon steel: Blast furnace route

Figure 04 shows a diagram of the production of steel via the blast furnace route. The main steps are outlined below. A detailed description of the blast furnace route can be found in VDEh (2015). It should be noted that the individual installations in the blast furnace route are often combined into integrated mills. These combine the essential steps of the processing of iron ore and coal into steel in a vertically integrated shared site. This structure allows the raw materials used to be used efficiently (Cavaliere 2019). For example, high-energy gases from the steel mill can be used to generate electricity. Finding a method for allocating greenhouse gas emissions to the individual steps is problematic and is not done by the German Emissions Trading Authority (DEHSt 2019).

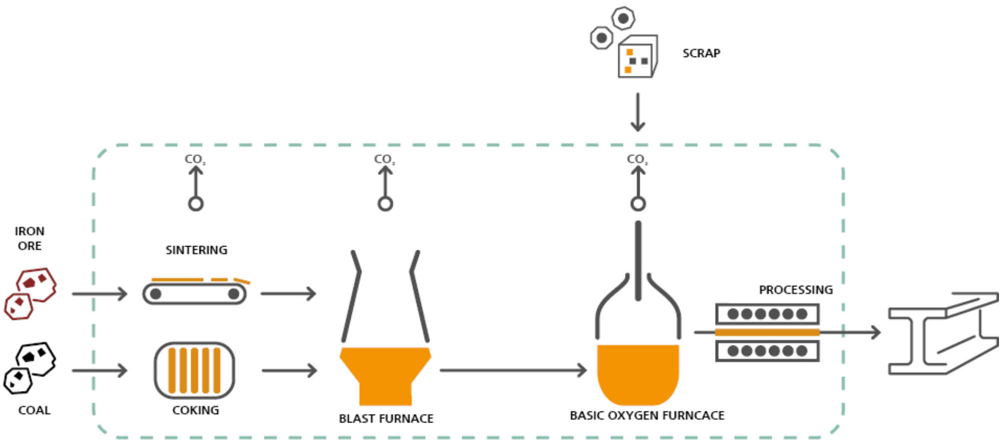


Fig. 04: Diagram of the blast furnace route.
Source: Own diagram

Iron ore mining and pelletizing

The first step in the blast furnace route is the extraction and treatment of iron ore. In 2018, about 2.5 billion tons of iron ore with an iron content of 1.5 billion tons were mined. Australia, with a production volume of 900 million tons, was the leading ore-mining country, ahead of Brazil (460 million tons), China (335 million tons) and India (205 million tons). With a production volume of 35.8 million tons in 2018, Sweden was the most important ore-mining country in Europe (USGS 2020b). In 2018, the European Union imported 108.6 million tons of iron ore (Eurostat 2021) — equivalent to approximately 74 percent of its total requirement of 134.3 million tons (World Steel Association 2019). Internationally traded iron ore is usually transported by sea on bulk carriers. In 2018, Germany mainly purchased its ore from Sweden, Canada and Brazil (Eurostat 2021).

Iron ore is mined in both open-cast and underground mining processes. In the first step after extraction, worthless components of the ore (»gangue«) are separated in order to increase the iron concentration and reduce transport costs. In order to ensure uniform physical properties, coarse ores are crushed and fine ores are formed into clumps. Particularly fine ores with grain sizes of significantly less than one millimeter are shaped into pellets of about 10 mm to 15 mm. For this purpose, they are burned together with a binding agent at temperatures above 1 000 degrees Celsius. Pelletizing usually takes place near the mine, before the ore is shipped. Greenhouse gases are emitted in this process (VDEh 2015).

Coal mining and coking

Coke is a hard, brittle and porous carbon carrier made from low-sulfur hard coal. It is used as a reducing agent in the blast furnace. The coking process is often part of the integrated steel mill. It takes place in slim, tall horizontal chamber furnaces. In this process, the coal is heated in the absence of air to separate volatile components (»dry distillation«). After the coking process, the coke is transported to a quenching tower and cooled. The high-energy gas produced in the furnace during the coking process is used for power generation. Other by-products are used, for example, in the chemical industry (VDEh 2015).

Sintering

Similar to pelletizing, sintering is used to shape iron ores into clumps. Unlike pelletizing, sintering is usually carried out in the integrated steel mill. Thus, the sintering of ore used in Europe takes place primarily in Europe. Moist fine ore is mixed with coke and aggregates and ignited to bake the ingredients together (VDEh 2015).

Blast furnace

The iron ores that are heavily used in industry are oxides, i.e. compounds of iron and oxygen. In the blast furnace, the iron oxides are reduced to raw iron. The oxygen reacts with the carbon contained in the coke and in other reducing agents (coal, natural gas) to form CO_2. Blast furnaces are continuous working shaft furnaces, with heights of up to 35 meters. They are coated at the top with a mixture of coke, ores and aggregates. The reduction process produces liquid pig iron with a carbon content of 4.0 percent to 4.7 percent. The pig iron is transported to the converter for further processing.

Basic oxygen furnace

The next process step is to reduce the carbon content of the raw iron to the desired level and to separate unwanted accompanying elements. In a process known as refining, pure oxygen is blown from above into the basic oxygen furnace through a water-cooled lance. The oxygen binds to the carbon in the pig iron and escapes as CO_2. Other accompanying elements are bound in the slag, in some cases after the addition of lime.

Scrap is of great importance for refining. The reaction of carbon and oxygen produces so much heat that steel scrap has to be added to the melt to cool it. It should be noted that for technical reasons, the amount of scrap in the converter is limited to 20 to 30 percent.

2.3.2
Carbon steel: Electric arc furnace route

The electric arc furnace route is the second of the main process routes used in steel production. Figure 05 illustrates the production of steel in this route. In the electric arc furnace route, scrap metal is primarily used as a raw material.[2] The scrap is melted down in electric arc furnaces to produce new steel. The arc reaches temperatures of more than 3 500 °C and can therefore be used to produce alloyed steel varieties. Fossil fuels such as natural gas can be added to reduce electricity costs and accelerate the melting process.

[2] Direct reduced iron (DRI) can also be used in the electric arc furnace route. In Europe, however, the use of scrap predominates: in 2018, approximately 700,000 tons of DRI were produced in the EU, the majority of which was produced in Germany (World Steel Association 2019).

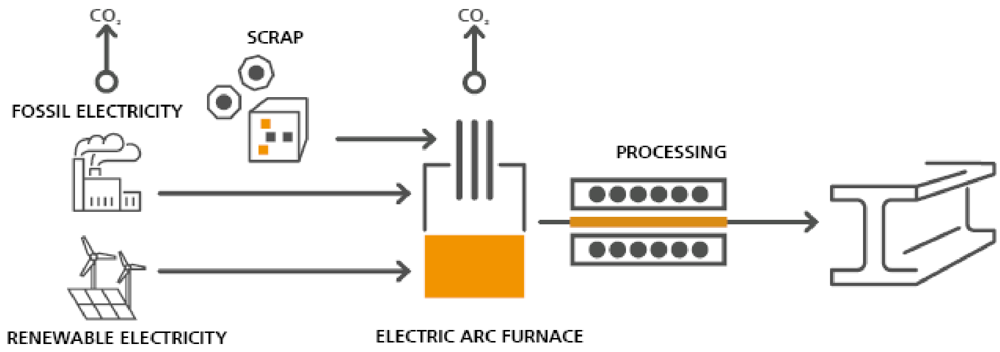


Fig. 05: Diagram showing steel production in the electric arc furnace route.
Source: Own diagram

The greenhouse gas emissions from the electric arc furnace route are mainly generated indirectly through fossil-based power generation. In 2018, for example, only about 3 percent of direct steel production emissions were accounted for by electric arc furnace steel mills (DEHSt 2019). The direct emissions in the electric arc furnace route come from the use of natural gas, but also from other process-related sources such as carburizing agents, electrode burn-off or aggregates (DEHSt 2021a). A less CO_2-intensive electricity mix has a positive effect on the overall carbon footprint of electric arc furnace steel production. By using green electricity, scrap can be melted in a largely CO_2-neutral manner (Fan and Friedmann 2021).

2.3.3
Stainless steel: Electric arc furnace route

In Europe, stainless steel is produced without exception via the electric arc furnace route. A diagram of the electric arc furnace route in stainless steel production can be found in figure 06. It is similar to the production of carbon steel in the electric arc furnace route. In both cases, scrap is mainly used as a raw material and melted down using electricity. In addition to the scrap metal, ferroalloys — in particular ferrochrome and ferronickel — are also used as raw materials. The raw material mix differs between stainless steel manufacturers and is not published.

Chromium is the decisive component for the special corrosion resistance of stainless steel. In 2018, 43.1 million tons of chromium ore were produced worldwide. The largest producers of chromium ore were South Africa (17.6 million tons), Turkey (8.0 million tons), Kazakhstan (6.7 million tons) and India (4.3 million tons). In Finland, the only EU member state with significant chromium production, 2.2 million tons of ore were mined (USGS 2020a). The main area of application of chromium is stainless steel production where it is used as ferrochrome, an alloy of chromium and iron (Gasik 2013).

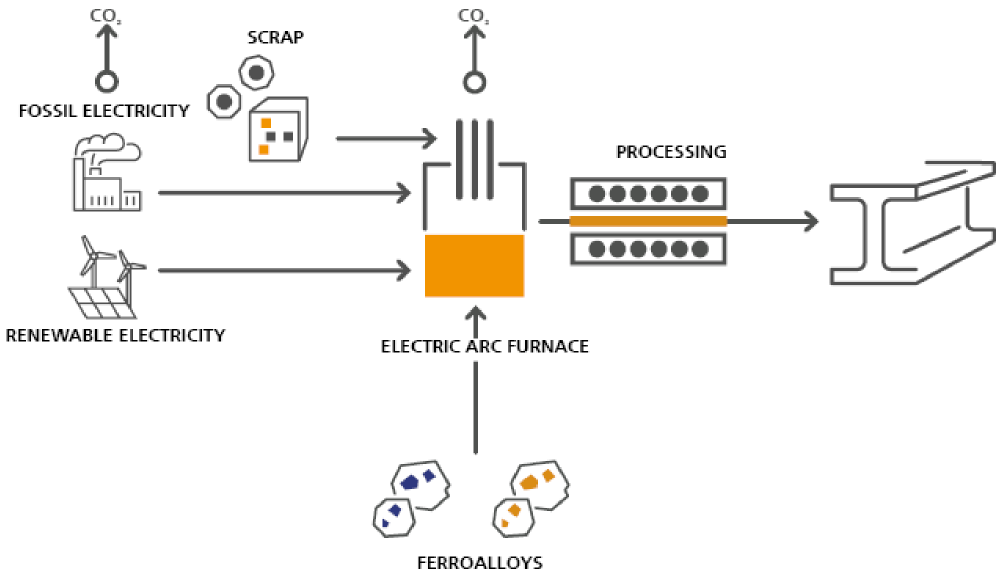


Fig. 06: Diagram of stainless steel production in the electric arc furnace route.
Source: Own diagram

Nickel is another element that plays an important role in stainless steel production. Nickel serves as an alloying element, especially in non-magnetic austenitic stainless steels, and further improves the corrosion resistance of the stainless steel. Worldwide, ores with a nickel content of about 2.4 million tons was mined in 2018. The EU is responsible for only a small share of global nickel extraction (USGS 2020c).[3] Nickel is used for stainless steel production but also for nickel-based super alloys, as well as for battery production (Nickel Institute 2021). In stainless steel production, nickel is primarily used as ferronickel. (Gasik 2013)

The production of ferroalloys is associated with significant greenhouse gas emissions. Haque and Norgate (2013) estimate the carbon footprints of ferrochrome at 3.0 t CO_2e per ton and of ferronickel at 13.9 t CO_2e per ton. Nickel Institute (2020) reports greenhouse gas emissions of 13.0 t CO_2e per ton of nickel along the entire value chain (scope 1–3). The study by Fraunhofer UMSICHT (2010) evaluated different life cycle assessment databases and determined that emissions of between 9 and 17 t CO_2e were produced per ton of ferronickel.

[3] One exception is the French overseas territory of New Caledonia, located to the east of Australia. In 2018, ore with a nickel content of 216,000 tons was produced in New Caledonia. However, New Caledonia is not part of the European Union.

3
Scrap bonus: Definition and quantification

The use of scrap as a raw material leads to positive ecological effects along the value chain of steel production. It avoids greenhouse gas emissions, reduces local pollution and saves finite resources (Broadbent 2016; Johnson et al. 2008). The »scrap bonus« indicator quantifies the social benefits that result from the use of scrap. The scrap bonus measures the cost avoided due to reduced environmental pollution when using one ton of scrap in steel production compared with production from primary raw materials (Fraunhofer IMWS 2019).

The environmental pollution avoided is quantified on the basis of life cycle assessments. These life cycle assessments record emissions along the value chain, from the mine to the gates of the steel mill. Emissions are classified into categories of environmental impact such as climate change. Economic studies that estimate the economic costs of environmental pollution evaluate the emissions saved in financial terms. Emissions are converted from tons into monetary units. Through its prevention of greenhouse gas emissions in particular, the use of scrap helps to reduce environmental impact and economic costs. The use of one ton of carbon steel scrap leads to a reduction of 1.67 t CO_2, while the use of one ton of stainless steel scrap leads to an emission reduction of 4.3 t CO_2 compared with primary production. Figure 07 shows the value and breakdown of the scrap bonus for carbon steel scrap. The benefit to society of using carbon steel scrap comes to between 79 and 213 euros per ton. The scrap bonus for stainless steel scrap is between 158 and 502 euros per ton. These ranges reflect different scenarios relating to the cost of climate change. It is not possible to accurately quantify these costs. Therefore, the scrap bonus is calculated at 30 euros per ton of CO_2 (»lower reference«), 70 euros per ton of CO_2 (»medium reference«) and 110 euros per ton of CO_2 »upper reference«).

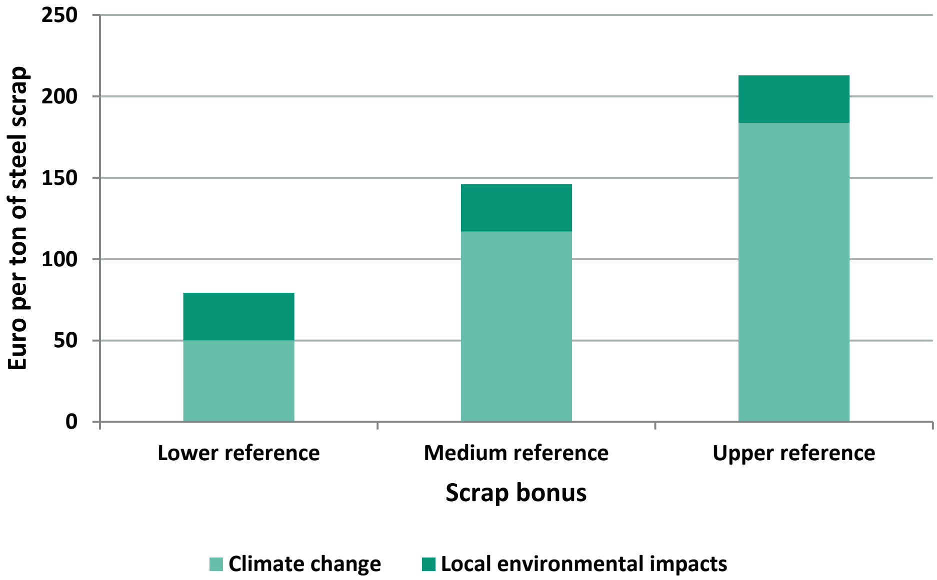


Fig. 07: Scrap bonus in euros per ton of carbon steel scrap for three assumptions about the social costs of one ton of CO_2.
Source: Fraunhofer IMWS (2019)

The positive ecological effects of scrap use are external effects. As a result of the displacement of more CO_2-intensive raw materials, the use of scrap as a raw material for steel production brings with it societal benefits that are not automatically reflected in the market price and thus not compensated. This distorts the relative market prices of scrap and primary raw materials in favor of the latter: Ores and coke are too cheap compared with scrap, because the positive ecological effects of the use of scrap are not compensated unless policy measures are taken to correct this. This, in turn, distorts competition between the raw materials of steel production. The integration of the scrap bonus into the pricing mechanism, often referred to as internalization in the economic context, thus contributes to fair competition and helps mitigate climate change.

Figure 07 shows that the use of scrap creates benefits for society, especially by reducing greenhouse gas emissions. This raises the question of to what extent climate policy instruments contribute to fair competition between the raw materials involved in steel production. Estimates of effective CO_2 prices by the OECD indicate that there is a significant need for action at global level (OECD 2021). In Europe, the European Emissions Trading System (EU ETS) is the central policy instrument for the pricing of greenhouse gas emissions. In the following, we will examine to what extent the EU ETS integrates the scrap bonus in the pricing mechanism and where there are flaws when it comes to internalization.

4 European Emissions Trading System (EU ETS)

4.1 Basic mechanisms

With the signing of the Kyoto Protocol in 1997, 37 industrialized countries decided to set binding targets for reducing greenhouse gas emissions. The European Emissions Trading System (EU ETS) was created in 2005 as the world's first greenhouse gas emissions trading system[4] to meet the targets set in the Kyoto Protocol.

Currently, its scope extends to about 15 000 fixed-location installations used for power generation, industry and air traffic. This includes the European Union, Iceland, Liechtenstein and Norway. In 2018, 1.75 billion tons of CO_2 were released by installations and flights regulated by the EU ETS. 7.0 percent of this was accounted for by the production of iron and steel.

The EU ETS has come to be regarded as a global role model: ICAP (2021) reports that in 2021, around 16 percent of global greenhouse gas emissions are regulated by emissions trading systems. A number of very heterogeneous countries and regions use emissions trading systems, including Mexico, California, Kazakhstan and China. In the People's Republic of China, however, with the exception of certain regions, only emissions from electricity production have been included so far.

Emissions trading systems are referred to as »cap and trade systems«. This term indicates that they combine two mechanisms. The »cap« is a fixed limit on greenhouse gas emissions that may be produced per year within the (regional and sectoral) scope of the emissions trading system. This means that the amount of permitted emissions is limited. Over time, the cap is lowered to reduce greenhouse gas emissions.

The EU ETS follows the »polluter pays« principle: Companies regulated using an emissions trading system must obtain and prove emission allowances for their greenhouse gas emissions. In the case of the EU ETS, these are referred to as EU Allowances (EUA). They are often also called emission certificates. In this study, the terms emission allowances and certificates are used interchangeably. An EUA authorizes its holder to release pollutants with a global warming potential of one ton of CO_2.

»Trade« refers to the second mechanism of an emissions trading system. Emission allowances can be traded. This leads to an efficient reduction of total emissions. Companies that can easily and cheaply reduce their emissions can prevent these emissions and thus sell certificates. Companies for which a reduction is associated with higher costs can buy certificates on the market instead. As such, they remunerate companies that can save greenhouse gas emissions more cheaply. This mechanism ensures that emissions are avoided in those areas where it costs the least to prevent them.

Figure 08 illustrates the economic impact of an emissions trading system. The horizontal axis represents the amount of CO_2 emissions of an economy in tons. CO_2 prices are shown on the vertical axis. The orange line represents the amount of greenhouse gas

[4] An earlier example of an emissions trading system is the United States' »Acid Rain Program«, which came into force in 1995 and aims to reduce air pollution caused by sulfur dioxide and nitrogen oxides.

European Emissions Trading System (EU ETS)

emissions released in the economy as a function of the CO_2 price. The higher the CO_2 price, the lower the emissions, because as the CO_2 price increases, the incentives to invest in environmentally friendly products and technologies increase. If the CO_2 price is zero, i.e. there is no emissions trading system or CO_2 tax, a quantity of M^0 is released.

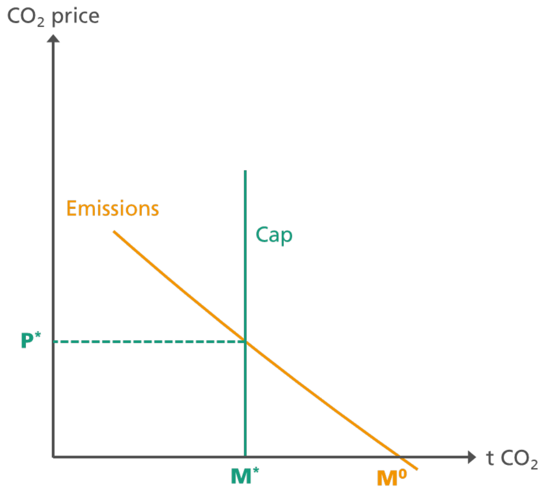


Fig. 08: How an emissions trading system works.
Source: Own diagram

The cap of the emissions trading system is represented by the vertical green line. It limits the amount of emissions to M^*. The market price for emission allowances develops based on the equilibrium between the cap and demand. At a price of P^*, the companies in the national economy want to release a quantity of M^* CO_2. This shows the fundamental difference between emissions trading systems and CO_2 taxes in the pricing of greenhouse gas emissions. In emissions trading, the amount of emissions is fixed and the market determines the CO_2 price. A tax fixes the CO_2 price, while the market determines the amount of emissions.

The energy-intensive industries in Europe suffer disadvantages in international competition if their foreign competitors do not have to pay a price for their greenhouse gas emissions. There is a threat of »carbon leakage«, which means the relocation of CO_2-intensive stages of production to non-European countries. The EU ETS includes two instruments intended to prevent carbon leakage. On the one hand, there is the free allocation of emission allowances to companies in sectors threatened by carbon leakage. This free allocation is intended to compensate at least partially for additional costs and thus competitive disadvantages caused by CO_2 prices. It should be noted that there is still an incentive for the companies concerned to reduce greenhouse gas emissions. They can sell the certificates that are freed up by reducing their emissions on the market and thus generate revenue. The second instrument to protect against carbon leakage is intended to compensate indirect costs caused by the EU ETS. Article 10a(6) of the EU ETS Directive allows member states to provide financial support to electricity-intensive companies as compensation for indirect CO_2 costs of allowances included in the electricity price.

The EU ETS was developed in four phases. The first ran from 2005 to 2007 and was a test phase. During this phase, the EU ETS covered CO_2 emissions from the energy sector and energy-intensive sectors (including the steel sector). Most of the certificates were allocated free of charge. The objective of this process was to test the EU ETS and to build the necessary infrastructure.

European Emissions Trading System (EU ETS)

In the second phase (2007–2012), the emissions cap was lowered. Iceland, Norway and Lichtenstein joined the EU ETS during phase two. Other changes included the inclusion of nitrogen oxide emissions in some countries and the reduction of free allocation to 90 percent of emission allowances. Some countries began auctioning certificates. From 2012, aviation was included, at least for flights within the scope of the EU ETS.

In the third phase (2013–2020), a linear reduction factor of 1.74 percent per year was introduced for the emission cap. Thus, in the third phase of the EU ETS, the emission cap for fixed-location installations was reduced annually by 1.74 percent of the cap for the second phase. The ceiling for aviation remained constant during the third phase. With the financial crisis in 2008, economic output and greenhouse gas emissions fell significantly. There was a surplus of emission allowances, which pushed down the price of the certificates and reduced the incentives to abate CO_2 emissions. In the third phase, »backloading« was introduced as a short-term instrument, whereby 900 million emission certificates that were to be auctioned between 2014 and 2016 were not auctioned until 2019–2020.

In order to avoid an oversupply of emission allowances in the long term, the Market Stability Reserve was introduced. The reserve absorbs all allowances not auctioned at the end of the year so that there is not a massive surplus of emission allowances on the market. It will also bring additional allowances to the market if the number of emission allowances falls below the minimum level in order to stabilize the price level. This is intended to prevent prices both from sinking too low and climbing too high (Vivid Economics 2020).

Since the beginning of 2021, the EU ETS has been in its fourth phase (European Commission 2018), which is set to run from 2021 to 2030. In the fourth phase, the linear reduction factor was increased from 1.74 percent to 2.2 percent. The free allocation of certificates will remain in place until 2030 for sectors at particular risk of carbon leakage.

Since the start of the third phase of the EU ETS, the free allocation of emission allowances has been linked to product-based benchmarks. The benchmarks are based on the »average performance of the 10 % most efficient installations in a sector or subsector in the Community in the years 2007 and 2008«. (European Commission 2009). If an installation releases more CO_2 than the respective benchmark, no free certificates are allocated for the emissions above the benchmark.

In the fourth phase of the EU ETS, a carbon leakage indicator (CLI) was introduced to determine whether an industry is at risk of carbon leakage. This is calculated as follows:

$$CLI = \frac{\text{Exports third countries[EUR]} + \text{Imports third countries[EUR]}}{\text{Market size [EUR]}} \times \frac{\text{Emissions [kg CO}_2\text{]}}{\text{Value added [EUR]}}$$

The market size is defined as the sum of turnover and imports for the industry, taking both direct and indirect emissions into account. If the carbon leakage indicator exceeds 0.2 percent, the industry is considered to be at risk of carbon leakage and receives up to 100 percent of its benchmark emission allowances free of charge (European Commission 2009). The benchmarks are to be set for 2021 to 2025 and 2026 to 2030. In addition, they are to be reduced annually to take account of technical progress. For the steel sector, the reduction is to be fixed at the lower limit of 0.2 percent, as it is deemed to be heavily threatened by carbon leakage and faces high avoidance costs (ICAP 2021).

4.2 Steel production in the EU ETS

The activities covered by the EU ETS are defined in the EU ETS Directive (European Commission 2009, Annex I). The steel industry has been part of the European Emissions Trading System since 2005. It is covered both directly and indirectly by the EU ETS. Emissions from the combustion of fuels in installations with a total combustion heat output of more than 20 MW are covered by the EU ETS (European Commission 2009, Annex I).[5] This means that all major fossil-based power plants are subject to the EU ETS. Indirect emissions from fossil-fuel-based power generation, which account for a large proportion of the greenhouse gases released by electric arc furnace steel mills, are taken into account accordingly in the EU ETS. The amount of CO_2 costs for electric arc furnace steel mills depends on the greenhouse gas intensity of the electricity mix. The greater the share of electricity from renewable sources, the lower the number of emission allowances to be procured. For industrial applications, the EU ETS covers the production of coke, the roasting, sintering and pelletizing of metal ores, the production of pig iron and crude steel in installations with a capacity of over 2.5 tons per hour (about 22,000 tons per year) and the production and processing of iron metals. For these activities, as in electricity generation, CO_2 is the only greenhouse gas taken into account.

	Average value of the 10 percent most efficient installations in 2016 and 2017 (t CO_2e/t)	**Benchmark value (certificates/t) for the period 2021–2025**
Coke	0.144	0.217
Iron ore sinter	0.163	0.157
Liquid pig iron	1.331	1.288
Carbon steel obtained through the electric arc furnace route	0.209	0.215
High-alloy steel obtained through the electric arc furnace route	0.266	0.268
Cast iron	0.299	0.282

Table 01: Product benchmarks in the EU ETS for 2021–2025.
Source: European Commission (2018)

In Germany, there are currently 123 installations in the steel sector that are subject to emissions trading (DEHSt 2021b). In 2018, they released about 37.9 million tons of CO_2, 83 percent of which came from integrated mills, 3 percent from electric arc furnace steel mills and 14 percent from the further processing of steel. It should be noted that these figures only include direct emissions from steel production (DEHSt 2019).

The free allocation of emission allowances is of great importance for the steel industry, which is characterized by a high level of competition and a high use of energy. It is one

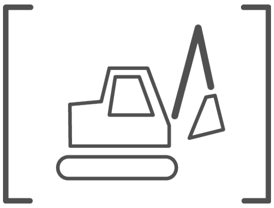
[5] The total thermal output is the thermal output of an entire installation and therefore cannot be broken into the individual components. The thermal output is the heat content (lower heating value) of the fuel used that can be supplied to a continuously operated combustion plant per year.

of the economic sectors which will also receive free allowances in the fourth phase of the EU ETS (European Commission 2019a). In 2018, the steel industry in Germany received free allowances for 85.9 percent of its emissions that were subject to the EU ETS. In calculating this percentage, the further use of blast furnace gases, i.e. high-energy exhaust gases from steel production, in power generation is taken into account (DEHSt 2019). Table 01 shows the benchmarks for 2021 and 2025 for various iron and steel products.

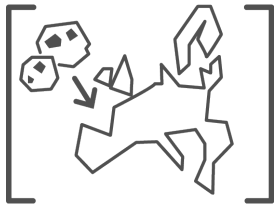
European Emissions Trading System (EU ETS)

4.3 Gaps in the EU ETS

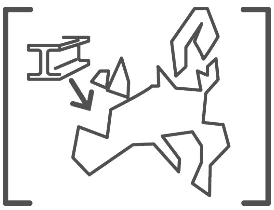
Carbon steel and stainless steel scrap are valuable domestic raw materials. Their use prevents environmental pollution and social costs. This section identifies the gaps in the EU ETS that hinder the full internalization of the scrap bonus. These gaps can be divided into five categories.



Greenhouse gas emissions produced in **mining** operations are only accounted for in the EU ETS in exceptional cases. In iron ore mining, emissions are taken into account if they come from a pelletizing plant. This means, for example, that three sites of the iron ore mining company LKAB are covered by the EU ETS (European Commission 2021h). Even though mining emissions in Europe account for a small part of the total emissions of steel production, not taking them into account distorts relative prices to the detriment of scrap. This counteracts the internalization of the scrap bonus and fair competition among raw materials.



Imports of raw materials and intermediate products such as ferroalloys are not regulated by the EU ETS. Scrap as a raw material therefore has to compete with raw materials whose emissions are often not subject to a pricing mechanism. This leads to a further gap in the internalization of the scrap bonus. It should be noted that the European steel industry depends on the import of raw materials. Table 02 shows imports, exports and net imports of three raw materials of (stainless) steel production: iron ore, ferrochrome and ferronickel. The imports and exports are from and to third countries in each case. Trade within the EU is not taken into account. The European Union imported about 108.6 million tons of iron ore and exported 9.1 million tons in 2018. Assuming a CO_2 intensity of 11.9 kg CO_2e per ton of iron ore (Haque and Norgate 2015), then European iron imports would be associated with emissions of about 1.3 million t CO_2. By comparison, domestic air traffic in Germany released around 2.2 million tons of CO_2 in 2018 (European Environment Agency 2021). These emissions are not subject to a pricing mechanism, so the relative prices of the raw materials are distorted to the detriment of scrap.

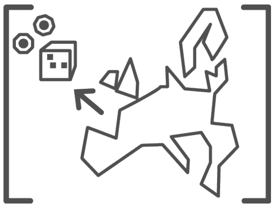


There is also a gap in the European Emissions Trading System when it comes to **steel imports**. This puts the European steel industry at a disadvantage when it comes to international competition. European firms are competing with companies from third countries that are not subject to a specific climate policy or are subject to less ambitious policies and can therefore carry out production at a lower cost.

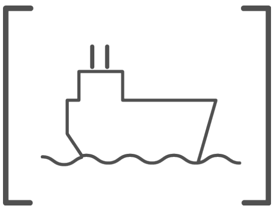
European Emissions Trading System (EU ETS)

	Imports	Exports	Net imports
Iron ore [million t]	108.6	9.1	99.5
Ferrochrome [1000 t]	718	131	587
Ferronickel [1000 t]	230	1	228

Table 02: European Union trade in iron ore, ferrochrome and ferronickel with third countries in 2018. Source: Eurostat (2021)



There is another gap in relation to **scrap exports**. If scrap is exported to regions that have no or an unambitious climate policy, the willingness of the steel producers there to pay does not reflect the ecological benefits of the use of scrap. The scrap bonus is not internalized outside Europe. The use of scrap as a raw material for steel production is therefore motivated solely by economic considerations, which do not take into account the environmental advantages.



Another gap in the EU ETS is **transport**. The emissions from the transport sector are not taken into account in a consistent way. (Electrified) rail transport is indirectly covered by the EU ETS through electricity generation, while emissions from diesel-powered trains are not. Road transport is not subject to the EU ETS. However, it is regulated by other instruments such as the European fleet limits (European Commission 2019b) or the Fuel Emissions Trading Act (BEHG) in Germany. Shipping is not covered by the EU ETS. This is precisely what puts primary raw materials, which are often imported from third countries by ship, in a better position.

*The icons used on page 23 and page 24 were created for our own illustration purposes.

5
Scrap bonus in the European Green Deal

5.1
European Green Deal and Fit for 55

In 2019, the European Commission presented its European Green Deal (European Commission 2019c) as a new growth strategy. The Commission's objective is to »transform the EU into a fair and prosperous society with a modern, resource-efficient and competitive economy«. (European Commission 2019c, p. 2). It is intended to address the challenges posed by climate change, the extinction of species and the pollution of forests and oceans. The European Commission's communication on the European Green Deal included an initial roadmap, strategies and measures to achieve the goals it set.

The European Climate Law is a concrete expression of the climate policy ambitions set out in the European Green Deal. It defines a reduction of net greenhouse gas emissions[6] of at least 55 percent from the level in 1990 by 2030 as a binding target (European Commission 2021c). Before that, the European Union was seeking to reduce greenhouse gas emissions by at least 40 percent from the level in 1990 by 2030. The European Union is aiming to be climate-neutral by 2050 (European Commission 2021c).

On July 14, 2021, the European Commission published the Fit for 55 package, which aims to implement the European Green Deal and achieve the ambitious climate targets for 2030 (European Commission 2021d). According to the European Commission, the package is the »most comprehensive set of proposals [it] has ever presented on climate and energy« (European Commission 2021d). It includes, among other things, a revision of the European Emissions Trading System, the adaptation of emission standards for cars and vans, as well as regulations on climate protection in air travel.

Two instruments are particularly important for the internalization of the scrap bonus: The revision of the EU ETS (European Commission 2021e) and the introduction of a Carbon Border Adjustment Mechanism (CBAM) (European Commission 2021a). These instruments — or their changes compared with the existing policies — are analyzed below.

[66] Net greenhouse gas emissions means the release of greenhouse gases less their reduction in carbon sinks such as forests.

5.2 Climate policy changes and scrap steel

5.2.1 Revision of the EU ETS

The Fit for 55 package includes a revision of the EU ETS, complemented by a revision of the EU ETS for aviation (European Commission 2021f) and the Market Stability Reserve (European Commission 2021g). The revision of the EU ETS itself is of primary importance for the internalization of the scrap bonus (European Commission 2021e). The following key adjustments should be noted.

A more ambitious reduction target

The 55 percent reduction of the EU's net greenhouse gas emissions by 2030 requires a higher level of ambition when it comes to emissions trading. Therefore, the aim is that by 2030, greenhouse gas emissions from activities regulated by the EU ETS will fall by 61 percent compared with their level in 2005. This is a significantly more ambitious goal compared with the previous reduction target of 41 percent.

In order to achieve that target, the linear reduction factor is to be increased from its current level of 2.2 percent per year to 4.2 percent per year. The increase in the linear reduction factor will lead to a faster reduction of the emission cap in the EU ETS. There will also be a one-off reduction of the quantity of the certificates when the revision enters into force. The aim is to put the EU ETS on a path which corresponds to a linear reduction of the cap by 4.2 percent per year, starting in 2021 (European Commission 2021e, p. 29).

Integration of shipping

Currently, the EU ETS does not cover greenhouse gas emissions from shipping. However, today's emissions from shipping exceed those from 1990 and an analysis by the European Commission predict further increases by 2030 (European Commission 2021e, p. 2). The European Commission is therefore proposing to integrate shipping into the European Emissions Trading System.

For shipping within the EU, the responsible companies are to acquire certificates for 100 percent of the emissions generated. For incoming and outgoing shipping, certificates are to be purchased for 50 percent of the emissions (European Commission 2021e, p. 41). The obligation to issue certificates is set to take effect in 2023. In the first year, it will be necessary to be able to produce certificates for 20 percent of emissions. This will be increased gradually. From 2026, certificates must be purchased for 100 percent of the emissions caused (European Commission 2021e, p. 42).

The integration of shipping into the EU ETS will more comprehensively set a price for greenhouse gas emissions from the transport of raw materials to Europe, contributing to the internalization of the scrap bonus. However, transport from third countries is placed at an advantage over shipping within Europe, since only 50 percent of the resulting emissions are taken into account for the transport from third countries. This represents a competitive advantage for imports of raw materials from third countries.

Emissions trading for road transport and buildings

Greenhouse gas emissions from fossil fuels used in road transport or in buildings are to be priced using a second emissions trading system. The system is described as »separate but adjacent emissions trading« (European Commission 2021e, p. 3) and aims to end the unequal treatment of district heating and electric vehicles, whose emissions are already covered by the EU ETS.

The European Commission has decided to regulate emissions from road transport and buildings with a second emissions trading system rather than integrating them into the existing EU ETS in order to avoid disrupting the EU ETS, which is functioning very well (European Commission 2021e, p. 3). It is generally assumed that a CO_2 price that is the same for all emitters is a more efficient way of preventing greenhouse gas emissions than a fragmented emission pricing system (Böhringer et al. 2006). However, the integration of the less price sensitive sectors of road transport and buildings could lead to a significant increase in the price of the certificates in the EU ETS, which in turn would increase the risk of carbon leakage.

The emissions trading system for road transport and buildings is expected to come into effect in 2025, and the obligation to purchase certificates will begin in 2026. Unlike in the EU ETS, it is not the parties who release the greenhouse gases that are subject to the obligation. Instead, the second emissions trading scheme will impact the party bringing the fuels on to the market (European Commission 2021e, Annex III).

The way the emissions trading system for road transport and buildings works will be based on the EU ETS. The linear reduction factor is expected to be 5.43 percent per year (European Commission 2021e, p. 54). The emission allowances will be auctioned off in full (European Commission 2021e, pp. 54–55). The revenues are to be used, among other things, to help those suffering from the effects of social hardship.

Emissions trading for road transport and buildings integrates additional greenhouse gas emissions into an emissions trading system. It is of lesser importance for the internalization of the scrap bonus.

Free allocation of certificates

Another change proposed by the European Commission in the context of the revision of the EU ETS is the introduction of the Carbon Border Adjustment Mechanism. The Carbon Border Adjustment Mechanism (CBAM, see section 5.2.2) is intended to serve as a tool to protect against carbon leakage and replace the free allocation of emission allowances. Until the full introduction of the CBAM, the allocation of free allowances will be reduced and will be subject to additional conditions.

The European Commission is proposing to exclude sectors from the free allocation of allowances if their products are covered by the CBAM. A gradual transition is planned, with 100 percent of the free allocations envisaged to be carried out by 2025. In 2026, this share is to be reduced to 90 percent, before being further cut by 10 percentage points in each of the years thereafter. As a result, industry sectors covered by the CBAM are set to stop receiving free allowances from 2035 (European Commission 2021e, p. 30).

The allocation of free allowances to competitive industries that produce high levels of emissions is carried out on the basis of a benchmark system (see section 4.1). The maximum adjustment of the benchmarks is to be increased from 1.6 percent to 2.5 percent in order to take account of technical progress (European Commission 2021e, p. 30). In addition, the definitions of the activities covered by the EU ETS will be made more technology-neutral and the structure of the benchmarks will be reviewed. For steel production, the European Commission proposes to delete the reference to pig iron (European Commission 2003) and to take into account all iron and steel products (European Commission 2021e).

Another proposal to limit the allocation of free allowances is linked to the Energy Efficiency Directive (European Commission 2012). This proposal would see installations that are subject to the obligation to carry out energy audits[7] only being allocated their full quota of free allowances if the recommendations of these audits are implemented. This applies if the investment costs are proportional and do not exceed an amortization period of five years. Alternatively, operators can demonstrate that they have achieved equivalent greenhouse gas reductions by taking other measures. If these conditions are not met, the allocation of free allowances will be reduced by 25 percent (European Commission 2021e, p. 45).

The proposals regarding the free allocation of emission allowances show that the CBAM is intended to replace and not supplement the allocation of free allowances. Changes in product benchmarks and definitions also indicate a reduction in free allocations. In addition, the granting of certificates will be linked to conditions that will create further incentives for climate protection.

5.2.2
Carbon Border Adjustment Mechanism

As outlined above, the European Commission plans to replace the free allocation of emission allowances with the CBAM (European Commission 2021a). The European Commission justifies this on the basis that the free allocation of emission allowances would limit the effectiveness of the price signal (European Commission 2021a, p. 5).

Climate policy provides incentives for low-carbon production processes, which — at least in the short and medium term — are associated with higher economic costs. Companies in regions without (ambitious) climate policies in place do not incur these costs. Carbon border adjustment mechanisms are designed to compensate for these inequalities (Ismer and Neuhoff 2007). To this end, the CO_2 emissions of imported products will be subjected to a pricing mechanism and/or the climate protection costs of domestic products will be offset during exporting. The CBAM would be the first carbon border adjustment mechanism implemented in practice.

Carbon border adjustment mechanisms: Incentivizing effects and conformity with WTO rules

Carbon border adjustment mechanisms are being intensively discussed in scientific literature, with the focus resting primarily on two key research questions: on the one hand, the compatibility of carbon border adjustment mechanisms with the rules of the World Trade Organization (WTO) (Holzer 2014; Monjon and Quirion 2011) — a challenge which the European Commission's proposal takes into account (European Commission 2021a, p. 5) — and on the other hand, the economic incentives that carbon border adjustment mechanisms create (Branger and Quirion 2014). In particular, the research is focused on how the structure of a carbon border adjustment mechanism impacts carbon leakage and production in energy-intensive industries. In the following, we will discuss studies that investigate the economic incentive effects of carbon border

[7] The energy audits »should take into account the relevant European or international standards such as EN ISO 50001 (energy management systems) or EN 16247-1 (energy audits) or, if including an energy audit, EN ISO 14000 (environmental management systems)« (European Commission 2012).

adjustment mechanisms. For the most part, these consist of economic simulation studies with models that allow an analysis of carbon border adjustment mechanisms before they are introduced in practice.

Kuik and Hofkes (2010) investigated the effects of a carbon border adjustment mechanism in the steel and cement sectors. Their economic model simulations suggest that carbon border adjustment mechanisms could significantly reduce carbon leakage and that the steel sector would benefit more than cement production.

Monjon and Quirion (2010) examined different options for structuring a carbon border adjustment mechanism in terms of their conformity with WTO rules and their economic effects. They took into account the production of steel, aluminum and cement, as well as the electricity sector. In order to bring carbon border adjustment mechanisms into line with WTO rules, non-discrimination must be ensured: Importers must not be burdened more than domestic companies. Monjon and Quirion (2010) propose using benchmarks for CO_2 emissions if measuring emissions is associated with disproportionate costs for importers. This could be done using the benchmarks for determining the free allocation of emission allowances. Monjon and Quirion (2010) point out that taking into account indirect emissions (especially from electricity generation) is associated with challenges in terms of methodology. They also note that exceptions must be made for countries with their own climate policies in order to avoid double pricing of emissions and ensure equal treatment.

Monjon and Quirion’s economic model calculations (2011) indicate that carbon border adjustment mechanisms lead to a reduction of carbon leakage. Their results show that a carbon border adjustment mechanism reduces the migration of greenhouse-intensive industries by at least 50 percent compared with the full auctioning of all emission allowances without cost compensation. The free allocation of emission allowances has a limited impact on carbon leakage. In addition, a carbon border adjustment mechanism provides incentives for emission reductions outside Europe. Companies in third countries can export to the EU at a lower cost if they carry out their production in a climate-friendly manner. The inclusion of exports strengthens the effectiveness of the carbon border adjustment mechanism. The production of energy-intensive goods decreases compared with the allocation of free allowances, as the prices of CO_2-intensive products increase.

Bendnar-Friedl (2012) have drawn the conclusion that industries in which process emissions occur benefit more from carbon border adjustment mechanisms than industries whose emissions are solely energy-related. As a rule, process emissions take far more effort to reduce than energy-related emissions, which can be avoided by using alternative energy sources.

Economic model simulations show that carbon border adjustment mechanisms lead to a greater reduction in carbon leakage than the free allocation of emission allowances. The structure of these mechanisms plays a decisive role here. The more comprehensive the carbon border adjustment mechanism, the more effectively it can limit the migration of CO_2-intensive industries (Branger and Quirion 2014). At the same time, the more comprehensively a carbon border adjustment mechanism sets a price for emissions, the more complex its implementation becomes and, accordingly, the more expensive it becomes. It must also be ensured that it is compatible with the rules of the WTO.

Last but not least, there is a risk that the introduction of a carbon border adjustment mechanism will be perceived as a protectionist measure rather than a climate policy instrument and will lead to conflicts with key trading partners. The European Union must take these conflicting priorities into account when developing the CBAM.

Structuring the carbon border adjustment mechanism

The border adjustment mechanism proposed by the European Commission is a system of greenhouse gas pricing based on the EU ETS. It is intended to ensure equivalent CO_2 prices for domestic and imported products (European Commission 2021a, p. 16). Companies must prove that they have emission allowances for the direct greenhouse gas emissions stemming from the production of the products they export to Europe (»CBAM certificates"). The CBAM certificates are sold, and the free allocation of allowances is not intended. The price of the CBAM certificates corresponds to the weekly average price determined by the EU ETS (European Commission 2021a, p. 37). Unlike the EU ETS, quantitative restrictions on CBAM certificates are not envisaged (European Commission 2021a, p. 17). The CBAM certificates are to be traded and — to a limited extent — sold back to the EU. They lose their validity after two years. This prevents importers from obtaining CBAM certificates on a large scale today and thus hedging against rising prices in the future. CO_2 prices paid in the country of origin (CO_2 taxes, emissions trading systems) can be deducted. This ensures that imports are not subject to charges on both ends.

The quantity of allowances to be issued should correspond to the direct emissions actually released during the production of imports. If this is not possible for individual importers, then default values will be set, while allowing for regional differentiations. These default values will be set by the European Commission on the basis of the best available data.

Indirect emissions are not covered by the CBAM. There are also no plans to reimburse the costs of climate protection for exports. The inclusion of indirect emissions and the extension of the CBAM to cover additional products will be investigated prior to the introduction of the obligations to pay duties in 2026 (European Commission 2021a, p. 42). By 2025, importers will be required to report on the greenhouse gas emissions released in the production of imported goods.

The selection of products covered by the CBAM is based on the installations covered by the EU ETS. It partially covers cement, electricity, fertilizers and aluminum. In addition, iron and steel as well as goods made of iron or steel[8] will be covered by the CBAM.

Exceptions are provided for chemical and petrochemical products, as the co-production of various products in these sectors makes it difficult to clearly assign emissions to specific products. The CBAM provides exceptions for iron and steel. Scrap and ferroalloys will not be taken into account as significant emissions are not created in their production (European Commission 2021a, p. 20). While this argument seems valid for scrap, it is not plausible for ferroalloys. For example, the production of one ton of ferronickel involves greenhouse gas emissions of 9 to 17 tons of CO_2 (Fraunhofer UMSICHT 2010; Haque and Norgate 2013). However, the accompanying regulatory impact analysis makes reference to problems caused by the non-uniform nature of ferroalloys and the lack of benchmark data from the EU ETS (European Commission 2021b, p. 76).

The European Commission's Joint Research Centre estimates that the CBAM will generate revenues of 1.5 billion euros per year from 2026 onwards. Revenue is expected to rise to 2.1 billion euros per year by 2030 (European Commission 2021a, p. 58). The proceeds are set to be used to help pay for the COVID-19 recovery package NextGenerationEU.

[8] The definitions of product groups are based on the Combined Nomenclature (CN) of the European Union. Iron and steel are covered in Chapter 72 and goods made of iron or steel in Chapter 73 (European Commission 2020).

CBAM and scrap steel

The carbon border adjustment mechanism could offset the disadvantages that energy-intensive industries in Europe face in competition with competitors that are subject to less ambitious climate policy regulation. In the steel sector, imports of products from integrated steel mills, whose greenhouse gas emissions are predominantly direct emissions, bear the brunt of the burden. Products from electric arc furnace steel mills, whose emissions are generated mainly in the production of electricity, face hardly any additional strain.

By setting a price for emissions from imported steel production, the CBAM generates incentives for climate protection in steel production and thus for the use of scrap in third countries. These incentives take effect both within (additional use of scrap to reduce direct emissions in the integrated steel mills) and between the process routes. The scrap bonus will thus be better internalized when it comes to imports.

5.2.3
Timeline

In the Fit for 55 package, the European Commission has proposed major adjustments to the current European climate policy in order to achieve the target set in the Paris Agreement (European Commission 2021d). It will take more than ten years for these adjustments to be implemented. Figure 09 provides an overview of the schedule for selected elements of the Fit for 55 package. However, this schedule depends on how long the negotiations between the European institutions on the introduction of the package take.

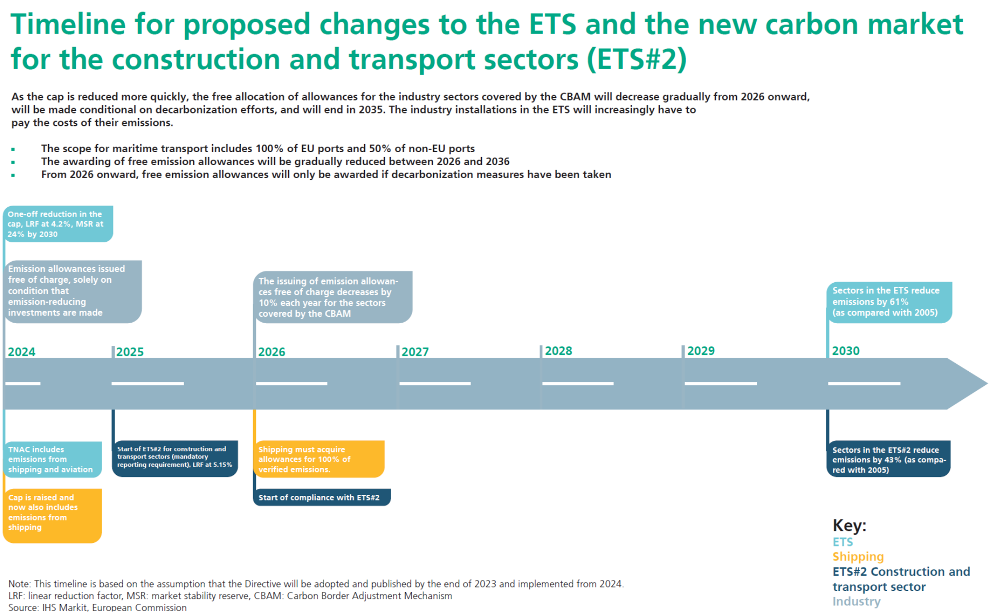


Fig. 09: Possible timeline for the implementation of the Fit for 55 package. Source: Own diagram based on Brooks (2021).

(A larger version of figure 09 is included as an appendix on page 48.)

In **2023**, shipping will be integrated in the EU ETS. In the first year, the companies affected will be obliged to issue certificates for 20 percent of their emissions. The EU ETS emissions cap will be adjusted to take account of the integration of shipping. In addition, from 2023 onward, the CBAM will enforce mandatory reporting on emissions from imports into the EU.

Depending on how long the negotiations for the introduction of the Fit for 55 package take, **2024** could see the one-off reduction of the EU ETS emission cap and an increase of the linear reduction factor to 4.2 percent. In addition, the free allocation of emission allowances may start to be subject to certain conditions (implementation of energy audit recommendations).

The emissions trading system for road transport and buildings will come into effect in **2025**, but without an obligation to demonstrate compliance by means of certificates. From 2025 onwards, parties that bring fossil fuels on the market will be subject to a reporting obligation.

A number of changes are planned for **2026**. Demonstrating compliance in the emissions trading system for the road transport and building sectors will be mandatory as of 2026. In the same year, the obligation to purchase CBAM certificates will begin. In 2026, the shipping industry will have to provide certificates for 100 percent of its relevant greenhouse gas emissions. In addition, the reduction of the free allocation of emission allowances will begin and will take place in annual increments of 10 percentage points. According to current regulations, the second benchmark period of the fourth phase of the EU ETS will start in 2026.

The main objectives of the Fit for 55 package must be achieved by **2030**. Emissions in the EU ETS are to be reduced by 61 percent in comparison to 2005, while those in the emissions trading system for road transport and buildings need to fall by 43 percent. Overall, Europe's greenhouse gas emissions must fall by at least 55 percent, taking their level in 1990 as a starting point. In **2035**, the free allocation of emission allowances to sectors whose products are covered by the CBAM will end.

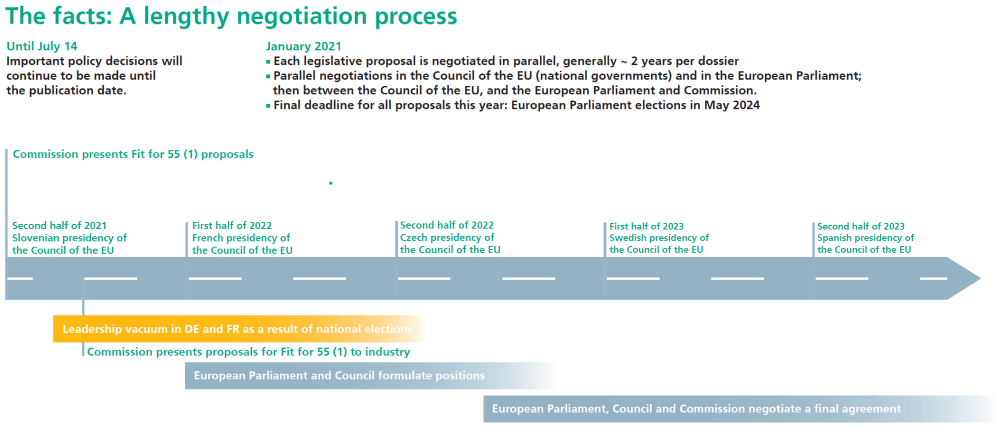


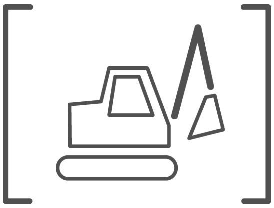
Fig. 10: Possible timeline for the negotiations of the Fit for 55 package. Source: Own diagram based on Dufour (2021).

(A larger version of figure 10 is included as an appendix on page 49.)

Given the scope, complexity and ambitious nature of the Fit for 55 package, lengthy negotiations between the European Commission, the European Parliament and the member states are expected. Both the CBAM and emissions trading for road transport and buildings are likely to lead to major conflicts, not least between individual member states. Dufour (2021) expects the negotiation process to last for two to three years. Dufour (2021) has estimated the final deadline for the Fit for 55 package as the European Parliament elections in May 2024. Figure 10 illustrates a possible timeline for the negotiations.

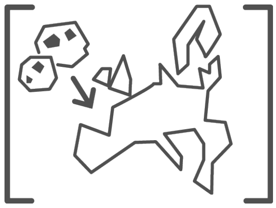
5.3 Implications for the gaps in the EU ETS

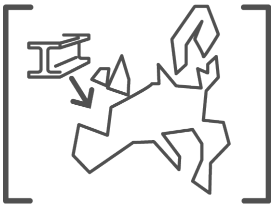
With the Fit for 55 package, the European Commission has proposed a comprehensive and ambitious climate protection program. However, the internationalization of the scrap bonus raises the following questions: To what extent does the package contribute to resolving the previously identified gaps in the European Emissions Trading System? And what gaps remain that hinder fair competition between the raw materials used in steel production?



There are no plans to integrate **mining** into the EU ETS. The use of fossil fuels in raw material extraction is also not covered by emissions trading for road transport and buildings. Greenhouse gas emissions from the extraction of ore and coal are therefore still not subject to a pricing mechanism.

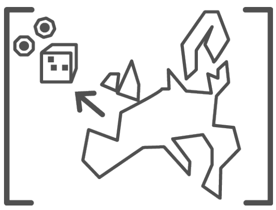
A gaps remains in European climate policy when it comes to the **importing of raw materials and intermediate products**. Mining is not part of the EU ETS and is therefore not covered by the CBAM. Ferroalloys, the further processing of which is associated with significant greenhouse gas emissions in some cases, are explicitly excluded. Scrap use thus remains at a disadvantage.

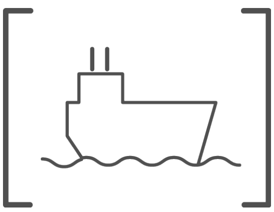




The scrap bonus will be taken into account by the CBAM for imported steel in progressive increments starting in 2026. The CBAM will apply a price to direct emissions from steel production outside Europe. This creates incentives for the use of scrap, because both the use of larger amounts of scrap in the blast furnace route and scrap-based electric arc furnace steel production reduce emissions, which in turn saves on costs incurred through the CBAM. These incentives are not all-encompassing, as indirect emissions from fossil-based power generation, mining and the manufacturing of intermediate products are not taken into account. The CBAM thus only partially resolves the gaps relating to the **importing of steel**.

Exports of steel and scrap are still not taken into account by the CBAM. European steel, the production of which takes the scrap bonus into account at least partially, continues to be at a competitive disadvantage on world markets. The scrap bonus is still not internalized when it comes to exporting scrap to regions without an ambitious climate policy.





Transport is more widely taken into account in European climate policy. Shipping is provided for as part of the EU ETS and road transport is subject to a separate emissions trading system. However, there are still disadvantages for scrap. For example, only half of the emissions from ore transport to Europe by sea are taken into account by the EU ETS.

*The icons used on page 33 and page 34 were created for our own illustration purposes.

6
Instruments for internalizing the scrap bonus

The analysis of the Fit for 55 package shows that the scrap bonus would not be fully taken into account in the European Emissions Trading System (EU ETS) and the Carbon Border Adjustment Mechanism (CBAM), despite the extensive revision of Europe's climate policy instruments. In this section, concrete proposals for a more complete internalization of the scrap bonus will be formulated.

A global CO_2 price would fully internalize the climate protection benefits of using scrap. Emissions would be priced regardless of where and in which sector they are produced (Fraunhofer IMWS 2019). This would make the use of scrap cheaper in comparison with the use of ore. Despite the efforts in the worlds of science (Nordhaus 2015) and politics to agree on a harmonized climate policy at least between major emitters, this economically and ecologically optimal solution remains unrealistic.

Restrictions can be expected in the structure of the CBAM when it comes to taking into account indirect emissions or exports. The cost of tracking emissions along the entire value chain in a verifiable and tamper-proof way currently appears too high. Legal uncertainties remain in relation to the application of carbon border adjustment mechanisms and there is a risk that these instruments will trigger trade conflicts.

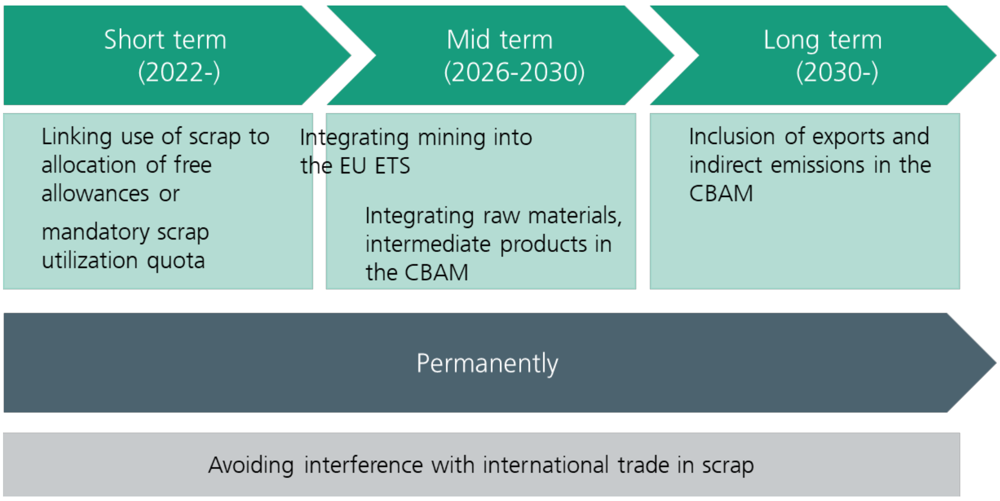


Fig. 11: Overview of the instruments for internalizing the scrap bonus.
Source: Own diagram

Figure 11 shows the options for the further internalization of the scrap bonus outlined below. They aim to integrate the advantages of scrap use into the pricing mechanism in an economically viable way, within the framework of the current restrictions. These measures would make it possible to implement the scrap bonus in practice.

The instruments can be divided into four categories. As short-term transitional instruments, the linking of the free allocation of emission allowances to the scrap bonus and the introduction of mandatory scrap utilization quotas are discussed. As a medium term measure, integrating a pricing mechanism for CO_2 emissions from mining and the production of steel intermediate products into the revision of the EU ETS and the introduction of the CBAM is recommended. For this purpose, mining should be integrated into the EU ETS and primary raw materials and steel intermediate products should be included in the CBAM. In the long term, the CBAM should be reviewed with a view to extending it to include indirect emissions and exports. The free trade in scrap should not be restricted in the short or long term.

Linking the use of scrap to the allocation of free allowances

Gaps and flaws remain in the internalization of the scrap bonus in the short and medium term. Under the CBAM, the obligation to demonstrate compliance via certificates is set to begin in 2026. Until then, market distortions at the expense of scrap as a raw material will remain, for example, due to the lack of a pricing mechanism for greenhouse gas emissions in imported steel. It seems unlikely that the CBAM will be extended to include indirect emissions before the end of this decade. Moreover, under the current political and economic conditions, neither a global CO_2 price nor a complete compensation of the competitive disadvantages outside Europe are realistic options. A dedicated instrument could help bridge the gaps in the internalization of the scrap bonus.

The review of the EU ETS aims to link the full allocation of free emission allowances to conditions such as the implementation of the recommendations of energy audits (European Commission 2021e). This proposal can be interpreted as a way of creating further incentives for climate change mitigation through the allocation of emission allowances. This approach could be used as a means of developing a transitional instrument for internalizing the scrap bonus, i.e. linking the allocation of free allowances to the use of scrap. The revision of the EU ETS is set to make allocation dependent on certain criteria; these could be extended to include reaching a scrap utilization quota. Here, the scrap utilization quota is understood as the ratio of scrap utilized to the output quantity. The scrap utilization quota to be achieved could be varied across electric arc furnace steel mills and integrated steel mills in order to account for their respective technical restrictions. They could be calculated by dividing deliveries of external scrap from steel recycling companies by the quantities of steel produced.[9]

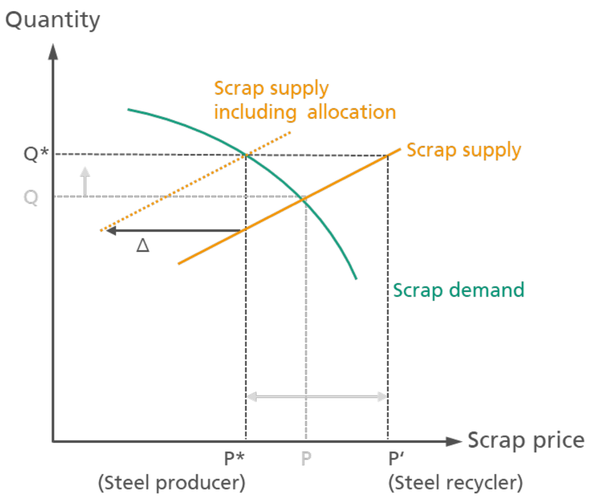


Fig. 12: Effect of free allocation of emission allowances linked to the use of scrap on the scrap market.
Source: Own diagram

[9] Internal scrap should not be included in the calculation of the utilization quota in order not to generate incentives for the production of scrap in the process.

Figure 12 illustrates how the free allocation of allowances affects the use of scrap. The horizontal axis shows the scrap price, the vertical axis shows the quantity. The demand for scrap is represented by the green curve. It falls as the scrap price rises. If the scrap price rises relative to the price of ore, steel manufacturers will increasingly turn to ore for production. The orange line represents the scrap supply. The higher the scrap price, the higher the scrap supply. Higher prices, for example, make more expensive methods for collecting, sorting and preparing scrap competitive. The market reaches equilibrium when supply and demand are equal. This is the case for the price P and the quantity Q.

Linking the allocation of free allowances represents a monetary advantage associated with the use of scrap. The extent of that advantage depends on the concrete structure and the amount of the CO_2 price in the EU ETS. It is shown as Δ in figure 12. From the point of view of scrap buyers, the monetary advantage shifts the supply curve to the left, meaning the use of scrap becomes cheaper for steel manufacturers. As a result, the demand for scrap increases and the quantity used increases from Q to Q*. The monetary advantage of the allocation of emission allowances thus increases the use of scrap.

The scrap price, which was P in the initial situation, also changes due to the monetary advantage of free emission allowances. From the point of view of the steel mills (demand), this results in a lower price P*. From the point of view of the suppliers, i.e. the steel recycling industry, the price is P' and thus above the price in the initial situation (P). The difference between P* and P' is Δ, that is, the monetary advantage of the allowances granted free of charge.

Figure 12 shows that the linking of scrap use and free allowances creates an incentive that promotes the circular economy and reduces greenhouse gas emissions. This could support the internalization of the scrap bonus, as long as primary raw materials and steel intermediate products are not fully taken into account in the EU ETS and CBAM.

Positive incentives are better than mandatory scrap utilization quotas

A mandatory scrap utilization quota could encourage the use of scrap as a raw material for steel production. To achieve that, a minimum proportion of scrap in the raw material mix of steel production would need to be legally established. A mandatory quota could be implemented either on a technology-specific basis for each steel mill or for the steel sector as a whole. The latter would be more efficient economically, as the scrap would be used where it would make the greatest economic contribution.

A system of tradable recycling certificates could prove that the quota has been met. Such a system is used for packaging materials in the UK. Packaging recovery notes require companies to demonstrate that the raw material mix of their packaging contains the specified proportion of secondary raw materials. The packaging recovery notes are issued by accredited reprocessors and are freely tradable. Packaging recovery notes must be submitted for imported products and imported packaging materials (Matsueda and Nagase 2012).

Mandatory scrap utilization quotas set a minimum threshold for the proportion of scrap in the raw material mix. If these are above the level achieved without them, they increase the demand for scrap, which in turn triggers an increase in the relative scrap price. Mandatory scrap utilization quotas thus indirectly affect the internalization of the scrap bonus (Fraunhofer IMWS 2019).

Mandatory scrap utilization quotas do not directly take into account emissions from steel production, but rather the proportion of scrap in the raw material mix. There is no guarantee that incentives will be linked to the CO_2 price in Europe. In the case of mandatory scrap utilization quotas, a challenge would be to achieve equal treatment of imported and European steel. In contrast to the linking of the allocation of free allowances to scrap utilization, they would place a burden on steel manufacturers in Europe. In addition, mandatory scrap utilization quotas would constitute a more severe intervention on the market than an incentive system that promotes scrap use with monetary benefits. That is why a positive incentive for the use of scrap would be preferred from an economic point of view.

Integrating mining into the EU ETS

Greenhouse gas emissions from mining are not covered by the EU ETS. The revision of the EU ETS does not provide for the integration of greenhouse gas emissions from mining into emissions trading. Thus, emissions from the burning of fossil fuels (see Farjana et al. 2019 for an overview) and further greenhouse gas emissions such as methane released in coal mining are still not covered by the pricing mechanism (Burchart-Korol et al. 2016). This constitutes a distortion of competition at the expense of scrap.

Life cycle assessments quantify the extent and composition of emissions in mining. Ferreira and Leite Ferreira and Leite (2015) estimate the greenhouse gas emissions of iron ore mining in Brazil to be 13.3 kg of CO_2e per ton of concentrated ore. At 32 percent, electricity generation is responsible for the largest share of these emissions. Excavators, trucks and other diesel-powered vehicles account for around 21 percent. Haque and Norgate (2013) calculate emissions from iron ore mining in Australia at 11.9 kg of CO_2e per ton of ore. About half of these emissions are released when the ores are loaded and transported inside the mine. Additional greenhouse gas emissions are caused by the use of explosives. Gan and Griffin (2018) calculate emissions of between 35 and 39 kg CO_2e per ton of ore in open-cast mining in China. The higher emissions are due to the fact that iron ores in China are further below the surface and are less concentrated than in Australia. About 67 percent of greenhouse gas emissions are accounted for by the loading and transport of the ores. In addition, Gan and Griffin (2018) identify the loss of vegetation as a source of greenhouse gas.

The Fit for 55 package offers two options for integrating mining into emissions trading. In one option, mining operations in Europe could be required to participate in the EU ETS. Alternatively, the use of fossil fuels in mining could become part of the emissions trading system for road transport and buildings. One argument in favor of the second option is that it would result in minor regulatory challenges for mining companies, as the system is based on the placing of fossil fuels on the market. The relatively small number of mining sites in Europe limits the significance of the implementation costs. Arguments for integration into the EU ETS include the fact that other sources of emissions, such as methane release or explosives, could then be taken into account. It would also be possible to set a price for emissions from imported raw materials in the CBAM, because the CBAM only covers products that are included in the EU ETS.

The inclusion of mining in Europe would in itself have only a limited impact on the internalization of the scrap bonus. Firstly, the share of direct emissions from mining in total steel production is small — the life cycle assessments cited indicate a share in the low single-digit percentage range. Secondly, the EU imports most of its metal ore from third countries. Nevertheless, the integration of mining into the EU ETS would be a building block for fair competition between the raw materials used in steel production.

Integrating raw materials and intermediate products in the CBAM

To fully internalize the scrap bonus, a price must be set for the CO_2 emissions from steel production along the entire value chain. That pricing mechanism should be used regardless of whether emissions are released inside or outside Europe. Therefore, the

CBAM should cover imports of raw materials and intermediate products used in steel production.

In 2018, 83.5 percent of iron ore used in the EU was imported from third countries (World Steel Association 2019). The EU also has similar import dependencies in relation to other metals, including important alloy elements involved in (stainless) steel production, such as nickel, chromium, molybdenum and manganese (European Innovation Partnership on Raw Materials 2018). The high proportion of imports for steel raw materials make it clear why the integration of mining into the EU ETS should be accompanied by the inclusion of imported raw materials in the CBAM.

Ferroalloys are explicitly excluded in the draft version of the carbon border adjustment mechanism (European Commission 2021a, Annex I). However, the production of ferroalloys is associated with significant greenhouse gas emissions in some cases (e.g. 3.0 t CO_2e / t ferrochrome or 9–17 t CO_2e / t ferronickel (Fraunhofer UMSICHT 2010; Haque and Norgate 2013). To fully cover these emissions under a pricing mechanism and to integrate the scrap bonus, it makes sense to include not only raw materials but also steel production intermediate products in the CBAM. Accordingly, the exemptions for ferroalloys should be removed.

Applying a price to emissions caused by primary raw materials and intermediate products would contribute to fair competition between raw materials. Primary raw materials, in particular, come mainly from third countries, so it is desirable to integrate them into the EU ETS and CBAM.

Reviewing the inclusion of exports and indirect emissions in the CBAM

The European Commission draft for the CBAM takes into account direct emissions from the production of selected products. Indirect emissions released in fossil-based power generation, mining or the production of intermediate products would not be covered. Thus, greenhouse gas emissions from imports would still not be completely covered by a pricing mechanism. The costs of emission allowances for exported products are not reimbursed (European Commission 2021a). As a result, Europe’s energy-intensive industries remain at a competitive disadvantage in non-European markets. The economic literature suggests that limiting the carbon border adjustment mechanism to imports limits its effectiveness (Branger and Quirion 2014).

These gaps in the CBAM lead to flaws in the internalization of the scrap bonus: Emissions from the use of ore and coal in imported raw materials are not fully covered in the CBAM. The scrap bonus for exported scrap is either not covered at all or is not fully covered, depending on the destination country.

The fact that the introduction of the CBAM is accompanied by major regulatory, technical and political challenges represents an argument in favor of limiting the CBAM to direct emissions and imports. Its implementation must be compatible with WTO rules, and it must be possible to meet the requirements of the carbon border adjustment mechanism at a reasonable cost. Nevertheless, the European Commission should regularly review the possibility of extending the CBAM to include indirect emissions and exports. Until this is possible, implementing the recommendations above would contribute to a more extensive internalization of the scrap bonus and thus to a fairer competition.

Avoiding interference with international trade in scrap

Export restrictions would make it possible to keep scrap as a raw material in Europe and to lower the price of scrap in the EU (Pothen et al. 2013). This would create competitive advantages for the European steel industry. However, it is likely that export barriers for scrap would not only distort the market, but also increase greenhouse gas emissions.

Figure 13 provides an overview of the European scrap market. The horizontal axis shows the scrap price, while the vertical axis shows supply and demand volumes for scrap in Europe. The green curve represents steel manufacturers' demand for scrap, which falls with the price. In other words, the higher the scrap price at a given level of demand for steel, the less scrap the steel sector wants to use as a raw material. It should be noted that the use of scrap in steel production cannot be increased arbitrarily — at least in the short term. The use of scrap in integrated steel mills is limited for technical reasons and in the electric arc furnace route, capacity levels limit the use of scrap. The dashed gray line represents that upper limit. The supply of scrap in Europe is illustrated by the orange line. If the scrap price rises, the volume of scrap supplied increases.

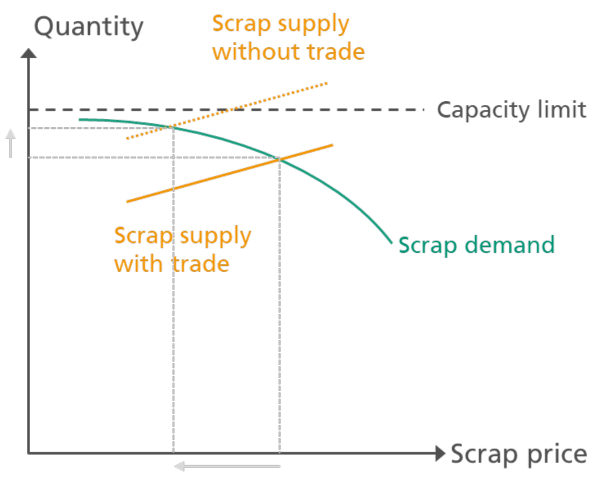


Fig. 13: How export barriers for steel scrap in Europe work.
Source: Own diagram

Figure 13 shows that an export restriction on scrap shifts supply volumes upward. The European market will have a larger quantity of scrap available at the same price, as the option of exporting is restricted. This is indicated by the dashed orange line.

It is expected that the quantity of scrap used in Europe will increase while the price of scrap falls. The exact effect depends on the extent to which the steel industry in Europe is in a position to use the additional supply in its production. The more flexibly it can increase its use of scrap, the greater the increase in quantities. If, as indicated in figure 13, the amount of scrap used is already close to the capacity limit, a small increase in the quantity used is to be expected. At the same time, falling scrap prices lead to lower supply, as costly processes for collecting and preparing scrap are no longer economically viable.

On the world markets, export barriers make European scrap more expensive and thus less attractive from an economic point of view. (Stainless) steel manufacturers, who rely heavily on European scrap as raw material, will look for alternative suppliers. It is to be expected that the shortage of supply from Europe on the world market will lead to rising prices and falling use of scrap. If the additional demand in Europe does not compensate for this decline, which is particularly likely when capacity limits are close to being reached, the use of scrap worldwide will be reduced. As a result, export barriers for scrap would not only lead to market distortions, but also to additional greenhouse gas emissions.

It is therefore advisable to set incentives for increased use of scrap in Europe (for example, by allocating free emission allowances) and to refrain from direct and indirect export restrictions.

Instruments for internalizing the scrap bonus

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Conclusion

In order to ensure fair competition between the raw materials used in steel production, the benefits of the use of scrap for society as a whole should be reflected in the prices. The »Scrap bonus concrete« study proposes measures that can be used to complete the internalization of the scrap bonus into the pricing mechanism. The gaps and flaws that would remain even after the implementation of the European Commission's Fit for 55 package could thus be closed and resolved.

The integration of mining into the European Emissions Trading System (EU ETS) and the Carbon Border Adjustment mechanism (CBAM), as well as the removal of the exemptions for ferroalloys, could ensure this internalization of the scrap bonus right at the beginning of the value chain. This would place a price on the greenhouse gases that arise in the production of raw materials or in the production of intermediate products, contributing to fairer competition between raw materials.

The use of scrap could be rewarded within the EU ETS by linking it to the free allocation of emission allowances. Extending the planned conditions for the free allocation of allowances to include scrap use could link monetary benefits to the use of scrap. This link would provide a positive incentive for using scrap until the remaining gaps in EU ETS and CBAM are resolved.

Alternatively, mandatory scrap utilization quotas could promote the use of scrap as a raw material for steel production. However, such mandatory quotas would constitute a more severe market intervention than the rewards granted via the EU ETS system. In addition, they could put a strain on the steel industry. This would apply in particular if imported steel is not regulated to the same extent as steel produced in Europe. Positive incentives for the use of scrap, such as rewards like free emission allowances, therefore appear to be a better transitional solution for the economy.

International trade in scrap should not be restricted. Restrictions on scrap exports would reduce demand for European scrap from third countries, thereby lowering scrap prices within the EU. This could increase the use of scrap in Europe. At the same time, the restricted supply from the EU would increase prices outside Europe and the use of scrap would fall. Therefore, when considered from a global perspective, export barriers could hamper recycling and undermine climate policy efforts.

8
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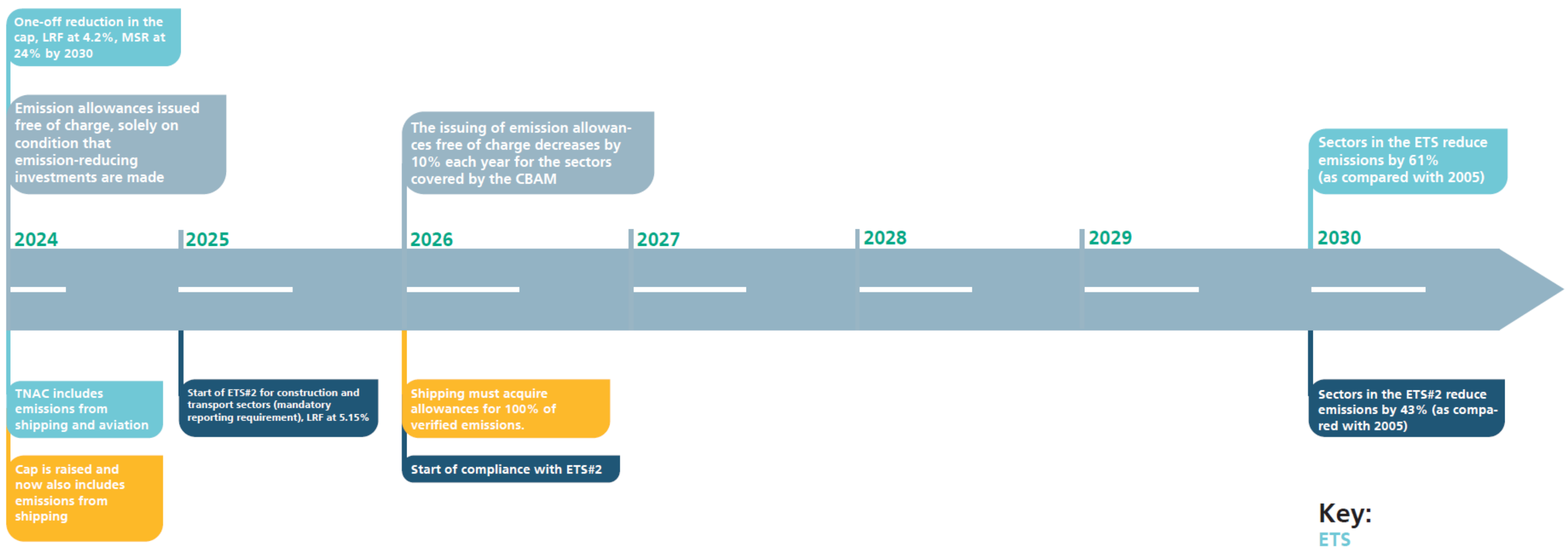
Timeline for proposed changes to the ETS and the new carbon market for the construction and transport sectors (ETS#2)

As the cap is reduced more quickly, the free allocation of allowances for the industry sectors covered by the CBAM will decrease gradually from 2026 onward, will be made conditional on decarbonization efforts, and will end in 2035. The industry installations in the ETS will increasingly have to pay the costs of their emissions.

- The scope for maritime transport includes 100% of EU ports and 50% of non-EU ports
- The awarding of free emission allowances will be gradually reduced between 2026 and 2036
- From 2026 onward, free emission allowances will only be awarded if decarbonization measures have been taken



Note: This timeline is based on the assumption that the Directive will be adopted and published by the end of 2023 and implemented from 2024.
LRF: linear reduction factor, MSR: market stability reserve, CBAM: Carbon Border Adjustment Mechanism
Source: IHS Markit, European Commission

Fig. 09: Possible timeline for the implementation of the Fit for 55 package.
Source: Own diagram based on Brooks (2021)

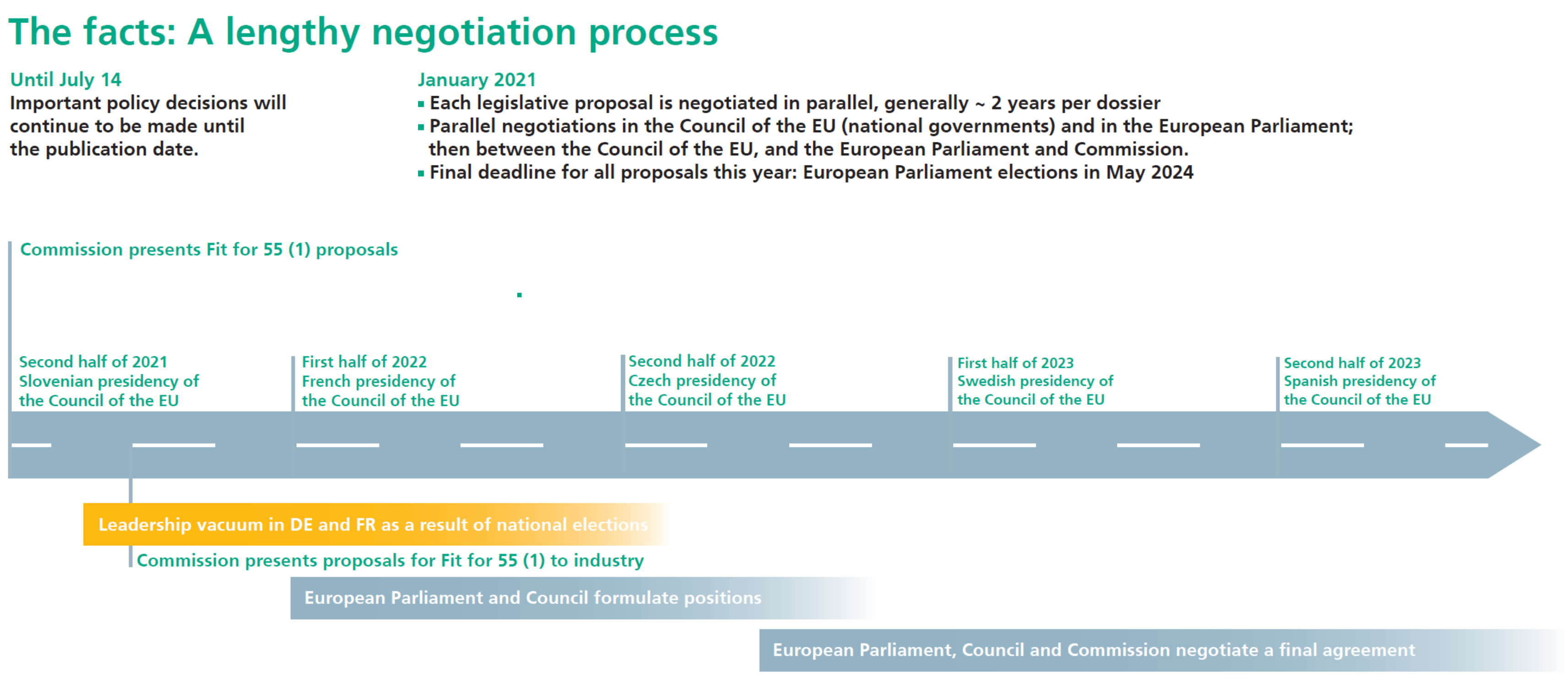


Fig. 10: Possible timeline for the negotiations of the Fit for 55 package.
Source: Own diagram based on Dufour (2021)

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