INSTITUT CIRKULÁRNÍ EKONOMIKY

Risks, barriers and priorities for maximising the production and consumption of recycled steel

Circular economy opportunities for Czech industry decarbonisation

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Executive Summary

Globally, the steel industry accounts for 7% of anthropogenic greenhouse gas emissions and 5% of total CO2e emissions in the EU. Increasing the share of recycled steel in total production is a key strategy in decarbonising the steel industry. The use of electric arc furnaces (EAF) and scrap steel as an input material can result in **a reduction of energy consumption during production by approximately 75% (albeit with a significant increase in electricity consumption) and a reduction in greenhouse gas emissions of 75% to 95%** compared to existing primary production processes.

In 2022, secondary steel production accounted for ~43% of total EU steel production compared to ~70% in Turkey or the USA, while the availability of scrap without exports from the EU could theoretically satisfy the material requirements of over 65% of EU production and an even higher share in the coming decades. Almost the entire production of both steelworks in the Czech Republic (Liberty Steel Ostrava and Třinecké železárny) is currently carried out through the primary route. In 2021, the Czech steel industry contributed 7.8% (9.2 Mt CO2e) to the total CO2e emissions of the Czech Republic (118.4 Mt, excluding LULUCF) including direct and indirect emissions (Scope 1 and 2). The transition of over 75% (5.1 Mt) of the existing capacities to EAFs is planned by 2031 which **has the potential to reduce these emissions by 5.8 up to 6.4 Mt CO2e (65–70%) compared to 2021**, even assuming a 23% increase in crude steel production.

In addition to the large requirements for financing investments and building sufficient capacity for affordable emission-free energy (and the lack thereof), one of the main risks of this transition in the Czech Republic is the increase in future anticipated domestic demand for steel scrap from approximately **1.4 Mt in 2021 to approximately 5 Mt per year after 2030**, with the need for external market purchases increasing fivefold to ~4.3 Mt. The historical annual amounts of domestic steel scrap in the Czech Republic (2.8-3.1 Mt) could theoretically cover about 70% of such scrap purchases, but only assuming zero exports from the Czech Republic, while a minimum of 1.5 Mt would need to be imported.

In reality, the scrap market is fragmented based on the current demand, with low quality requirements for primary production feedstock, price operating as the only market driver and annual exports of 2.0-2.5 Mt heading mainly to other European countries. Lower domestic amounts of scrap are expected in the future due to the gradual depletion of historical stocks of steel products, their extended service life and other factors. At the same time, global demand and the volume of scrap exports from the EU are growing, while potential export restriction measures are problematic from a free trade perspective. Simultaneously, a more sophisticated market setup is prevented by a lack of reliable data and motivation to invest in innovative technologies for efficient sorting, processing and decontamination of scrap for wider use in end-use applications with more demanding performance parameters, such as in the automotive industry.

In order to reduce future risks associated with the availability and quality of scrap for steel production in the Czech Republic and the implementation of investments in Electric Arc Furnaces (EAFs), the following **priority areas** need to be addressed:

- accurate mapping of the flows of steel scrap as a strategic material for decarbonising the steel industry,
- increasing the application of waste/non-waste criteria for scrap metal,
- building a more sophisticated scrap market (including a better database on material flows, guaranteeing the origin of materials and investing in advanced sorting and processing technologies),
- establishing procedures for efficient separation and tracking of metal flows in the value chain (as part of ecodesign requirements and digital product passports),
- engaging in research and development of secondary production of flat and other steel products with more stringent requirements for scrap, especially in the automotive industry,
- ensuring sufficient emission-free energy for the future needs of the steel industry with the greatest possible share of renewable energy sources (also as part of the ongoing updates of the State Energy Policy and the National Energy and Climate Plan),
- accelerating the process of approving subsidies for large projects and supporting projects that enable the application of secondary production in practice (e.g. investments in scrap metal sorting, processing and decontamination technologies, utilisation of other EU and Czech subsidy programmes outside the Modernisation and Innovation Fund),
- promoting demand for low-carbon steel (robust definition of green steel, green public procurement, voluntary industrial partnerships, tax incentives for secondary materials),
- developing a coherent strategy for industry decarbonisation, including the steel sector, both by updating existing policies and plans and by creating a coherent framework and overarching industrial policy for decarbonising energy and emissions intensive industries.

Note: In this document, 'steel scrap' is used as an umbrella term for steel scrap and cast iron scrap, i.e. secondary raw materials classified as 'ferrous metals' according to basic classification.

International and European context

Globally, the steel industry accounts for 7% of anthropogenic greenhouse gases and 5% of total CO2e emissions in the EU.[1] In the context of the EU's 2050 climate neutrality targets, the steel industry represents a key challenge both in terms of its carbon footprint and the demands of decarbonising the (still prevalent in the EU) primary production process.

The Fit for 55 package and the update of the EU Emissions Trading Scheme (EU ETS) increased the EU's target for reducing CO2 emissions from ETS sectors (including steel production) by 2030 to 61% compared to 2005. In parallel, the new Carbon Border Adjustment Mechanism (CBAM) is being rolled out between October 2023 and 2034. After a transitional trial period, the permanent system will enter into force on 1 January 2026, after which importers will be required to annually declare the quantity of goods imported into the EU in the previous year and the greenhouse gases embodied in such goods, and hand over the corresponding number of CBAM certificates. The price of the certificates will be calculated based on the weekly average auction price of the EU ETS allowances expressed in €/tonne of CO2 emitted. The phasing out of the free allocation of emission allowances under the EU ETS will take place in parallel with the phasing in of CBAM in the period 2026–2034 and is intended to motivate EU producers to further reduce emissions due to the increasing price of allowances.[2]

Secondary steel production in EAFs using steel scrap is one of the main routes to decarbonising the steel industry. Production in EAFs accounted for ~43% of total steel production in the EU in 2022, approximately 30% less than in Turkey or the USA, where EAF production accounts for around 70%. Historically and today, the EU is a net exporter of scrap.[3] In the same year it exported 17.6 Mt of steel scrap, equivalent to more than 22% of total EU scrap consumption.[4] The availability of sufficient quantities of this secondary raw material therefore becomes a critical factor for the successful implementation and long-term sustainability of the planned investments for decarbonising this sector in the EU.

In recent years, global events have not been conducive to the development of the EAF route. In particular, the energy crisis caused by the war in Ukraine led to significant increases in the cost of electricity needed to operate them[5], resulting in a reduction in competitiveness, in some cases shutdowns of existing furnaces and the postponement of projects to build new facilities. The availability of electricity from emission-free (including renewable) sources and its stable price in the future is also a key factor for investments in the construction of new EAFs.

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[1] Technologies to decarbonise the EU steel industry – JRC (March 2022), p. 20
[2] Carbon Border Adjustment Mechanism (European Commission)
[3] European steel in figures 2023 – EUROFER (2023), p. 15
[4] European steel in figures 2023 – EUROFER (2023), pp. 57-58
[5] Electricity price statistics – Eurostat (September 2023)

Other ambitions of the European steel industry include obtaining additional and sufficient sources of funding for decarbonisation projects, including the transition to EAF production, and creating an efficient market for low-carbon steel and related products, including the promotion of demand for them.[6]

[6] An EU industrial policy providing a strong business case for green investment in Europe – EUROFER (March 2023)

Decarbonisation potential of the transition to secondary steel production

Impact on the emission factor of steel

European Union

In 2021, the emission factor of primary steel production using blast furnaces and basic oxygen furnaces (BF-BOF) in the EU averaged 1.7–1.9 tonnes of CO2/tonne of steel produced (Scope 1 and Scope 2). The emission factor for secondary steel production in EAFs was 0.3–0.4 tonnes of CO2/tonne of steel produced, with a reduction to 0.1–0.2 tonnes of CO2/tonne of steel when using electricity from emission-free sources.[7]

The reduction in the emission factor per tonne of steel after transitioning from BF-BOF to EAFs therefore ranges on average between 76% and 95% depending on the efficiency of the existing furnaces and the level of use of emission-free energy.

Czech Republic

Essentially the entire production of both steelworks in the Czech Republic (Liberty Steel Ostrava and Třinecké železárny) is currently carried out via the primary route.[8]

Liberty Steel has already begun upgrading its existing production and its transition to secondary production, which will include hybrid electric arc furnaces (EAFs) capable of processing steel scrap. In 2022, the company planned to commission the furnaces in 2025[9]; as of Q3 2023, the commissioning was to be postponed to 2026 with the possibility of further postponement depending on the economic situation. The company plans to transition to using 40% steel scrap and 60% pig iron in production by 2027, when it expects emissions to drop to 1.57 tCO2 per tonne of steel. By 2030, it is planned that the steelworks will produce using either 100% scrap or a combination of

[7] Technologies to decarbonise the EU steel industry JRC (2022 - based on own estimates and data from Material Economics), pp. 16, 18

[8] Although Třinecké železárny is equipped with EAFs, according to the annual report, more than 98% of steel is produced using the basic oxygen steelmaking process based on oxygen refining of liquid pig iron.

[9] LIBERTY initiates historic investment in the transformation of the Ostrava smelter into a green steel producer - Liberty Steel (July 2022)

60–70% scrap and 30–40% HBI/DRI (hot briquetted iron/direct reduced iron), with emissions reduced as follows:

- initially to 0.74 tCO2 per tonne of crude steel using blue hydrogen and HBI briquettes to supplement scrap where necessary; and
- subsequently to 0.15 tCO2 per tonne of crude steel using green hydrogen and a combination of HBI briquettes and DRI pellets to supplement scrap where necessary.[10]

Třinecké železárny plans to cover half of its production capacity through the EAF route by 2031.[11] The commissioning of the EAFs by 2031 depends on the allocation of subsidies from the Modernisation Fund, the start of investments by 2026/2027 and the construction of the necessary energy infrastructure. The remainder of production will continue to be via the current primary production route with continued investment in energy efficiency and increased use of emission-free sources.[12]

The following table summarises the emission factors of both steelworks for 2021, the year in which total crude steel production in the country recovered from the impact of the first year of the COVD-19 pandemic. The future decarbonisation scenario uses the period 2031/2032 based on the currently planned date of commissioning of the new EAFs in Třinec. The factors shown are projections based on the published plans of the steelworks. The spread of the EAF emission factor reflects the difference between the current energy mix and the use of 100% emission-free energy sources.

Steelworks	Emission factor t CO2e / tonne of crude steel (Scope 1 and 2)			
	2021		Plan for 2031/2032	
	BF-BOF	EAF	BF-BOF	EAF
Liberty Steel Ostrava	2.40	–	–	0.15–0.30
Třinecké železárny	1.60	–	1.60	0.15–0.30

Source: Annual reports, CSR reports and presentations disclosed by the steelworks, consultations with the steelworks

[10] LIBERTY Ostrava's transformation to GREENSTEEL and CN30 – Liberty Steel (2022)
[11] Třinecké železárny ušetří čas, chystaná ocelárna se obejde bez studie EIA [Třinecké železárny will save time, planned steelworks will not require an EIA study] - iDNES (July 2023)
[12] Třinecké železárny investují miliardy do ekologizace výroby oceli. Energetika Třinec přejde od uhlí k plynu [Třinecké železárny will invest billions in the greening of steel production. Energetika Třinec will switch from coal to gas] - Ekonomický deník (May 2023)

Long-term outlook for steel production

European Union

The European Steel Association (EUROFER) scenario assumes a 1.8% compound annual growth rate in the EU's steel production to 2030 and 0.9% over the entire period to 2050, with 50% of production in 2050 being conducted through BOF and EAF and 50% using new process technologies (DRI and CCUS).[13] In its Carbon Cost scenario, the Mission Possible Partnership (MPP) assumes higher growth (3.5%) to 2030, but only a slightly higher growth rate than EUROFER over the whole period to 2050 (1.1%).[14]

EU steel production scenario, millions of tonnes		
Year	**EUROFER**	**MPP (Carbon Cost)**
2021	153	-
2030	179	208
2050	200	213

Czech Republic

The total capacity of the two Czech steelworks is approximately **6.6 million tonnes**. Following the planned investments in production modernisation, the total capacity will remain unchanged. There has been a highly volatile trend in production over the last four years (2020: 4.45 Mt; 2021: 4.7 Mt, 2022: 4.2 Mt) due to the COVID-19 pandemic, the war in Ukraine and developments in the international economic situation and energy prices, with both steelworks being predominantly export-oriented. EU Member States remain a key market for Czech steel, especially the neighbouring countries of Poland, Germany and Slovakia.[15] In the first half of 2023, production fell by a further 20% compared to the first half of 2022.[16]

Due to the great uncertainty of many factors affecting the future trend of steel production in the Czech Republic, no long-term production outlook exists at the national level. The following scenario is based on the planned production level after the implementation of the decarbonisation projects with this probably being the optimum option in terms of capacity utilisation (87–88%) after investments in modern production technologies (for Liberty Steel Ostrava, this is a significant increase compared to historical production levels). (In the long term until 2050, a trend similar to the EU level is anticipated, i.e. marginal growth or stagnation of production, also due to the fact that a significant increase in production would require additional investments in new capacity).

[13] Low carbon roadmap pathways to a CO2 neutral European steel industry - EUROFER (2019)
[14] Making NetZero Steel Possible - Mission Possible Partnership (September 2022)
[15] Spotřeba i výroba oceli v ČR i EU loni klesla, výhled je nejistý [Steel consumption and production in the Czech Republic and the EU fell last year, the outlook is uncertain] - Ocelářská unie [Steel Union] (March 2023)
[16] Výroba i zjevná spotřeba oceli v ČR v 1. pololetí roku významně klesla [Production and apparent consumption of steel in the Czech Republic fell significantly in the first half of the year] - Ocelářská unie [Steel Union] (September 2023)

Scenario for the decarbonisation of Czech steelworks

Based on the projected emission factors and production volumes, CO2 emissions from the steelworks would decrease by a total of **5.8 to 6.4 Mt CO2e** (65–70% decrease) compared to 2021 as a result of the planned investments.

Steelworks	Production, Mt of crude steel					
	2021			Plan for 2031/2032		
	BF-BOF	EAF	Total	BF-BOF	EAF	Total
Liberty Ostrava	2.3	–	2.3	–	3.2	3.2
Třinecké žel.	2.3	<0.1	2.4	1.3	1.3	2.6
Total	**4.6**	**<0.1**	**4.7**	**1.3**	**4.5**	**5.8**

Source: Annual reports, CSR reports and presentations disclosed by the steelworks, calculations by INCIEN

Steelworks	Steelworks CO2 emissions, Mt (Scope 1 and 2)					
	2021			Plan for 2031/2032		
	BF-BOF	EAF	Total	BF-BOF	EAF	Total
Liberty Ostrava	5.5	–	5.5	–	0.5–1.0	0.5–1.0
Třinecké žel.	>3.6	<0.1	3.7	2.1	0.2–0.4	2.3–2.5
Total	**>9.1**	**<0.1**	**9.2**	**2.1**	**0.7–1.4**	**2.8–3.5**

Source: Annual reports, CSR reports and presentations disclosed by the steelworks, calculations by INCIEN. Projected emission factor 2031/2032 (Mt CO2 per tonne of steel): BF-BOF: 1.6; EAFs: 0.15–0.3 depending on the source of electricity.

Scrap consumption in the transition to secondary production

The consumption of steel scrap in the two steelworks in the Czech Republic was around **1.4 Mt** per year in 2021 (on average 30% of the feedstock for the primary production using BF-BOF). Of this, approximately 60% was purchased on the market and 40% was recovered as scrap from production.

Once the planned EAFs are in operation, there will be a 3.5-fold increase in the current scrap consumption to about 5 Mt per year with external purchases increasing fivefold to 4.3 Mt.

Liberty Steel plans to transition to up to 100% steel production from scrap in EAFs by 2030 if sufficient quantities are secured. With a projected future production of 3.2 Mt per year and an assumed processing of about 1.1 tonnes of scrap per 1 tonne of steel, potential consumption would thus be up to **3.5 Mt** per year, representing an increase of more than four times compared to 2021 (~0.8 Mt). In case of scrap shortages, it would be possible to replace up to 40% with HBI briquettes or DRI pellets with the new EAFs.

With a planned production of 2.6 Mt of steel per year, the consumption of Třinecké železárny would be up to **1.5 Mt** of steel scrap per year (0.3 Mt of feedstock for primary production and 1.1 Mt in EAFs). This would increase the current scrap consumption (~0.5 Mt) about threefold. Up to 40% (with the average estimated at 20%) of other raw materials (HBI briquettes) will be added in the feedstock to purify the scrap to achieve the required quality.

Barriers to implementation

Availability of steel scrap at a European and national level

European Union

Most scenarios in studies examining the long-term development of the European steel and steel scrap markets assume a steadily increasing volume of steel production and associated higher amounts of steel scrap. By 2050, according to a model developed by Agora Industry and Material Economics, recycled steel produced from scrap could satisfy up to 80–90% of EU steel demand (assuming copper content of up to 0.12% per tonne of steel).[17] The projections of the Mission Possible Partnership (MPP) show similar figures, specifically a stable demand for crude steel in the EU of around 200 million tonnes per year between 2030 and 2050 and slightly increasing amounts of scrap, ranging from around 160 million tonnes per year in 2030 to around 180 million tonnes per year in 2050 (80–90% of demand).[18] EUROFER also anticipates increasing amounts of steel scrap in the EU (albeit at a relatively lower rate: 122 million tonnes (2030), 135 million tonnes (2040) and 147 million tonnes (2050), approximately 70% of steel demand), based on three factors: increasing amounts of obsolete steel products and more efficient recycling, increased amounts of scrap generated from the treatment of steel products and scrap generated directly in steelworks due to the increasing trend in production.[19] The 2022 analysis by the European Commission's Joint Research Centre (JRC) assumed that urbanisation and infrastructure development would slow down, leading to a saturation of European inventory of scrap and its greater availability. It presents some scenarios according to which scrap inventory could reach or even exceed the level of demand for finished steel products by 2050.[20]

Czech Republic

According to an analysis of material flows for 2017 (as part of the update of the Secondary Raw Materials Policy 2019–2022), 4.3 Mt of steel and cast iron scrap existed in the Czech Republic, of which 3.0 Mt was post-consumer (old) scrap, 0.9 Mt was production scrap and 0.5 Mt was imported. Domestic consumption was 2.1 Mt and the remaining 2.2 Mt was exported. A similar trend has apparently continued in recent years. The historical annual amounts of domestic steel scrap in the Czech Republic (about 2.8–3.1 Mt) could theoretically cover about 70% of the planned scrap purchases made by steelworks after 2030 (4.3 Mt), but only assuming zero exports from the Czech Republic, while a minimum of 1.5 Mt would need to be imported.

[17] Mobilising circular economy – Agora (2022), p. 26
[18] Making Net-Zero Steel Possible – MPP (2022), p. 32
[19] Low carbon roadmap pathways to a CO2-neutral European steel industry – EUROFER (2019)
[20] Technologies to decarbonise the EU steel industry – JRC (March 2022)

The availability of scrap in the longer term depends on further development of scrap generation in the Czech Republic and the level of exports, which will be influenced by the development of EAFs in the region. Another key variable is the efficiency of the scrap market in ensuring that each steel mill receives not only the necessary volume of scrap, but also the quality required by its product range. The analysis further states that the Czech Republic can expect a **lower domestic volume of steel scrap** in the future based on the end of the period of intensive scrap collection (from end-of-life machinery, equipment and industrial halls) accumulated before 1990, and the decreasing consumption of steel products (in early 1990s, the consumption of steel products in the Czech Republic dropped by 40% compared to the late 1980s).[21] Another factor is the higher quality and durability of steel products and the slowing down of the return cycle of scrap in the form of end-of-life steel products (today, approx. 20 years on average).[22]

However, the robustness of these projections are limited by a **lack of high-quality statistical data** on the generation, processing and use of scrap. In the Czech Republic, there are several hundred facilities for metal waste/scrap purchasing and collection. Only an estimate of the capacity of these facilities currently exists, which is approximately 5-5.5 million tonnes per year, but exact figures are not available. The question also remains as to the timing of the reduction in scrap availability in the future. The Secondary Raw Materials Policy mentions that the demand for scrap is determined by the development of the economy and states that "more precise figures cannot be responsibly estimated".[23] Simultaneously, the document explicitly states that metallurgical companies need to have projections for scrap volume for 10 or more years ahead. An evaluation of the Secondary Raw Materials Policy is currently underway as part of its update for the period 2023–2027, which is expected to be completed in mid-2024.

Growing demand for steel scrap in global markets

Steel scrap is a globally traded secondary raw material and its amounts and demand for it in the Czech Republic are inherently linked to trading on international markets. A similarly dramatic increase in demand for scrap steel as in the Czech Republic can be expected in many other EU countries where producers are implementing other EAF projects. The EU has historically been a net exporter of steel scrap with an increasing trend. In 2022, total exports were ~18 Mt (~14 Mt net exports after subtracting imports). The raw materials suppliers committee at the 2023 meeting of the International Rebar Exporters and Producers Association (IREPAS) estimated that steel scrap demand on the EU market and its availability in the region will be in balance within five years (2028), after which the EU is likely to become a net importer of steel scrap.[24]

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[21] Analýza současného stavu vybraných komodit druhotných surovin a jejich zdrojů včetně vize rozvoje daného odvětví [Analysis of the current status of selected secondary raw material commodities and their sources, including vision for the development of the industry] (Ministry of Industry and Trade, 2018)
[22] Jak úspěšně dekarbonizovat ocelářství? [How to successfully decarbonise the steel industry?] – Ocelářská Unie [Steel Union] (October 2022)
[23] Analýza současného stavu vybraných komodit druhotných surovin a jejich zdrojů včetně vize rozvoje daného odvětví [Analysis of the current status of selected secondary raw material commodities and their sources, including vision for the development of the industry] (Ministry of Industry and Trade, 2018)
[24] REPAS in Barcelona: Challenging times for global longs industry – IREPAS (May 2023)

In other words, despite the scenarios of increasing amounts of scrap in the EU in the long term, there is a risk of medium-term unavailability of scrap during the period when the new EAFs are being put into operation in the Czech Republic and other European countries.

In order to secure sufficient regional and domestic scrap supplies for the future, EUROFER supports efforts to reduce scrap exports outside the EU, especially to Turkey, which is the destination for 90% of scrap exports.[25] The proposed revision of the **EU Regulation on Waste Shipments** is an indirect measure to this effect, as according to the revised version, exports of non-hazardous waste for recovery should only be allowed to non-OECD countries under the condition that the ability to treat the waste in a sustainable manner is demonstrated (independent audit of the waste management facility in the destination country every three years).[26] While restrictions on waste exports to these countries are incorporated in this way in the European Commission's proposal, some OECD member countries (Turkey in particular) are actually not required to comply with equivalent sustainability standards when treating waste. EUROFER therefore argues that the level of control should be the same within the OECD, because otherwise scrap exports from the EU to Turkey as an OECD member country remain unaddressed.

Another option, which is being actively discussed at the Czech and European level, is to restrict the export of steel scrap from the EU to third countries based on the definition of steel scrap as a strategic raw material. In September 2023, the European Parliament adopted the opinion of the Parliament's ITRE Committee on the forthcoming **EU Critical Raw Materials Act**, which, among other things, supported the creation of a 'secondary list' of additional strategic raw materials, mentioning scrap iron as an example. However, the European Recycling Industries' Confederation (EuRIC) strongly opposes this proposal, questioning its factual validity and arguing that the amount of steel scrap in 2022 could theoretically be sufficient to increase the share of secondary production from scrap in the EU to 68%.[27]

The different stances on this issue at the European level are also reflected at regional and national levels, i.e. the interest of steel mills to secure future scrap supplies for the increasing EAF production in the context of decarbonisation on the one hand and the interest of the scrap and recycling industries to trade in and sell scrap freely based on international demand and the most favourable prices on the other. From the perspective of the Czech scrap industry, the scenario of restricting scrap exports is therefore unlikely due to the way the market functions. Foreign buyers currently have more purchasing power than Czech steelworks and it is not profitable for scrap steel trading companies to favour domestic demand in the Czech Republic. This trend is expected to continue in the future. In addition, for the time being, export restrictions do not seem to have political support in the Czech Republic under free trade rules.[28]

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[25] Stop waste and scrap export to countries not meeting EU environmental and social standards – EUROFER (May 2022)
[26] Waste shipments: Council ready to start talks with Parliament – EU Council (May 2023)
[27] Recycled steel scrap is not a strategic nor a critical raw material – EuRIC (July 2023)
[28] Consultations with the Ministry of Industry and Trade and representatives of the Czech steel industry

A technologically unsophisticated system of discarded steel collection and sorting

In practice, there are two main obstacles to a more efficient scrap market in the Czech Republic.[29] The first is the **legislative definition of scrap (waste/non-waste)**, which has not been completely resolved in the Czech Republic. Since the 2001 revision of the Waste Act, scrap metal has been classified as waste. In the new Waste Act (2021), scrap (and its processing) is declared in a separate annex as a commodity that is not subject to all the requirements of the standard waste regime, but is still classified as waste. In practice, scrap is traded abroad as a secondary raw material. The Council Regulation (EU) No 333/2011 of 31 March 2011[30], which is currently in force, establishes criteria determining when certain types of steel and cast iron cease to be waste and become secondary raw materials. This regulation is currently not widely applied in practice by metal waste processors. This is due to the more difficult and costly handling of scrap as a product than as metal waste. In order to trade scrap as a secondary raw material, it is necessary to meet the requirements of the EU REACH regulation, obtain registration of the elements contained and demonstrate the environmental safety of the material. The associated costs (e.g. related to additional quality management and staff training) and the need to register with ECHA (European Chemicals Agency) remain key obstacles to treating scrap as a secondary raw material on the domestic market. However, there has also been a lack of demand for the application of the regulation from customers (steelworks) for whom the legal form of scrap is not important. The current practice can thus lead to contamination of scrap metal between the stage of steel product removal and the handover of the scrap to the processor (steelworks). This reduces the overall quality of the scrap and limits the possibility of using the scrap for different types of steel (especially for flat products).

The second obstacle is the **supply of scrap as a secondary raw material of the necessary quality** that meets the requirements for the input raw material for the production process and complies with the adopted technical regulations, standards and quality management systems in place. The Industrial Technology Roadmap under the European Research Area (ERA) platform identifies the need for significant investment for pilot project development, deployment and commercialisation as the main challenges for the development of innovative technologies. Most of such technologies rely on technological advances in IT, the development of AI and machine learning, and smart management based on data processing.[31] They would help to guarantee the maximum level of sorting by alloy, but they are not yet applied in the Czech environment due to high investments. According to representatives of scrap companies, they would only pay off in the case of precious metals of a higher value. Furthermore, this problem can be expected to intensify in the future as the amounts of additives and elements used to achieve the desired properties of steels (e.g. surface treatment) continue to increase. However,

[29] Analýza současného stavu vybraných komodit druhotných surovin a jejich zdrojů včetně vize rozvoje daného odvětví [Analysis of the current status of selected secondary raw material commodities and their sources, including vision for the development of the industry] (Ministry of Industry and Trade, 2018), p. 61
[30] Council Regulation (EU) No 333/2011 of 31 March 2011 – (EC, March 2011)
[31] ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries – European Commission (2023), p. 69

scrap companies consider the currently used procedures on the Czech market to be sufficient for efficient metal waste treatment.

Copper contamination and limited use of recycled steel

In the international context, copper contamination of steel is the main problem reducing the quality of steel scrap as a raw material for EAF production. Unlike many other alloys and trace elements, copper does not pass into the steel slag during remelting; therefore it cannot be separated from the bath and fundamentally affects the strength and quality of the steel. Copper enters scrap both as an admixture in corrosion-resistant steel and because of inefficient sorting, where copper products such as electric motors and copper cables are left in the scrap mix. During each recycling cycle, additional copper is added to the steel.[32]

In particular, recycled steel does not meet the strict quality standards of the automotive industry. In practice, copper concentrations above 0.1% lead to surface defects in the manufacture of flat products (such as automotive sheet steel), limiting the use of recycled steel mostly to long products, for example in the construction industry, which may contain up to 0.4% copper.[33] In this respect, copper contamination presents relatively less of a problem for Czech steelworks owing to their product mix: their ratio of long to flat products is about 75% to 25%, whereas the EU average is significantly different (long products ~45% and flat products ~55%). A large share of flat products is consumed in the automotive industry, which accounts for almost 20% of the total steel consumption in the Czech Republic (versus 17% in the EU, 2022),[34] and these products are mostly imported by Czech automakers.

Třinecké železárny estimates that in 2031, the steel mill's demand for superior scrap (with copper content up to 0.25%) will account for about half of its demand, i.e. 0.6–0.7 Mt. Thus, more pressure on the development of advanced technologies to separate scrap by origin, copper content and steel type can be expected.

Scrap processors estimate that under optimal production conditions the domestic automotive industry will generate approximately 0.5 Mt of superior scrap. However, with the number of international partners and increasing demand for scrap, the question remains how to direct this scrap to Czech steelworks instead of exporting it.

[32] Preserving value in EU industrial materials – A value perspective on the use of steel, plastics, and aluminium – Material Economics (2020, update 2021), p. 28
[33] Technologies to decarbonise the EU steel industry – JRC (March 2022), p. 20
[34] European Steel in Figures 2023 – EUROFER (June 2023)

Insufficient guarantee of energy from sustainable sources

In the transition to a higher level of secondary steel production in the EAFs, the total amount of production energy will decrease, but the amount of electricity required will increase compared to the current state, resulting in the need for costly investments in upgrades of the Czech power grid. Czech steelworks are supplied by power plants that currently have an insufficient capacity for the requirements of EAF production. Furthermore, when producing from scrap, steelworks lose part of the electricity produced from process gases that are not generated by EAFs.[35]

The success of plans to transition to EAFs depends on the construction of a very high voltage (VHV) supply line to the Czech steelworks from ČEPS by 2030–2031, without which EAFs cannot operate. Production via this route requires a connection to a robust power grid due to the high volumes of electricity consumed and 24/7 operation. The situation is currently complicated by uncertainties regarding the financing of these investments.[36]

The current electricity consumption in the two main steelworks in the Czech Republic is around 2 TWh per year, about 1 TWh in Liberty Ostrava and 1 TWh in Třinecké železárny.[37] With 100% arc furnace production in 2027, Liberty Steel expects electricity consumption to rise to over 2 TWh per year. With the planned production by Třinecké železárny of 1.3 Mt using EAFs by 2030, an increase in electricity consumption to 1.3 TWh per year can be expected; this estimate reflects the assumption of shutting down other parts of production and the related reduction in energy consumption. With the start up of EAF production, total annual consumption in the Czech steel industry could thus increase from the current 2 TWh to 3.54 TWh.[38]

The current Czech National Energy and Climate Plan and other plans for the development of sustainable energy sources are unlikely to guarantee sufficient energy from RES and other low-emission sources, increasing the risk of investing in electric arc furnaces.[39] The plan is currently being updated and its final version should be available in June 2024. However, the draft update adopted by the Government of the Czech Republic on 18 October 2023 still does not take into account the multifold increases in electricity consumption that will be required by the already planned investments in decarbonisation of energy-intensive industry.

[35] Jak úspěšně dekarbonizovat ocelářství? [How to successfully decarbonise the steel industry?] – Ocelářská Unie [Steel Union] (October 2022)
[36] Připomínky Svazu průmyslu a dopravy ČR k materiálu Aktualizace Vnitrostátního plánu ČR v oblasti energetiky a klimatu [Comments of the Confederation of Industry and Transport of the Czech Republic on the Update of the National Energy and Climate Plan of the Czech Republic] (October 2023)
[37] Annual Report 2022 – Energetika Třinec (2023)
[38] Jak úspěšně dekarbonizovat ocelářství? [How to successfully decarbonise the steel industry?] – Ocelářská Unie [Steel Union] (October 2022)
[39] Decarbonisation of the Industrial Sector: Sustainable Finance as an Opportunity? – ISFC (2022), p. 43

Insufficient sources of financing for steelworks

According to analyses by ISFC and Climate & Company, the Czech steel industry **does not have enough capital** for a sustainable transformation.[40] The costs for the transition of 4.1 million tonnes of production capacity from the current primary production to EAF are estimated at €540 million in one-off capital investment (CAPEX) and €270 million per year in operating costs (OPEX).[41] In its scenario, ISFC projects that the Czech steel industry will have €1 billion available for investments between 2023–2029 (without further intervention by other firms or financial support from parent companies). This assumption is based on conditions of strong competition on the international steel market, long-term low margins in the steel industry and likely continued decline in revenues in the future.[42]

Two public programmes, the Innovation Fund and the Modernisation Fund, can be used for **public financing** of the decarbonisation of heavy industry, including the steel industry. Although they offer adequate financing, heavy industry companies in the CEE region have not been able to obtain resources from these programmes in the long term, which is evidence of the strong competition and a challenge for Czech companies in the future.[43]

By Q2 of 2023, only eleven heavy industry projects had been approved under the ENERG-ETS Modernisation Fund programme and supported with a total amount of only €35 million. Although the Modernisation Fund offers financing specifically for investments in EAFs, the approval of these projects is very time-consuming due to the individual assessment of large projects by Czech ministries and the European Investment Bank.

The Innovation Fund aims to support large innovative projects demonstrating new low-carbon technologies and practices in industry (e.g. CCUS) and is not directly relevant to EAF investments. The success rate of projects supported by the Innovation Fund is still only 10%. Only two Czech projects focusing on green hydrogen production and electric vehicle battery technologies are among the 71 projects supported so far in the 4 closed calls (by Q2 2023). Czech and Central European projects received less funding from the Innovation Fund than what would correspond to their share of ETS emissions.[44]

Green bonds and **sustainability-linked bonds** are other potential instruments for financing EAF projects, but the development of these bonds has been slow in recent years and as of Q2 2023 no green bonds had been issued by heavy industry in the Czech Republic. One of the factors that may be hindering the issuance of green bonds by Czech steelworks to finance EAF investments is the mandatory creation of a corporate 'green bond framework', presenting a financial and administrative burden.[45]

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[40] Accelerate shift towards green steel (Climate and Company, 2021), p. 39
[41] Accelerate shift towards green steel (Climate and Company, 2021), p. 4
[42] Czech Heavy Industry Decarbonisation – Policy and Financing Roadmap – ISFC (2023), 52
[43] Decarbonisation of the Industrial Sector: Sustainable Finance as an Opportunity? – ISFC (2022), p. 36
[44] Czech Heavy Industry Decarbonisation – Policy and Financing Roadmap (ISFC, 2023)
[45] Czech Heavy Industry Decarbonisation – Policy and Financing Roadmap (ISFC, 2023)

Low demand for green steel

Currently, there are no green public procurement rules applied on the market to promote demand for recycled steel and other low-carbon materials. Criteria developed at EU level do exist, but they are only voluntary for the time being and do not currently include steel and other basic materials.[46]

While some Western European countries, such as the Netherlands and France, already apply non-price criteria, including sustainability criteria, in public procurement in many cases, the Czech Republic and other CEE countries are still lagging behind in this area. According to Datlab, a Czech analytical company specialising in public procurement, price was the only criterion for 95% of public contracts awarded in the Czech Republic in the years 2018–2020.

As part of the adoption of the 2018 EU waste package, the Czech Public Procurement Act was amended to include, with effect from January 2021, a requirement for local governments and other contracting authorities in the Czech Republic to assess whether the principles of green and responsible procurement can be applied to each public contract. If so, they must take these criteria into account in all types of tendering procedures and all types of public contracts, whether for services, supplies or construction work. Despite this mandate, the criteria above are so far mostly applied only formally and with little real impact. Contracting authorities tend to be conservative because they fear sanctions for incorrectly set selection procedures. Therefore, the problem is not necessarily a lack of regulation, but rather a lack of will, incentives and know-how.

The lack of a roadmap for decarbonisation of industry in national strategies

Some government strategies and plans already take into account, to some extent, the role of circular strategies in the decarbonisation of heavy industry, including the steel industry and the transition to scrap-based EAF production specifically. However, there is no coherent framework, long-term plan and quantification of targets to support the necessary investments and the application of measures in practice.

The update of the Secondary Raw Materials Policy of the Czech Republic for the period 2019–2022 (2019, currently being updated) and the accompanying Material Flows Analysis see secondary steel production in EAFs using scrap as an important pathway to decarbonising the industry. The policy mentions the obstacles to greater development of EAFs in the Czech Republic and states that “in the future it is necessary to establish a strategy that would support the development of the domestic metal scrap market to the greatest extent possible in the sense of preserving and supporting the metallurgical and engineering industries in the Czech Republic”.[47] Such a strategy has not yet been developed.

[46] Technologies to decarbonise the EU steel industry JRC (2022 - based on own estimates and date from Material Economics), p. 42

[47] Secondary Raw Materials Policy of the Czech Republic 2019-2022 (Ministry of Industry and Trade, 2018), p. 35

The National Energy and Climate Plan (2019, currently being updated), a national greenhouse gas reduction plan in line with the Paris Agreement and EU legislation, projected only minimal reductions in CO2 emissions in heavy industry by 2040 from both fuel combustion and product processes and use. The plan did not further analyse emissions from industry, stating only that "achieving climate and energy targets in the manufacturing industry, which includes industries such as the steel, chemicals, ceramics, cement, glass, paper, brick and lime industries, is a separate and very complex issue. These industries have particularly significant potential in this respect and this should be taken into account in the development of national strategies and policies. [...] A prerequisite is the speedy development of a separate industrial policy of the Czech Republic for the period 2021–2030 with an outlook to 2050, addressing this industry comprehensively."[48] This policy has also not yet been developed. It is mentioned again in the draft Plan update from October 2023, but it is still not specified when and how such a policy is to be developed.

The Strategic Framework for the Circular Economy of the Czech Republic 2040 (2021) does not explicitly mention the area of recycled steel.[49] The follow-up Circular Czechia Action Plan 2040 (Cirkulární Česko 2040) for the period 2022–2027 already includes measures (including those proposed by INCIEN) to analyse opportunities for the implementation of circular industrial technologies (including related subsidy aid) within the ERA industrial technology roadmap for circular technologies with a focus on energy-intensive industries (steel, cement, chemicals), the construction industry and the textile industry. Other measures include mapping the synergies between digitalisation, artificial intelligence and the circular economy in industry and related technological processes in the framework of the national Industry 4.0 initiative and the more recent Industry 5.0 framework; support for the introduction of technologies for production from or use of secondary raw materials, technologies for the reuse of own production waste and technologies to increase the recyclability of products; and consideration of the decarbonisation of heavy industry by applying the principles of the circular economy when preparing the update of the Czech Republic's National Energy and Climate Plan (by the end of 2023).[50]

The National Research and Innovation Strategy for Smart Specialisation of the Czech Republic 2021–2027 ("National RIS3 Strategy", updated in 2022), specifically in the Decarbonisation and Circularity goal cards for the Mission entitled "Increasing the efficiency of the economy's material, energy and emission intensity", contains (following a recommendation from INCIEN) an explicit mention of the key role of scrap-based steel production in EAFs as one of the illustrative examples of R&D sub-topics within the circular economy. The general strategies concerning steel recycling include "outlining the role of technologies such as digital product passports and certificates of origin" to increase recycling efficiency and "promoting a higher proportion of recycled materials in products" in the Industrial Design and Materials section.[51] The RIS3 strategy is already being applied as an incentive bonus for R&D&I project proposals that contribute to the achievement of the Mission objectives based on these criteria.

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[48] National Energy and Climate Plan of the Czech Republic - Ministry of Industry and Trade (January 2020)
[49] Circular Economy Strategic Framework of the Czech Republic 2040 – Ministry of Environment (2021)
[50] Circular Czechia Action Plan 2040 for the period 2022-2027 - Ministry of Environment (November 2022)
[51] National Research and Innovation Strategy for Smart Specialisation of the Czech Republic 2021-2027 – Ministry of Industry and Trade (2022) pp. 74-75

Priorities to be addressed

Accurate mapping of flows of steel scrap as a strategic material

Competition between individual scrap collectors and the price of scrap on international markets are still the main drivers of the domestic scrap market. According to the previous analysis of material flows for the Secondary Raw Materials Policy, there is a need to map out the network of actors on the Czech scrap market and material flows in more detail to ensure its more efficient functioning and to set up better statistical data collection. In terms of future development, it is necessary to obtain more accurate data on the long-term amounts of scrap in the Czech Republic, as well as on the composition of the origin and quality of the flows, and thus to make predictions and projections of steel production and related availability of scrap. At national level and within the EU Single Market, better data (and its digitisation) can serve, among other things, to identify gaps and losses in the value chain and more efficient routing of the individual flows to key customers (steelworks and foundries) according to their quality requirements. Given the political impassibility of legislative restrictions on international scrap trade, such a system would at least increase the visibility and predictability of demand from large domestic customers for the purposes of long-term planning of raw material purchases.

Increasing the application of waste/non-waste criteria for scrap metal

Due to the expected spike in demand for steel scrap in the Czech Republic and the EU, as well as the efforts to minimise its contamination for use in more technically demanding applications, it is necessary to increase in practice the application of the requirements of the Council Regulation (EU) No 333/2011 on criteria determining when certain types of scrap metal cease to be waste to ensure more efficient collection and sorting of scrap sub-flows for further use.

Building a more sophisticated scrap market

Based on the current limited demand for steel scrap in the Czech Republic (mainly as part of the feedstock for primary production), scrap companies in the Czech Republic are not yet motivated to increase the efficiency of scrap collection and processing. This should change with the transition to the new EAFs in Czech steelworks and the gradual increase in quality requirements for scrap metal flows in the international context from the use of secondary steel for a wider range of end-use applications. This will increase the requirements for the professionalisation of the scrap market (as is currently the case, for example, in Italy), traceability and guarantee of origin (e.g. in the form of material ‘certificates or origin’) and contractual stipulation not only of quantity but also of quality parameters.

Efforts are already underway to establish closer cooperation between steelworks and scrap companies that could lead to more intensive use of domestic scrap by Czech steelworks. Another development option for steelworks is to gain more control over the market by creating or acquiring their own scrap steel processing capacities, by buying scrap directly from processing companies (e.g. in the automotive and engineering industries) or by contracting or providing the take-back of end-of-life products. In Germany, the barrier to financing similar projects was resolved by scrap processors cooperating with steel mills and obtaining public funding (ThyssenKrupp + TSR project with the support of the state of North Rhine-Westphalia).[52]

The digitalisation of processes and the use of innovative technologies for sorting steel scrap offer great potential. Examples include the characterisation of steel scrap based on laser beams (laser object detection, LOD), the development of sorting technologies with elements of robotics and automation or X-ray and ultra-red scanning as an alternative to laser technologies. X-ray technology is already offered today, for example, by Steinert and Tomra for sorting aluminium and electrical waste. Similarly, infrared scanning technologies are used today, but vary considerably in their degree of accuracy and efficiency. In terms of scrap collection and sorting, robotic scrap metal cutting is a medium to advanced technology, while laser-induced breakdown spectroscopy (LIBS) is at a medium level of maturity.[53]

Efficient separation and tracking of metal flows in the value chain

Copper contamination can be reduced or overcome not only by separating copper and steel in the recycling process or by closed-loop recycling, but especially by designing products with regard to their end-of-life separation and dismantling. More copper-resistant production processes may also be a solution.

In this context, early engagement and deeper interconnection between stakeholders in the steel product value chain in the Czech Republic will be essential in preparation for the upcoming requirements for intermediates (including iron and steel) arising from the draft of the **Ecodesign for Sustainable Products Regulation (ESPR)** (expected to be adopted in 2024 and in delegated acts in the following years)[54] and the **regulation on circularity requirements for vehicle design and on management of end-of-life vehicles** (expected to be adopted in 2025–2026).[55]

The introduction of digital product passports for maximum traceability of materials, components and their exact composition from initial processing to end-of-life and their optimal further use or disposal will be essential to the application of circularity parameters throughout the life cycle of steel (and other metal) products. Czech

[52] Steel scrap becomes high-quality recycled raw material for use in blast furnace – Thyssenkrupp Steel (April 2022)
[53] ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries – European Commission (2023)
[54] On making sustainable products the norm - European Commission (March 2022)
[55] Proposal for a Regulation on circularity requirements for vehicle design and on management of end-of-life vehicles - European Commission (July 2023)

steelworks have so far seen little interest in digital passports from domestic companies, but they are starting to focus on this topic.

Involvement in international technology platforms

While in the EU recycled steel is mostly used for the manufacture of long products, in the USA, 70% of steel is produced via EAFs and it is common to use recycled steel to manufacture high-quality flat products.[56] For example, BRS declares the possibility of producing AHSS (advanced high strength steel) using EAFs.[57] The local steelworks are capable of producing high quality flat products in modern mini-furnaces with more advanced EAF technologies and using high quality scrap by adding pig iron and directly reduced iron to 'dilute' impurities.[58] These technologies and higher EAF production rates are also typical for Italy. Flat steel products are currently supplied to the Czech automotive industry by, for example, Italian mini furnaces and the Swiss Steel Group. The Czech automotive industry is interested in being actively involved in research and technology platforms at international level to develop green steel and improve the production of flat steel products from recycled steel through EAFs (Clean Steel Partnership, European Steel Technology Platform or ESTEP).[59] Currently, the higher price of green steel is an obstacle for domestic carmakers, yet recycled steel represents a promising way to decarbonise the supply chain (currently 18% of Škoda Auto's CO2e emissions in Scope 1, 2 and 3).

Ensuring sufficient low-emission electricity for future needs of the steel industry

Updates to the National Energy and Climate Plan (NECP, final version expected in June 2024) and the State Energy Concept (also during 2024) should highlight the increasing electricity requirements of heavy industry in connection with decarbonisation, including higher electricity consumption in the EAFs. The energy requirements of heavy industry, including the steel industry and the inclusion of, for example, the higher ambition of the EU ETS, have not been elaborated on in detail in the existing plans or in the current draft.[60] The document entitled Background for the update of the State Energy Concept of the Czech Republic and related strategic documents contains a plan "to achieve a share of RES in the gross final level corresponding to the EU target by 2030 and to further increase this share by 2050 in line with achieving climate neutrality."[61]

[56] Preserving value in EU industrial materials – A value perspective on the use of steel, plastics, and aluminium – Material Economics (2020, update 2021), p. 22
[57] AHHS – BRS
[58] Technologies to decarbonise the EU steel industry – JRC (March 2022), p. 20
[59] Clean Steel Partnership
[60] Czech Heavy Industry Decarbonisation – Policy and Financing Roadmap – ISFC (2023), p. 43
[61] Background for the update of the State Energy Concept of the Czech Republic and Related Strategic Documents – Ministry of Industry and Trade (April 2023)

Accelerating grant approval processes, support for ancillary projects

Decarbonisation projects in the steel industry (e.g. in Třinec) are awaiting approval of support from the Modernisation Fund, but the time demands of the process result in the postponement of projects that have the potential of providing annual savings of several million tonnes of CO2. In EAF projects, it is also important to secure support for costly projects that do not directly result in significant CO2 emission savings, but enable the efficient functioning of such projects (EAF production with the highest scrap content and highest quality output), e.g. investments in advanced technologies for scrap metal sorting, processing and decontamination.

Other potential sources of funding for heavy industry such as the Clean Steel Partnership, Processes4Planet Partnership, European Innovation Council, EU Cohesion and Environment Programmes (primarily Operational Programme Technologies and Applications for Competitiveness 2021–2027 (OP TAC)) and the InvestEU Fund do not provide sufficient resources to finance the transition to EAFs in the order of hundreds of millions of euros, but may be relevant to support investments in sub-projects to improve technological processes and build related infrastructure and capacity. A summary of these programmes is provided in the annex.

Supporting demand for green steel

Several demand-side measures can increase the competitiveness of recycled steel (and offset its potentially higher price or perceived lower quality) relative to standard steel products with higher carbon intensity, and motivate producers to expand production of recycled steel.[62]

- **A robust definition of green steel:** Transparent disclosure of product carbon footprint data, including systems of guarantee of origin labelling that take into account the environmental impact of industrial intermediates. It will be necessary to clearly define 'green steel' at global and European level, especially in the context of the delegated acts on the Ecodesign for Sustainable Products Regulation (ESPR).[63] Work is currently underway to develop a standard methodology for calculating the carbon footprint, including defining the scope and individual emission levels for green steel, which is considered by the JRC as a crucial first step and is currently being addressed, for example, by the global ResponsibleSteel initiative.[64]

- **Green public procurement:** Establishing a timeframe for the introduction of mandatory green procurement criteria would motivate stakeholders to expand investment in green products, including recycled steel. Another recommendation is to link green public procurement standards to the EU

[62] Technologies to decarbonise the EU steel industry – JRC (2022), p. 42
[63] An EU industrial policy providing a strong business case for green investment in Europe – EUROFER (2023)
[64] Technologies to decarbonise the EU steel industry JRC (2022 - based on own estimates and date from ME), pp. 42

Taxonomy.[65] In order to develop green public procurement in the Czech Republic, it is necessary to update state public procurement policies to include sustainable/circular criteria to support the market for low-emission products, including recycled steel. Systematic application of green public procurement is essential especially in the construction industry where half of the projects in the Czech Republic are awarded by public institutions. In addition to the construction industry, the automotive industry is a key customer when it comes to, for example, contracts for public transport vehicles.[66] The Czech National Recovery and Resilience Plan allocates €1.4 billion to energy renovation of residential and public buildings and €1.1 billion to rail infrastructure, electric vehicle charging and cycle paths under the "Physical Infrastructure and Green Transition" pillar (€3.6 billion). Effective application of sustainability criteria (including carbon intensity) in public procurement of these and other ongoing and planned investments would stimulate domestic demand for low-carbon steel and other industrial materials and support the competitiveness of domestic producers. In terms of the sales of green steel from Czech steelworks, it is important to promote and enforce the public procurement criteria, especially at the European and Central European level, given their high export orientation.

- **Creating a "voluntary market for green products":** Individual actors are already trying to promote the use of green (primary) steel despite its higher price, e.g. the partnership between Daimler MercedesBenz and the Swedish start-up H2GreenSteel and the Swedish steelworks SSAB aiming to use green steel in the automaker's cars. SSAB is also working with the Volvo Group on a project focused on making cars using carbon neutral steel.[67] While these projects use steel produced via hydrogen-based direct reduction of iron (HDRI), they show the great potential of the automotive industry (the 2nd largest steel consuming industry in the EU with 17% of steel consumption) and other key downstream industries to drive demand for green steel. They can serve as an inspiration for similar projects in the Czech Republic using recycled steel, where instead of affordability the main obstacle lies in the quality parameters of the steel.

- **Tax incentives** for the use of secondary materials.[68]

[65] A green future for steel (CBI, 2022)
[66] Can the cars we buy drive green steel production? (CEPS, 2023), p. 9
[67] Technologies to decarbonise the EU steel industry JRC (2022), pp. 42
[68] Accelerate shift towards green steel – Climate and Company (2021)

Developing a coherent strategy for decarbonising industry, including the steel sector

The updates of the Secondary Raw Materials Policy and the National Energy and Climate Plan (and related strategic documents) currently underway are a key opportunity to develop the so far missing long-term plan to support the decarbonisation of Czech industry. This plan should provide a comprehensive set of measures and quantified targets to address the energy, material, societal and financial challenges and impacts of this transition for energy- and emissions-intensive industries in the Czech Republic. In addition to incorporating these measures into existing plans and policies, it is still desirable to create a coherent framework for the decarbonisation of these industries in the form of an Industrial Policy of the Czech Republic for the period 2024–2030 with an outlook to 2050 (previously mentioned in the NECP of the Czech Republic).

The transition pathways co-creation process for industrial ecosystems (part of the EU's Industrial Strategy) offers a comprehensive framework and a potential template for developing roadmaps, policies and targets for the twin green and digital transition of these industries at national level. The EU roadmap for energy-intensive industries was published in 2019 and the follow-up scenarios in September 2021. The transition pathway for the metals sector is planned for the first quarter of 2024.[69]

INCIEN offers this policy paper (and other sectoral analyses within this project) as a partial contribution to this process.

[69] Transition pathways for European industrial ecosystems – European Commission

Annex: Other sources of funding

Programme	Description
Clean Steel Partnership (CSP)	The main objective of the CSP is to develop technologies in the steel industry with a high technology readiness level (TRL 8) that can reduce emissions from steel production by 80–95% compared to 1990 levels, and by doing so, help achieve carbon neutrality, including EAFs. **Increasing the recycling of steel scrap and supporting the circular economy in the EU** is one of the 6 specific objectives of the programme. The CSP budget is around €1.6 billion for the period 2022–2034. This budget should fund at least 16 TRL 7 projects (up to €480 million), 12 TRL 8 projects (up to €720 million) and 4 demonstration projects (up to €400 million).
Processes4Planet Partnership	The total P4P budget is €2.6 billion (€1.3 billion from Horizon Europe and €1.3 billion from private partners). The main focus is on the development of new technologies and the advancement of already developed technologies to a higher technology readiness level (TRL) to achieve the expected CO2 emission reductions by 2030 and to reach their full potential by 2050. The programme does not directly mention EAFs.
European Innovation Council	The European Innovation Council (EIC) supports breakthrough and transformative innovation under Horizon Europe. The total EIC funding for this programming period 2021–2027 is €10.1 billion, of which €3 billion is for the EIC Fund. In 2022, the EIC opened up funding opportunities valued at more than €1.7 billion.
EU Cohesion and Environmental Programmes	In the years 2021–2027, the main source of EU funding is the European Structural and Investment Funds (ESIF), with the European Regional Development Fund (ERDF) being the most significant contributor, bringing in €10 billion of the total €24 billion available to the Czech Republic from the ESIF and other funds such as the Just Transition Fund (JTF). At the level of the Czech Republic, these funds are redistributed through operational programmes managed primarily by the Ministry of the Environment and the Ministry of Industry and Trade.

Programme	Description
	Of the 12 available programmes, the **Operational Programme Technologies and Applications for Competitiveness 2021–2027 (OP TAC)** is relevant for heavy industry, but it is mainly aimed at small and medium-sized enterprises, and its use in the steel industry is therefore limited. In the years 2017–2022, projects totalling €50 million were funded from the national operational programmes, and the average amount of funding was below EUR 1 million.
InvestEU Fund	The InvestEU programme aims to support investment in carbon neutrality in the EU. It is capable of mobilising more than €372 billion of public, but mainly private funding, through an EU budget guarantee of €26.2 billion. The programme supports advanced production technologies for steel processing without directly mentioning EAFs, but with recycling among the priority areas.

Source: Czech Heavy Industry Decarbonisation – Policy and Financing Roadmap – ISFC (April 2023) https://www.estep.eu/cleansteelpartnership/

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Study
Opportunities of circular economy for decarbonising Czech industry – Risks, barriers and priorities for maximising the production and consumption of recycled steel

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