

**DECARBONISATION OF THE STEEL INDUSTRY – PATHWAY TO BRIGHTER FUTURE –  
SLOVAKIA AND CZECH REPUBLIC CASE STUDY**

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**Abstract**

The aim of this study is to analyze the potential of decarbonization of steel production in Slovakia and Czech Republic. The study examines the European CO<sub>2</sub> emissions policy, steel production trends, and the European emission trading system (EU ETS) allowances and emissions of Slovakia and Czech Republic steel producers. The production of iron, steel and non-ferrous metals has a significant presence in Slovakia and Czech Republic. The metal industry, mainly iron and steel, is one of the largest energy-consuming industry, followed by non-metallic minerals. Steel making ranks as one of the three highest CO<sub>2</sub> emitting industries, and since production occurs in a limited number of locations – the U.S. Steel Košice, s. r. o. steel-mill being the largest single producer of emissions in Slovakia and Třinecké Železárny, a. s. with Liberty Ostrava, a. s. being ones of the largest in Czech Republic – they are prime candidates for decarbonization. This paper deals with the analysis of the metallurgical sector of steel production in Slovakia and the Czech Republic using the European Union Emission Trading Scheme (EU ETS).

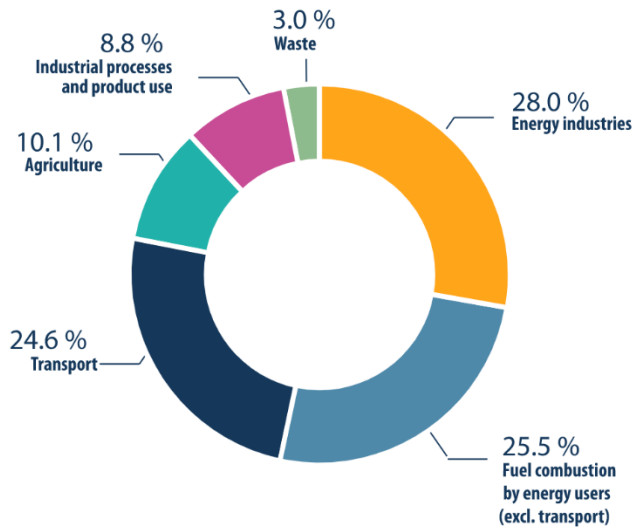
**Keywords:** decarbonization, metallurgy, emissions, EU ETS, green steel

**1. INTRODUCTION**

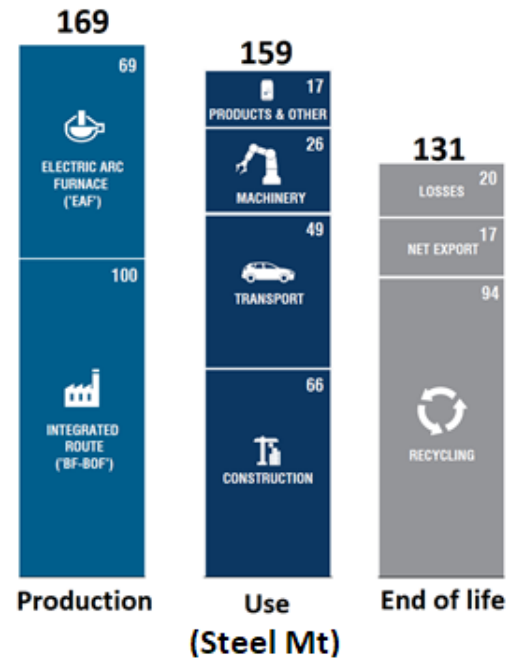
On the one hand, an ambitious European Climate Action Program to 2020 must be seen as a huge success, and on the other, real work is just beginning five years after the Paris Agreement, all 27 Member States of the European Union (EU) have agreed on an ambitious medium-term plan to reduce emissions by at least 55 % by 2030 compared to 1990, a proposal adopted by the European Council in December 2020 [1,2,3]. The European Union Emission Trading Scheme (EU ETS) is the primary tool for Slovakia and the Czech Republic in setting carbon prices and is also a central policy tool for reducing greenhouse gas emissions [4]. The EU ETS is a cornerstone of the European Union's policy to combat climate change and is a key tool for reducing greenhouse gas emissions cost-effectively, covering around 40 % of all greenhouse gas emissions in the European Union. The EU ETS operates on a "cap and trade" basis. A ceiling is set for the total amount of certain greenhouse gases that may be emitted by installations covered by this scheme. The limit decreases over time, so total emissions decrease [4].

The largest emitters of greenhouse gases in the European Union are the energy industry, fuel combustion and transport. Industrial processes produce only 8.7 % of emissions within the Union as shown in **Figure 1**. The production of key materials and chemicals – steel, plastics, ammonia, and cement – emits approximately 500 million tons of CO<sub>2</sub> per year, 14 % of the EU total. The greenhouse gas of most relevance to the world steel industry is carbon dioxide (CO<sub>2</sub>). On average, 1.9 tons of CO<sub>2</sub> are emitted for every ton of steel produced. According to the International Energy Agency, the iron and steel industry accounts for approximately 4-5 % of

total world CO<sub>2</sub> emissions. The European steel industry produces 169 million tons of steel per year as shown in **Figure 2** which stands for only 8,4% of 2019 worldwide steel production [5,6,7,8].



**Figure 1** EU sectoral greenhouse gas emission production [6]



**Figure 2** Production, use, and end of life of EU steel (Annual steel production Mt, 2017) [8]

The current trend in metallurgy is to achieve the production of high-quality and competitive steel on the world market with the lowest possible amount of CO<sub>2</sub> emissions per ton of steel produced. The increasing demand for quality steel on the world market is putting pressure on innovation and optimization of current technologies and the implementation of new processes in the metallurgical industry in order to achieve carbon neutrality.

## 2. RESEARCH FINDINGS

Slovakia produced 36,09 Mt and the Czech Republic produced 104,41 Mt of CO<sub>2</sub> emissions in year 2018 [9,10]. The Slovak steel production company U. S. Steel Košice, s. r. o. in year 2018 produced 9.3 Mt of CO<sub>2</sub> emissions, which makes up 25.77% of the total amount of emissions produced in Slovakia. In the case of the Czech Republic, the steel production company Třinecké Železárny, a. s. produced 4.3 Mt of CO<sub>2</sub> emissions in 2018 and Liberty Ostrava, a. s. produced 5.3 Mt of CO<sub>2</sub>, which represents 4.15% and 5.11%, respectively. The steel production capacity of individual companies is as follows: U. S. Steel Košice, s. r. o. 4.5 Mt, Třinecké Železárny, a. s. 2.6 Mt and Liberty Ostrava, a. s. 3.6 Mt.

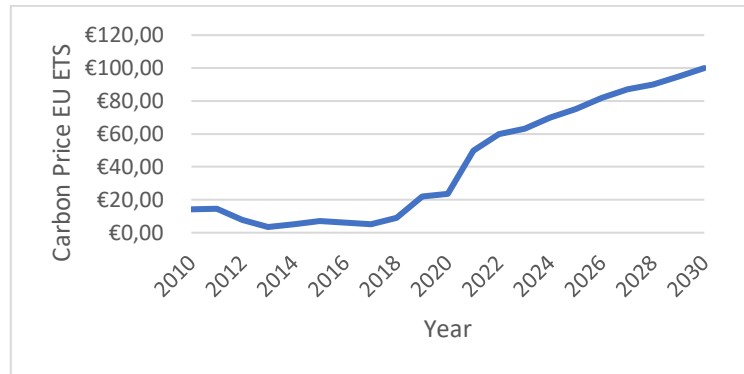
The production of CO<sub>2</sub> emissions in selected integrated steel plants was based on the European ETS trading system from 2010 including the prediction for 2030 as shown in **Table 1**. Predicted data for individual companies until 2030 were based on public statements of each individual steel producer with the assumption for continuous reduction of emissions until year 2030 without a significant change in the process and technologies used over the next 10 years. New measures and innovations of existing equipment will be introduced for each individual producers with the aim of reducing the amount of CO<sub>2</sub> emissions without the need to change their overall technological process. Due to the high initial investment costs and the time-consuming implementation of innovations in Integrated steel production, the transition to zero-emission steel in selected companies is expected beyond 2030. Potential interventions in the production cycle in the form of production limitation are not included in the prediction data. The forecast is informative and creates a picture

of the potential emissions costs of individual companies in the optimistic scenario of the development of the price of emission allowances as shown in **Figure 3**. Companies can get part of their quotas free of charge, the rest they must buy at auction or at the market. Each quota represents the right to emit one ton of carbon dioxide (CO<sub>2</sub>). The total costs associated with the purchase of emission allowances are based on the principle of the difference between Free Allocation and Verified emissions, the difference being the company's loss or profit.

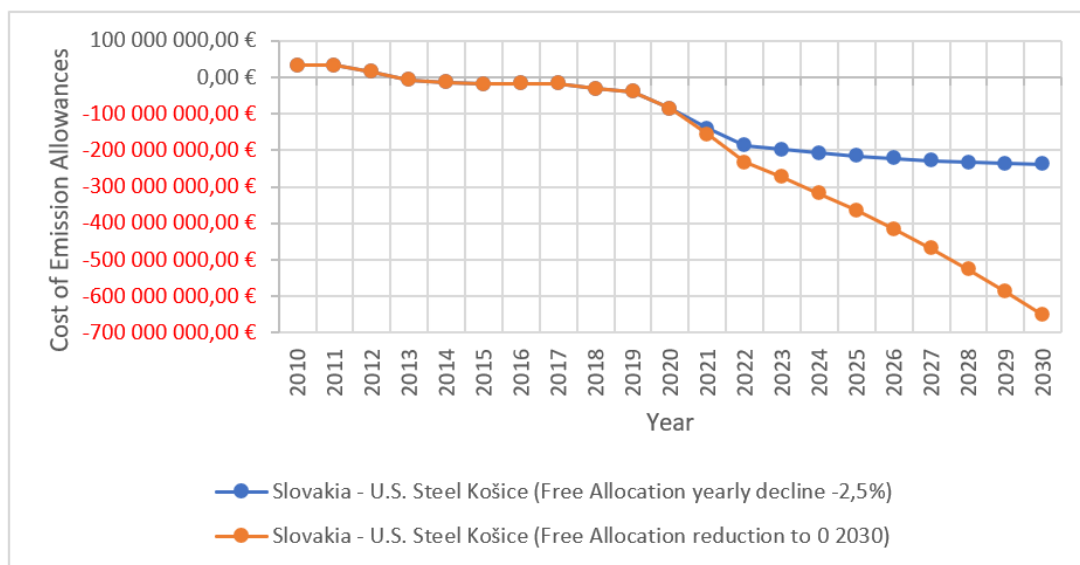
The European Commission is due to propose its Carbon Border Adjustment Mechanism (CBAM) on July 14, 2021, a move designed to put EU firms on an equal footing with competitors in countries with weaker carbon policies [11]. The European Parliament has already expressed its views on CBAM, saying free allowances must continue. In fact, a phase-in and phase-out period can be envisaged where both systems co-exist [12,13]. For this reason, two predictions of free allowances are given, with a year-on-year decrease of 2.5 % and 10 % by 2030. A 2.5 % reduction represents an ambitious plan to reduce emissions by 55 % by 2030 and a 10 % reduction represents a potential transition period for CBAM. The analysis of the price of emission allowances of individual steel companies is shown in **Figures 4,5,6**.

**Table 1** Analysis of emission quotas of steel mills - U. S. Steel Košice, s. r. o. Slovakia, Třinecké Železárny, a. s. and Liberty Ostrava, a. s. Czech Republic

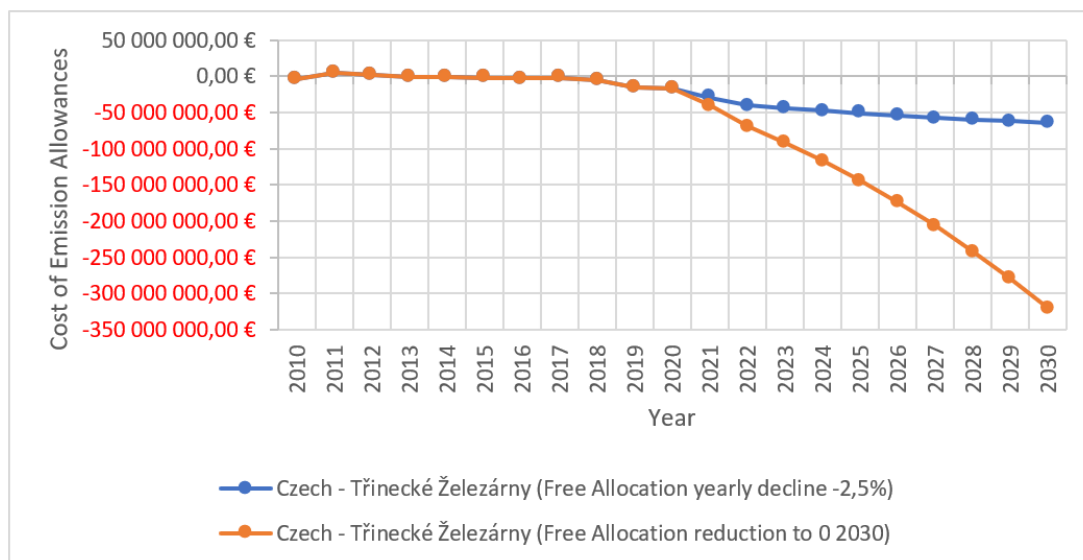
Year	Steel company								
	U.S. Steel Košice – Slovakia			Třinecké železárny – Czech Republic			Liberty Ostrava – Czech Republic		
	Verified emissions (CO <sub>2</sub> Mt)	Free Allocation (-2,5%p.a.)	Free Allocation (-10% p.a.)	Verified emissions (CO <sub>2</sub> Mt)	Free Allocation (-2,5% p.a.)	Free Allocation (-10% p.a.)	Verified emissions (CO <sub>2</sub> Mt)	Free Allocation (-2,5%p.a.)	Free Allocation (-10% p.a.)
2010	8 445 826	10 793 886		4 606 236	4 396 519		4 977 923	7 067 824	
2011	8 493 163	10 793 886		4 434 494	4 756 952		5 153 486	7 067 824	
2012	8 812 732	10 793 886		4 413 947	4 756 952		5 135 312	7 067 824	
2013	8 397 752	6 416 358		4 613 607	4 412 080		5 323 345	6 066 661	
2014	8 962 739	6 304 029		4 527 519	4 280 922		5 387 212	5 815 944	
2015	8 646 638	6 190 422		4 398 787	4 164 000		5 108 398	5 564 265	
2016	8 867 366	6 075 671		4 437 265	4 027 520		5 678 244	5 311 723	
2017	9 172 344	5 959 728		4 262 003	3 891 198		4 861 248	5 058 277	
2018	9 279 123	5 842 695		4 332 935	3 731 765		5 332 864	4 804 008	
2019	7 474 886	5 724 245		4 272 928	3 596 024		4 448 530	4 548 672	
Prediction of CO <sub>2</sub> emissions (Verified Emissions) and allocated allowances free of charge (Free Allocation) 2020 - 2030									
2020	9 179 782	5 605 421	5 605 421	4 220 147	3 461 684	3 461 684	4 367 779	4 293 040	4 293 040
2021	8 946 455	5 465 285	5 073 864	4 167 366	3 375 142	3 115 515	4 287 028	4 185 714	3863736
2022	8 713 128	5 328 653	4 513 322	4 114 585	3 290 763	2 769 347	4 206 277	4 081 071	3434432
2023	8 479 801	5 195 437	3 952 780	4 061 804	3 208 494	2 423 178	4 125 526	3 979 044	3005128
2024	8 246 474	5 065 551	3 392 238	4 009 023	3 128 282	2 077 010	4 044 775	3 879 568	2575824
2025	8 013 147	4 938 912	2 831 696	3 956 242	3 050 075	1 730 842	3 964 024	3 782 579	2146520
2026	7 779 820	4 815 439	2 271 153	3 903 461	2 973 823	1 384 673	3 883 273	3 688 015	1717216
2027	7 546 493	4 695 054	1 710 611	3 850 680	2 899 477	1 038 505	3 802 522	3 595 814	1287912
2028	7 313 166	4 577 677	1 150 069	3 797 899	2 826 990	692 336	3 721 771	3 505 919	858608
2029	7 079 839	4 463 235	589 527	3 745 118	2 756 316	346 168	3 641 020	3 418 271	429304
2030	6 846 512	4 351 654	0	3 692 337	2 687 408	0	3 560 269	3 332 814	0



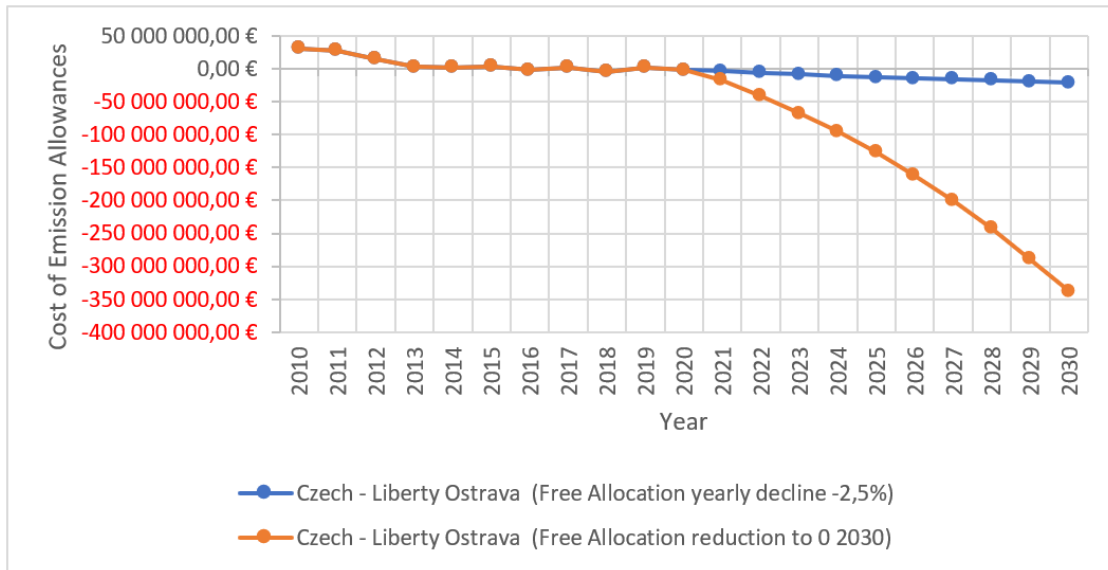
**Figure 3** Carbon price prediction 2030



**Figure 4** Price of emission allowances including prediction to 2030 - U. S. Steel Košice, s. r. o. – Slovakia

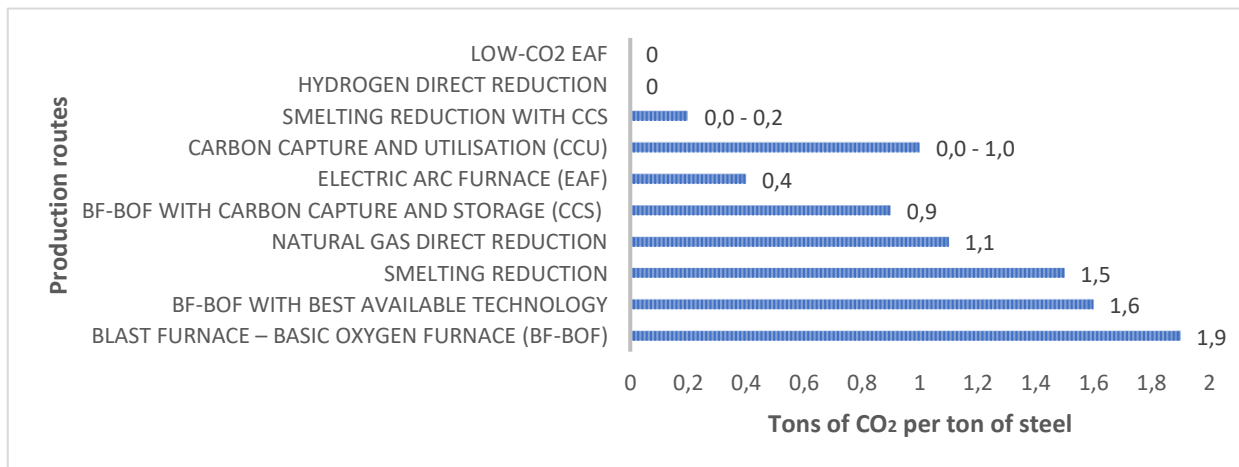


**Figure 5** Price of emission allowances including prediction to 2030 – Třinecké Železárny, a. s. – Czech Republic



**Figure 6** Price of emission allowances including prediction to 2030 – Liberty Ostrava – Czech Republic

To meet global energy and climate goals, emissions from the steel industry must fall by at least 50% by 2050 compared to the present situation, with continuing declines towards zero emissions being pursued thereafter. Deep emission reductions are not achievable without innovation in technologies for near-zero emissions steelmaking shown in **Figure 7**. A sustainable transition for the iron and steel sector will not come about on its own; governments will play a central role [14]. Major and rapid change will be necessary in all cases – and there are clear needs for policies to enable the transition. Far more resources must be devoted to accelerating innovation on several fronts. Credible new policy solutions are needed to make it viable to pursue low-CO<sub>2</sub> production routes that are up to 20% more expensive than current routes [8]. To remain competitive steel companies in Slovakia and the Czech Republic need a strategy until 2050 as soon as possible to achieve near-zero emission production of steel.



**Figure 7** CO<sub>2</sub> – Intensity of EU steel production processes - tons of CO<sub>2</sub> per ton of steel [8]

### 3. CONCLUSION

Europe's ambitious plan to achieve carbon neutrality by 2050 is a major challenge for the metallurgical industry. Individual metallurgical companies must make great efforts to achieve the highest possible reduction in CO<sub>2</sub> emissions despite potential technological, organizational, regulatory, and financial barriers. The rising price of

emission allowances in the coming years and the potential reduction of free allowances with the arrival of CBAM can cause for steel producers an increase in the production price by more than 100€ per ton of steel produced by 2030, which may lead to reduced competitiveness of Slovak and Czech steelworks. However, through innovation, low-carbon technology deployment and resource efficiency, iron and steel producers have a major opportunity to reduce energy consumption and greenhouse gas emissions, develop more sustainable products and enhance their competitiveness. However, financial assistance from the government and the European Union will be needed in this regard.

## ACKNOWLEDGEMENTS

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