Sectoral Differences in Emission Reduction in Hungary

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SUMMARY

The European Union sets ambitious environmental and climate protection targets. The Emissions Trading System (ETS), launched in 2005, is seen as one of the main tools for reducing emissions. The system is currently in its 4th phase of operation. This article looks at the emission reductions achieved by 114 Hungarian installations of 84 companies covered by the EU ETS during the 17 years of operation of the ETS. The analysis builds on verified emissions data from the Union Registry between 2008 and 2022. The present study provides a descriptive picture of the CO2 emission results of these companies. The methodology is limited to a simplified presentation of time-series results. The analysis shows that the installations have achieved an overall reduction in CO2 emissions of around 37% from 2005 to 2022, with the most significant contribution from companies in the energy sector. Installations in the energy sector have almost halved their total verified CO2 emissions, while manufacturing has reduced emissions by only 3 percent.

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INTRODUCTION

Since the turn of the millennium, the European Union has been setting increasingly ambitious environmental and climate protection targets. The current cornerstones are shaped by achieving the objectives agreed upon in the 2015 Paris Agreement. The Paris Agreement is one of the most significant agreements in the world, with countries agreeing to limit the global average annual temperature increase to below two °C above pre-industrial levels and to pursue efforts to reach 1.5°C. In line with this objective, the EU has set itself the objective of reducing CO2 emissions by 55% by 2030 compared to 1990 and achieving climate neutrality by 2050 (ET, 2023a). Hungary made progress in emission reduction until the 2010s, but experts warned about the potential threats of the Hungarian industrialisation strategy to the emission targets of the country (Bartha & Tóthné Szita, 2015a, 2015b).

The emissions trading scheme launched in 2005 is considered one of the main tools for reducing emissions. EU-wide CO2 emissions in the sectors covered by the ETS decreased by 41% between 2005 and 2020. Currently, the system is in its 4th phase of operation. The conditions of the scheme have become stricter during each trading period. However, new financial resources have been opened up under the ETS to support investments in energy efficiency and climate protection. The reform of the system is part of the Fit for 55 package. In EU ETS sectors, a 62% reduction is planned for 2030 instead of the previous GHG reduction target of 43% (ET, 2023b).

The research question of this article is: How many emission reductions have Hungarian installations covered by the EU ETS achieved during the 17 years of system operation so far? How has emission reduction developed in each sector of the national economy?

Section 1 of the study contains a literature summary. Section 2 presents a summary of the data collection and methodology. Section 3 describes the results of the analysis. Subsection 3.1 presents the aggregated CO2 reduction results of 114 installations of the 84 companies examined, while Subsection 3.2 presents the results achieved by sectors. Chapter 4 contains the main conclusions.

LITERATURE REVIEW

In recent decades, aspects of corporate social responsibility and corporate sustainability have come into the focus of scientific research with increasing intensity (see, for example, Hódiné, 2022; Piskóti &

Hajdú, 2013). The analysis and approach to environmental impacts are relevant for this study. Economic theories also deal with these questions more and more often. Pearce and Atkinson (cited in Kerekes 2007) distinguish between weak and strong sustainability based on three types of capital (artificial capital, human capital, and natural capital). Weak sustainability starts from the assumption of neoclassical economics that capital goods are infinitely interchangeable. There is a substitutability between natural and artificial capital in the case of weak sustainability. In the interpretation of strong sustainability, there is no possibility of substitution between capital elements, i.e. natural and artificial capital complement each other but do not replace each other. From an economic point of view, only achieving weak sustainability appears as a possible option; the economy cannot meet strong sustainability criteria, but at most, an attempt can be made to approximate it (Kerekes, 2007). In economics, environmental economics and ecological economics deal with the management of environmental problems. The topic of this article is closer to the principles of environmental economics, which is based on the principles of neo-classical economics and approaches environmental problems based on the principles of weak sustainability. It starts from the assumption that environmental problems can be solved with the tools of the economy (Kiss & Pál, 2006).

Environmental and climate pollution caused by industrial facilities can be identified as negative production externalities for society. Negative externalities mean that the company, through its activities, unintentionally creates an adverse external economic impact that reduces well-being (Kiss & Pál, 2006; Kerekes, 2007). The idea of dealing with external economic effects (externalities), i.e. the theory of internalization of externalities, can be linked to the name of the English economist Pigou. The essence is that adverse external economic effects caused by companies, such as the costs caused by pollution, must be internalized for the polluter. Related to this is the emergence of „the polluter pays" principle in environmental measures, first introduced by the OECD in 1972. Since then, it has been used more and more widely, for example, as one of the basic principles of EU environmental policy. By applying the principle, polluters are encouraged to avoid or reduce environmental damage and, where they cause pollution, to bear the financial burden thereof (European Court of Auditors, 2021).

There are various measures to optimise social damage resulting from pollution (i.e. internalisation of externalities), depending on whether the evolution of the price or quantity of pollution is determined by state regulation or market mechanisms. Based on this, Kocsis (2002) distinguishes 4 cases, which he depicts in the pollution control matrix (Table 1). The present study does not aim to present the matrix in detail. However, one means of reducing environmental pollution is the so-called emission rights market, where emission trading schemes, including the EU ETS system, can be classified. In the case of these systems, achieving the objectives set is formed through a combination of state regulation and market mechanisms.

Table 1

Pollution control matrix

		The AMOUNT of pollution is determined by the…	
		STATE	MARKET
The PRICE of pollution is determined by the…	STATE	Direct control devices (e.g. command and control, ban, norm, punishment)	Pigou (e.g. taxes, subsidies)
	MARKET	emission allowances market (e.g. emissions trading scheme)	Coase (e.g. market solutions)

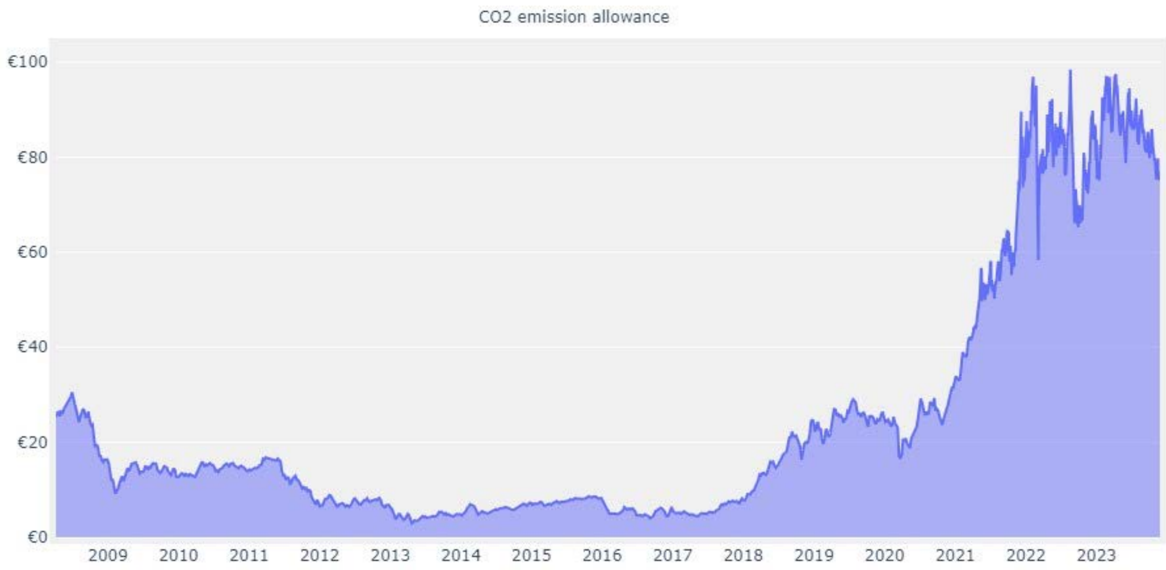
Source: Kocsis (2002)

This study aims to present in a simple descriptive way the CO_2 reduction results achieved so far by Hungarian installations covered by the EU ETS. Therefore, this chapter briefly presents the operation and main characteristics of the system.

The European Union Emissions Trading System (EU ETS) was launched in 2005 under Directive 2003/87/EC of the European Union. This system operates based on a cap-and-trade mechanism, which capped greenhouse gas emissions. Emission allowances, known as quotas, accompany this quantity. A quota entitles its owner to emit one tonne of CO_2 (or CO_2 equivalent). Companies must be able to account for a quota volume corresponding to tonnes of their emissions each year. The facilities covered by the scheme receive the necessary quota volume through free allocation, auction or trading (stock exchange or over-the-counter) and can sell their excess quotas. If the company does not have sufficient quotas, it must consider covering the deficit by purchasing quotas or taking measures to reduce emissions. The operation of the system is divided into trading periods. The first phase covered 2005-2007, the second phase covered 2008-2012 and the third phase covered 2013-2020. We are in the fourth trading phase, valid for 2021-2030 (Nyikos, 2022; EC, 2022).

The system's success (i.e. its contribution to achieving emission reduction targets) depends on several factors. The most essential cornerstones are:

1. The total quota quantity allowed. The system helps meet emission reduction targets by reducing the emission ceiling, i.e. the maximum allowable emissions, year on year.
2. Allocation of quotas. Installations received the initial quota volume through free allocation in the first two phases. From the third stage onwards, the gradual reduction of the quota allocated free of charge began. In addition to free quota allocation, companies increasingly receive their initial quota volume through auctions (except in sectors subject to carbon leakage, where free quota allocation still applies).
3. The price of quotas. The price of quotas is fundamentally determined by supply and demand. In the case of oversupply, the price of quotas decreases, while in the case of overdemand, it rises. If quota prices are too low, the original objective of the system will be undermined, as it will be cheaper for companies to buy the necessary amount of quota than to take measures to reduce emissions. Over-quotas can be avoided by reducing the emission ceiling and creating a market stability reserve to regulate the amount of quotas in circulation. Figure 1 shows the evolution of quota prices from 2008 to the present. From 2018 onwards, the price of CO2 quotas started to rise, and after a short decrease due to COVID-19 (2020), the price of CO2 quotas increased rapidly.



Source: Carbon Price Viewer. https://sandbag.be/carbon-price-viewer/

Figure 1. Evolution of the CO2 quota price from 2008 to 2023

Based on the experience of the first two trading periods, the system was gradually tightened from the third trading period onwards. As part of the Fit for 55 package, the system has been reformed to enable the EU to meet its Paris Agreement commitments by 2030 and 2050. The EU ETS is considered the main instrument of the EU's climate protection policy, which can best help achieve emission reduction ambitions through its stimulating effect. Several studies examine the effects of the ETS system(s). So, for example, Bolat et al. (2023) examined the macroeconomic carbon rebound effect of the EU ETS, and their results show that the positive economic spillover effect of the ETS may hamper efforts to meet climate goals (Bolat et al., 2023).

In addition to analysing macro-level results, it is worth examining the effects of the system at the sectoral and company levels. By pricing CO2 emissions, the ETS system can generate costs for companies or revenue by selling unnecessary quotas. This can encourage investments in energy efficiency and low-carbon technologies, affecting companies' competitiveness, profitability and productivity. Yu et al. (2022) examined the evolution of emission reductions and financial performance in connection with the pilot introduction of the Chinese ETS. Their investigations focused on whether the companies concerned could improve their financial performance by taking responsibility for emission reductions, a win-win combination of environmental and economic outcomes. The results show that the introduction of the pilot ETS improves the financial performance of the firms examined (Yu et al., 2022). Koch and Themann (2022) examined the impact of the EU ETS on companies' productivity. They conclude that the impact of the ETS on productivity depends on the company's technological development. It increases productivity for technologically advanced companies but slows down the catch-up of lagging companies (Koch & Themann, 2022). Purcel (2023) analysed the impact of the EU ETS on environmental spending. A positive effect was demonstrated in the short term, but no statistically significant correlation was found for long-term investment decisions. Their results conclude that the EU ETS is a viable instrument that is a critical incentive for companies to undertake environmental spending (Purcel, 2023). It is essential to analyse sectors subject to carbon leakage. This is the process by which companies relocate their activities to a third country to escape the scope of the EU ETS. Lagouvardou and Psaraftis (2022) looked at the issue from the perspective of the maritime sector, as in 2021, it was proposed to include this sector in the ETS's scope. Their analysis showed that even with relatively low quota prices, there is a real risk of relocation of loading nodes (Lagouvardou & Psaraftis, 2022).

The ETS focuses on achieving decarbonisation targets. It brings together the sectors that contribute most to CO_2 emissions. Thus, most installations covered by the EU ETS are in the energy sector or energy-intensive sectors (EC, 2022). In addition to the conditions of the EU ETS and the general global economic environment, the sectoral specificities will largely determine the results that can be achieved.

The simple question posed by this study is how much emission reductions have been achieved between 2005 and 2022 by the Hungarian installations covered by the EU ETS. How has the emission reduction been developed by sectors? Investigation of the causes and means is out of the aim of this study; this may be the subject of further research.

DATA AND METHODS

This study briefly overviews the emission reduction results of Hungarian installations covered by the EU-ETS from the start of the system's operation to the present day.

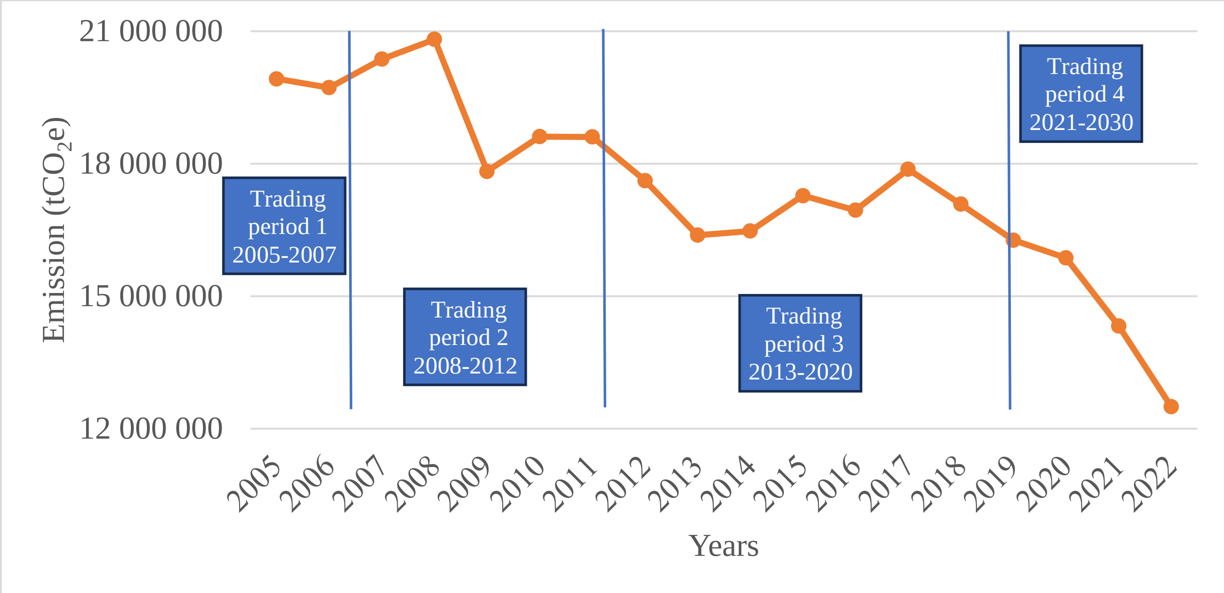
"Since the start of Phase 4 in 2021, the EU ETS has covered 27 EU Member States and European Free Trade Association (EFTA) countries such as Iceland, Liechtenstein and Norway, and power plants in Northern Ireland. The EU ETS regulates emissions from a total of 8 757 electricity and heat generating power plants and production facilities (stationary installations), as well as 371 aircraft operators flying between airports in the European Economic Area (EEA) and from the EEA to Switzerland and the UK. These installations represent around 36% of total EU emissions." (EC, 2022, pp. 4-5). The sectors concerned are, therefore, mainly electricity and heat generation, energy-intensive sectors and aviation. Installations in these sectors are covered if their emissions reach a certain threshold.

In compiling the database for the analysis, this study relied on data from the Union Registry, an online database containing the accounts of operators of fixed installations and aircraft (since January 2012). In order to participate in the EU ETS, companies need to open an account in the EU Registry. This registry ensures accurate accounting of allowances issued under the EU Emissions Trading System (EU ETS) (EC, 2023). This database collected the annual verified CO_2 emissions of the examined installations. The Hungarian facilities covered by the EU-ETS were identified in the first step. The list of facilities published in 2023 (EC, 2023a) includes 313 facilities of 210 companies in Hungary. Excluding companies whose licenses have been revoked, 190 installations from 140 companies are listed as active.

From now on, facilities with active status were examined in this study. Collecting verified emission data for installations with active status followed this step. The EC (2023b) database provided the basis for this, which contains verified emissions data from 2008 to 2022. The data from 2005-2007 (checking their consistency with the EU Register) were taken from a database published by Mura et al. (2021a,b). Given that the study aims to present the results from the beginning of the scheme to the present, the analysis will be further limited to those installations for which emissions data are continuously available in 2005-2022. It, therefore, does not cover installations that became covered by the scheme after 2005 or that have since ceased to be covered. In this way, the analyzed database is ultimately based on emissions data from 114 installations of 84 companies from 2005-2022. The present study only provides a descriptive picture of the CO_2 emission results of domestic installations covered by the EU ETS. Thus, the methodology is limited to a simplified presentation of time-series results.

RESULTS

This section presents the results of the analysis. Subsection 3.1 presents the aggregated CO_2 reduction results for 114 installations of the 84 companies analysed, while subsection 3.2 shows the results by sector.



* n=84 companies, 114 installations; the filtered database includes only those companies and installations that were continuously covered by EU ETS between 2005 and 2022, and their emissions data are available

Source: own calculation based on EC (2023a), EC (2023b) and Mura et al. (2021)

Figure 2. Total emissions of Hungarian installations covered by the EU ETS in the period 2005-2022*

Results based on aggregated data from installations examined

114 facilities of the 84 companies examined emitted a total of about 314.5 million tCO2eq into the atmosphere during the 17 years of operation of the system (2005-2022). From 2005 to 2022, their total emissions decreased from 19.92 million to 12.5 million tCO2eq, i.e. by 37.2 per cent (Figure 2).

The EU ETS is currently in phase 4. In Figure 2, the blue lines indicate the closing year of each trading period (except for Section 4). Chart 2 and Table 2 show how the aggregate output of the companies under review changed over trading periods. In the first phase, there was still an increase in emissions figures. From 2008, there was a marked decrease, which, in addition to the more efficient operation of the ETS system, is also related to the consequences of the 2008 global economic crisis. In the first half of the post-Kyoto phase (phase 3), there was an upward trend; after 2017, the aggregate emissions of domestic facilities decreased. The tightening of climate protection ambitions and the conditions of the ETS system can partly explain this reduction. It can be seen that entering stage 4, we see a sharp decrease in the first two years. In addition to the further tightening of the ETS system, the COVID-19 pandemic, rising energy prices, and the economic consequences of the Russia-Ukraine war are the reasons for this significant decline. Output increased in 18 companies compared to 2005. Data from other companies shows a decline.

Table 2

Changes in emissions from installations covered by the EU ETS in Hungary over the trading periods of the scheme

Trading periods	Period	Number of years	Change in total emissions from all installations compared to the last year of the previous period (%)	Annual average of the change in total emissions of the examined installations (%)
Phase 1	2005-2007	2	+2.25	+1.12
Phase 2	2008-2012	5	-13.51	-2.7
Phase 3	2013-2020	8	-9.93	-1.24
Phase 4	2021-2030	2*	-21.2	-10.1

*number of years so far
**n=84 companies, 114 installations; the filtered database includes only those companies and installations that were continuously covered by EU ETS between 2005 and 2022, and their emissions data are available

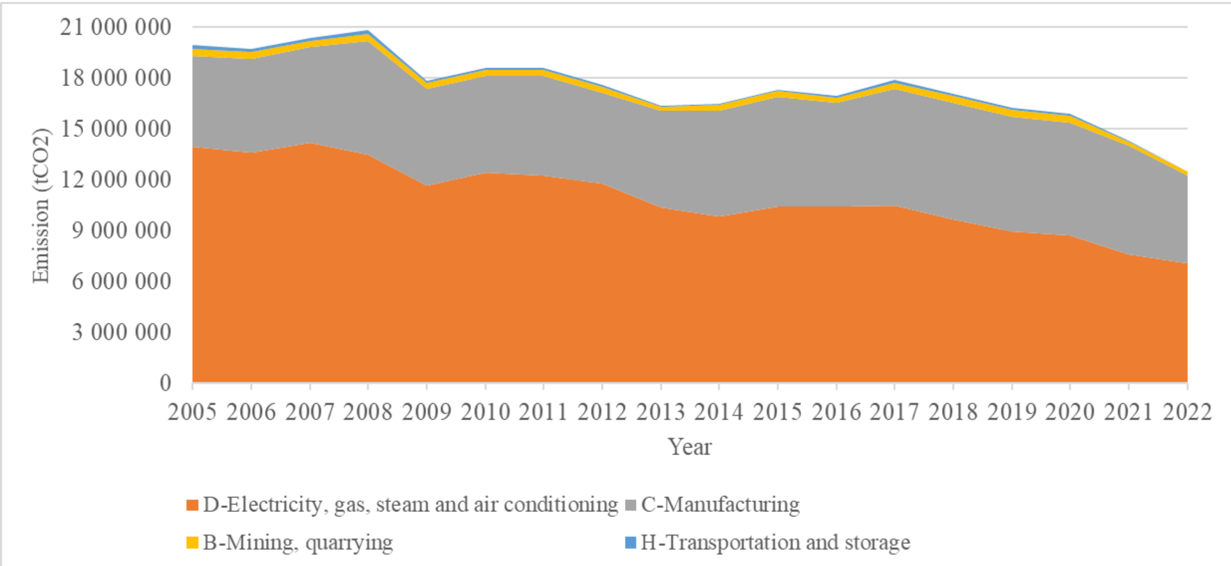
Source: own calculation based on EC (2023a), EC (2023b) and Mura et al. (2021)

Results by sector

Of the 114 installations of the 84 companies examined, 52 belong to the energy sector (predominantly in the electricity generation and district heating sectors). 53 are in the manufacturing sector, from which 25 installations are classified in the non-metallic mineral products manufacturing sector. The other nine facilities operate in the field of mining and transportation.

Figure 3 shows that the dominant part of the emissions of the Hungarian installations covered by the ETS comprises companies belonging to Section D-Electricity, gas, steam and air conditioning. The second largest share of CO2 emissions can be attributed to C-Manufacturing companies. Compared to these, B-Mining, quarrying and H-Transportation and storage appear negligible (with a total share of about 2-3 percent each year). What is noteworthy, however, is the transformation in the emissions structure. While in 2005, 70 percent of the total emissions of the 84 companies examined were emitted by companies of the Electricity, Gas, Steam and Air Conditioning sector, and about 27 percent were accounted for by the manufacturing industry, in 2022, the share of companies of the Electricity, Gas, Steam and Air Conditioning Supply Section in total emission decreased to 56.5 percent, while the share of manufacturing industry increased to 41.3 percent.

This structural change is because the Electricity, gas, steam and air conditioning supply section reduced its emissions more significantly (by about 49.4 percent) during the period under review than the manufacturing industry, where only a 3.17 percent decrease in emissions can be observed. The output of companies belonging to sections B and H also decreased. Thus, the energy sector contributed the most to the 37.2 percent reduction in emissions of the 84 companies.



* n=84 companies, 114 installations; the filtered database includes only those companies and installations that were continuously covered by EU ETS between 2005 and 2022, and their emissions data are available

Source: own calculation based on EC (2023a), EC (2023b) and Mura et al. (2021)

Figure 3. Emissions of Hungarian installations covered by the EU ETS broken down by activity in the period 2005-2022*

Based on 2022 data, 73 installations belonging to 8 sectors account for 90 percent of emissions. In the first place are 13 installations of electricity generation (NACE 35.11), which account for 39.4 percent of 2022 emissions. Typically, these are power plants. These facilities reduced their emissions by about 50.6 percent from 2005 to 2022. Power plants in Hungary still benefit from the derogation clause of Article 10(c) of the EU ETS Directive. Generally, electricity generation can no longer benefit from free quota allocation. However, Article 10c (1) of the EU Emissions Trading Directive (Directive 2003/87/EC) states that 'Member States whose GDP per capita in euro at market prices in 2013 was below 60 % of the Union average may temporarily allocate free allowances to installations generating electricity for modernising, diversifying and sustainably transforming the energy sector. The investments supported shall consistently contribute to the transition to a safe and sustainable low-carbon economy, the goals set out in the Union's 2030 climate and energy policies and the long-term objectives of the Paris Agreement." (EU, 2023, Article 10c, p. 46) The possibility of temporary free allocation also exists in phase 4, subject to stricter conditions. It shall not be mandatory for the Member State to apply it. In addition to Hungary in Phase 4, only Bulgaria and Romania apply Article 10c (EC, 2022).

The Production of electricity sector is followed by 38 installations (district heating suppliers and district heating producers) of the Steam and air conditioning supply sector (NACE 35.30) with a share of 16.6 percent, significantly reducing their emissions by 47 percent during the period. The third largest emitting sector is Manufacture of refined petroleum products (NACE 19.20), where certified emissions have increased by 11.4% over the past 17 years. The other major emitting sectors (about 20 installations) are Manufacture of other organic basic chemicals (NACE 20.14), Manufacture of cement (NACE 23.51), Manufacture of fertilisers and nitrogen compounds (NACE 20.15), Manufacture of basic iron, steel and ferroalloys (NACE 24.10) and Manufacture of bricks, tiles and construction products, in baked clay (NACE 23.32). All but one sector has seen reductions in CO2 emissions. The most significant decrease (60.8 percent) was in the manufacturing sector of basic iron, steel, and ferroalloys (NACE 24.10).

CONCLUSIONS AND RECOMMENDATIONS

In the context of increasingly ambitious energy and climate policy targets, the need for emission reductions is exceptionally high in the sectors that contribute most to climate pollution. As such, the energy and energy-intensive sectors (as well as other ETS sectors) are under increasing pressure from society and regulators to reduce their emissions. The introduction of the EU ETS is a vital tool for climate policy. The present study aimed to show the emission reduction achievements of Hungarian installations covered by the EU ETS between 2005 and 2023 and to identify sectoral differences in the results achieved.

Based on the analysis, the aggregated CO2 emissions of the 114 installations examined have decreased significantly (by 37%) during the 17 years of operation of the EU ETS system so far. The potential for CO2 emission reduction in each sector depends on several factors, with sector-specific factors being the most important. Sectors differ considerably regarding product differentiation, technologies used and geographical concentration. Aggregated emissions from Hungarian energy installations have fallen by around half during the examined period. However, installations in the manufacturing sector have seen a more modest decline (3%).

Further research must be conducted to identify the causes and tools of emission reductions since it does not matter whether the decrease results from efficiency improvements or production declines. The primary goal is to reduce emissions while maintaining (or even increasing) production, which is when we can discuss efficiency gains.

As CO2 emission is determined as a multiplication of the amount of energy used and its emission factor (Takácsné, 2023), the following options for CO2 reduction can be highlighted. Using zero- or low-emission energy sources can be one of the tools of decarbonization. For example, in the case of electricity generation, there is a high potential for a positive transformation of the energy mix and an increasing use of renewables. Policy decisions such as the decision to phase out coal from electricity generation by 2030 (PPCA 2019) or stricter rules for the sector within the ETS (EC 2022) are encouraging this process. The need to reduce CO2 emissions is becoming increasingly visible in the strategies of energy companies. They are progressively shifting their energy mix from fossil fuels towards alternative energy sources and looking for innovative technological solutions (Aastvedt et al. 2021, Jarboui 2021, Latapí et al. 2021, Horváth et al. 2022, RWE 2022, Uniper 2022, etc.)

Another important way of decarbonisation is a shift towards more energy-efficient technologies with lower specific CO2 emissions. The opportunities for technology shift may vary from sector to sector, depending on the degree of technology lock-in. In the steel industry, for example, the shift from the coal-based Blast Furnaces-Basic oxygen Furnaces (BF-BOF) to Electric Arc Furnaces (EAFs) with more favourable energy characteristics or Direct Reduced Iron (DRI) technology represents a breakthrough in energy efficiency (Yu & Tan, 2022; Zhang et al., 2022). In sectors with less potential for renewables, carbon capture and storage technologies can contribute to climate goals (Lee et al., 2022; Horváth et al., 2023).

Analysis of specific indicators (unit of production) and carbon intensity indicators would give a more accurate picture of the results. The absence of specific and other company data can be identified as a research limitation.

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