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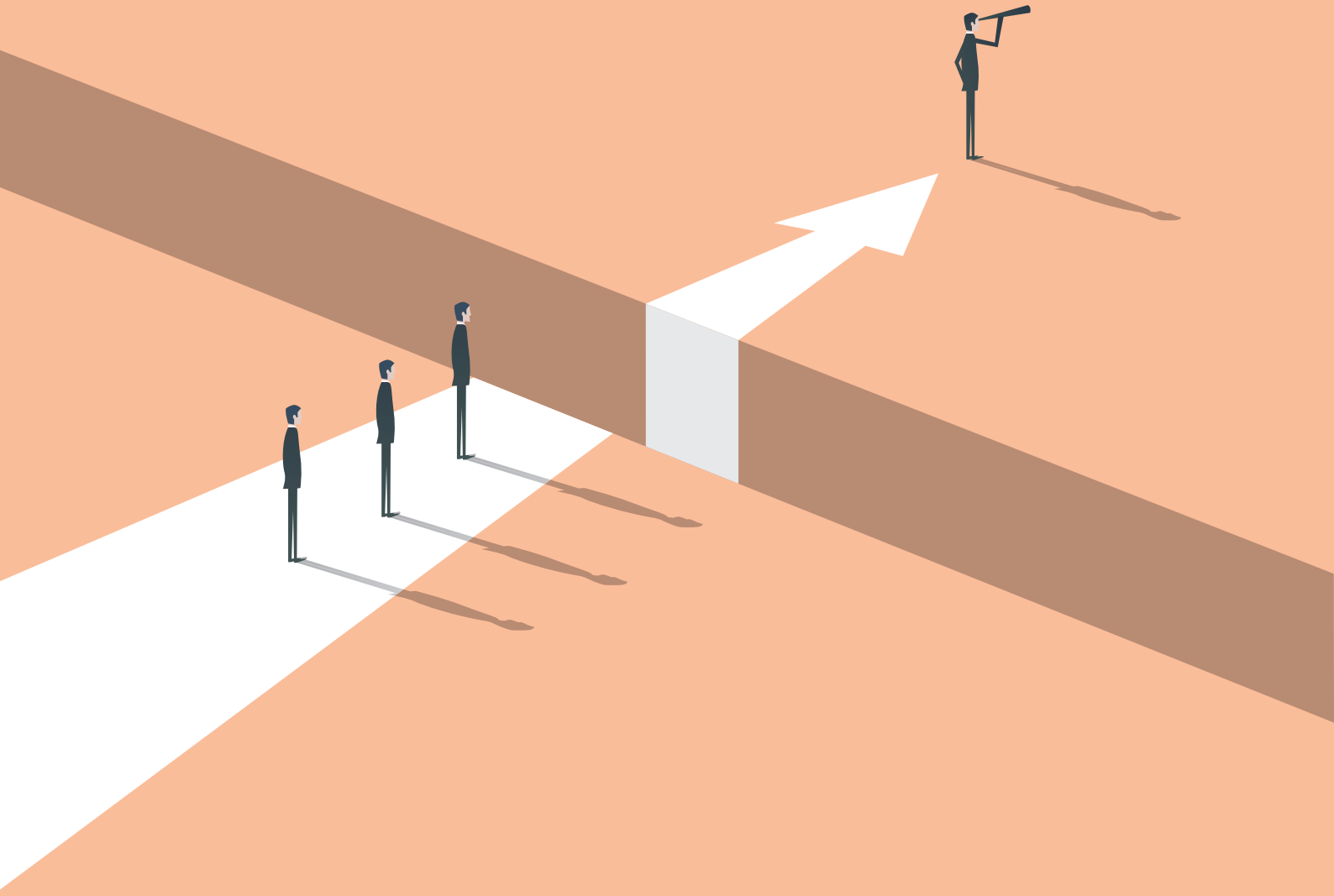

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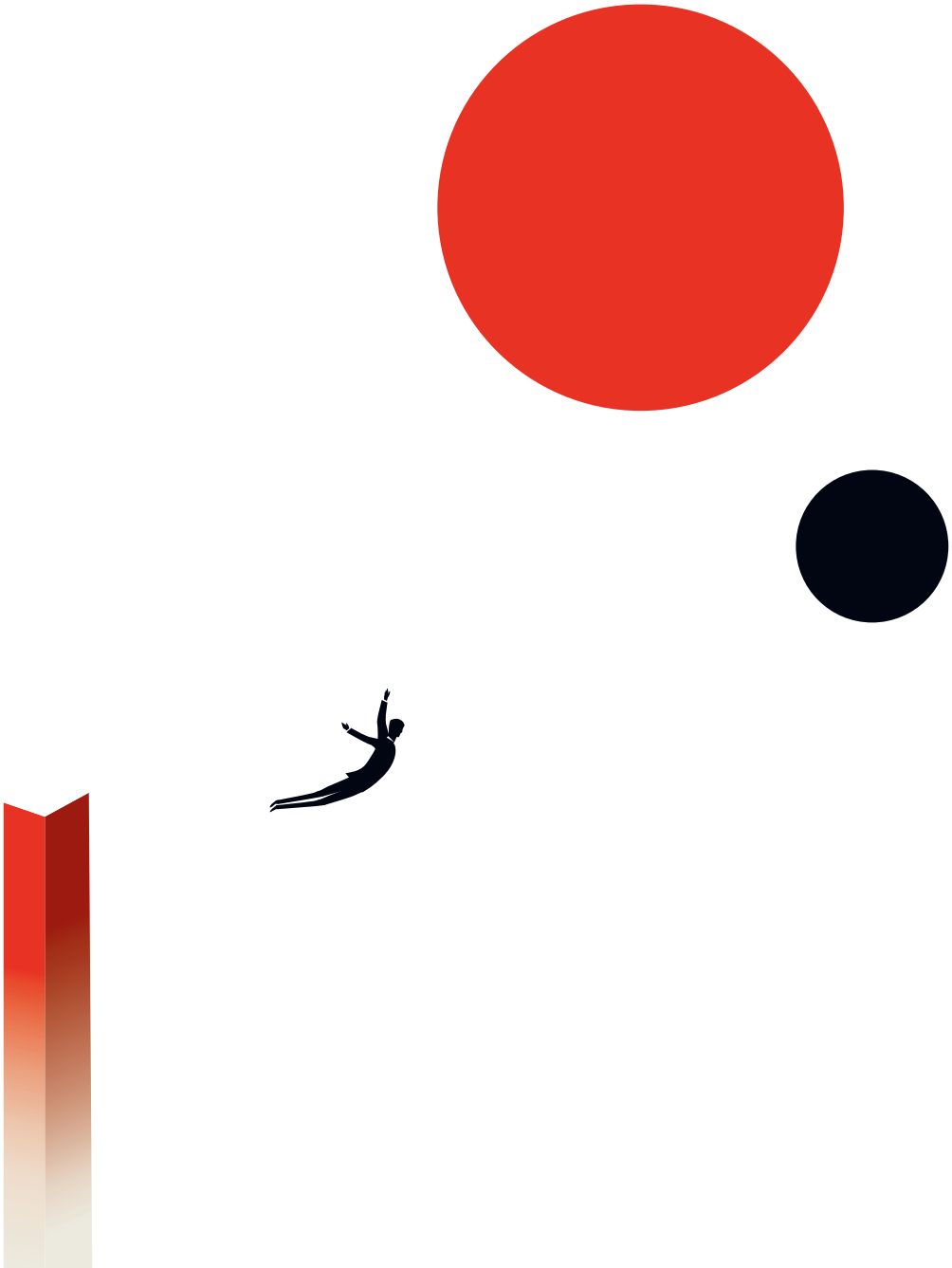

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Foreword

We are excited to present the fourth issue of the publication **'GO_2'50'**, published by the National Centre for Emissions Management (KOBiZE) operating at the Institute of Environmental Protection – National Research Institute (IOŚ-PIB). The year 2023, intensive in terms of events concerning the continuation of global changes, was a time of adaptation and recovery measures for all of us in the face of climate policy, economic and political challenges.

The recent months have been a time when we have been experiencing dynamic transformation of the EU energy and climate policy, in particular in the context of the 'Fit for 55' package as well as the reform of the EU Emission Trading System (EU ETS). In this issue, a lot of space is devoted to the analysis and interpretation of these significant changes that have a direct impact on the EUA prices in the EU ETS and the future of the entire system.

The first article explores the complexities of the EU ETS market in 2023, providing an overview of relevant trends and predictions for its development. The 'Fit for 55' impact on both the MSR reserve and the EUA prices and number of allowances in the EU ETS is discussed in particular, what in our opinion can help broaden the perception and understanding of new challenges and opportunities we all face within the Community climate policy.

Momentous changes and developments of the EU climate policy measures are discussed in the next article, focused on the new emissions trading system for buildings and the road transport, named ETS2, which extends the scope of carbon pricing. Authors focus on the legal conditions and consequences of this system and its impact on households in the EU, which seems crucial to illustrating and understanding the broad implications of these new regulations.

In this issue we also discuss new policy measures, such as the carbon border adjustment mechanism CBAM) and the role of 'green hydrogen' in the mix of efforts towards the energy sector decarbonisation.

Furthermore, as a continuation of our educational and information mission, we present an article discussing the proposal for the European CO_2 removal certification system and the AgETS system for agriculture, which are increasingly present in discussion on the path towards the EU climate neutrality in 2050. The question of carbon removals is explored also in the last article, in particular focused on the role of tropical forests, voluntary carbon markets and the REDD+ instrument.

As we all begin the debate on setting the EU climate policy targets for 2040 and accordingly the architecture of climate policy, we believe that articles we share will be received not only as a source of knowledge, but also as an inspiration to contribute to this discussion and exploration of effective ways to tackle global warming and achieving the climate neutral Europe in 2050.

We warmly encourage you to read the issue, share your comments and join the EU debate.

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Analysis of the EU ETS market: outlook and projections for 2024

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Analysis of the EU ETS market: outlook and projections for 2024

Key words: EUA prices, 'Fit for 55' package, EU ETS, MSR reserve, allowance supply, energy commodities, CO_2 market

Author:
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Abstract

The purpose of this article is to discuss the current situation in the EU ETS allowance market, to identify the factors that most influenced the formation of EUA prices in 2023, and to try to estimate the impact of fundamental (demand and supply in the CO_2 market) and technical (analysis of charts and indicators) factors on EUA[1] prices in 2024.

The first part of the article describes the formation of EUA prices in 2023, pointing out the most important causes affecting the volatility of the allowance market at that time. The same section also shows how the valuations of EUA's looked in comparison with other asset classes in 2023, such as US equity indices, commodities, metals, real estate, Bitcoin and currencies. The comparison was aimed at finding a possible price correlation with each asset class.

The second part of the article identifies potential supply-demand factors in the EU ETS that may affect the behavior of allowance prices in 2024. The group of supply factors may include those factors that determine the volume of allowances offered in the primary and secondary markets in the EU ETS. Examples of such measures include the implementation of the Fit for 55 package in the EU ETS part, i.e., among other things, the tightening of the reduction target and the operation of the MSR reserve, phasing out of free allowances or the need to monetize EU ETS allowances to finance partly the REPowerEU plan. In turn, the demand for allowances will be determined by the future behavior of EU ETS participants (operators, power producers and financial institutions) depending on their current emission and hedging needs.

In the last part of the article, based on a technical analysis, the current trend in the CO_2 market is identified and the most important technical factors that determined it are listed. In addition, two scenarios are presented for EUA prices in 2024. The upward scenario assumes a potential reversal of the currently ongoing downward trend, while the downward scenario assumes a deepening of the currently ongoing declines to levels determined by technical analysis. The article also outlines the technical conditions that must be met for either of the above scenarios to be realized.

[1] European Union Allowances.

High price volatility in CO_2 market in 2023

Between January and December 2023, the prices of EUA allowances on the spot market fluctuated between €65 and €97. Dynamic price increases occurred in January and February 2023, with values reaching around €97 on the spot market and even exceeding €100 on the futures market. Most market experts were surprised by the sharp price increases, as they had expected declines due to the anticipated larger supply of allowances at the 2023 auctions, the proceeds of which are intended to partially finance the REPowerEU plan. However, other factors may have played a role in this case, such as the drop in gas prices, which encouraged greater use of coal as a fuel. Additionally, the delay in issuing free allowances and the phenomenon of the "short squeeze[2]" in the futures market may have contributed to these unexpected price increases.

Despite strenuous efforts in March and April, prices could not be maintained above €90, as hoped by most experts who anticipated higher demand from installations operating in the EU ETS, which are required to settle emissions for 2022 by the end of April 2023. The negative outlook of investors in the CO_2 market probably resulted from the weakness in other markets, particularly equities, due to liquidity issues faced by banks in the US and Europe. It is worth noting that the CO_2 market has been closely correlated with the US equites, especially with the S&P 500 index.

The selling pressure persisted in May, with prices dropping below the significant level of €80. The weakness of the market was due to several factors, including an increase in short positions among investment funds in the futures market, lower hedging needs of energy producers due to the ongoing decarbonisation process, and weaker macroeconomic data in the EU.

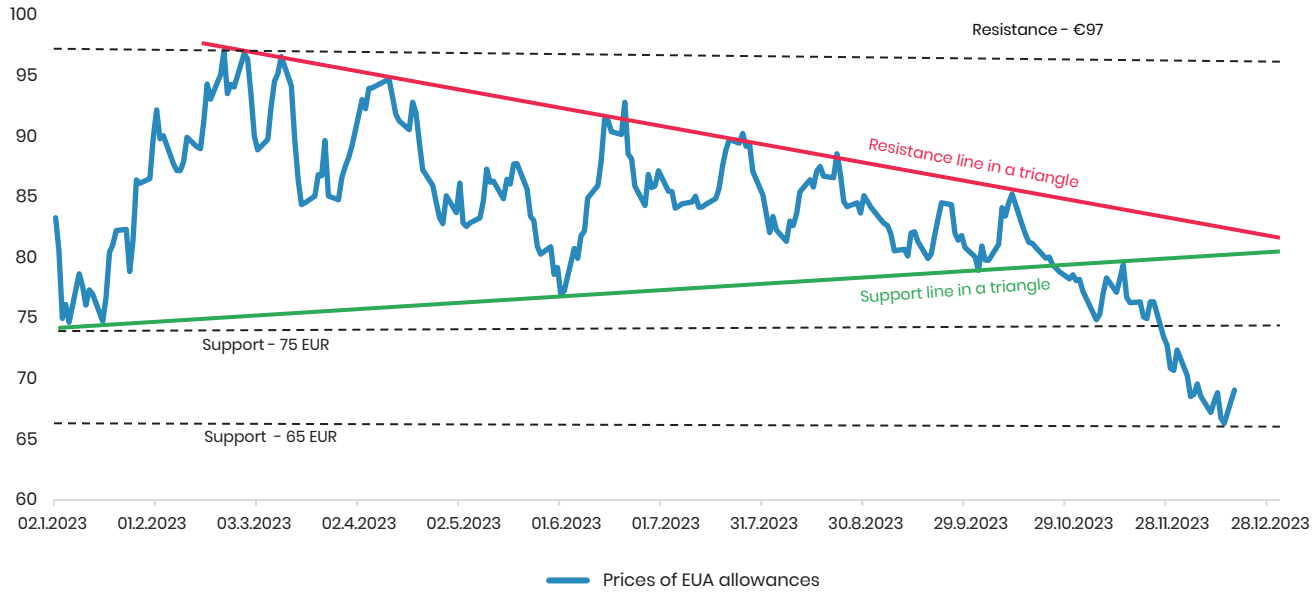
In June, the market rebounded strongly as the equity markets rose. As a result, EUA's quickly moved up above €90. However, buyers could only afford this much as prices failed to exceed €90 in the following months. The systematic sell-off of allowances continued, and the market was dominated by the supply side. By October, investors managed to defend the €80 level several times. However, in November, the declines deepened, first to the key support zone of €75, and at the end of November, EUA prices hit a new minimum at 2023, falling to the around of €70.

In mid-December, the minimum price was further reduced to €65. This is the same level as September/October 2022, when the global stock market declined, and February/March 2022[3], which marked the beginning of Russia's aggression against Ukraine. What caused such a significant drop in the EUA price? From a demand perspective, the reduction of energy consumption in the EU ETS appears to have been significant. Recent estimates indicate a considerable decrease in energy production within the EU ETS during the first nine months of 2023. This was due to increased use of renewable energy sources and lower gas prices, which led to a shift from coal to gas, resulting in lower emissions despite relatively higher coal prices. The decline in hedging volumes in the power industry, as decarbonisation accelerated in the sector, and the economic slowdown in the EU may have contributed to the decrease in EUA prices.

[2] The phenomenon is that a sudden rise in the price of allowances at a given point in time, unexpected to all, is caused by investors excessively closing short positions (short) in the futures market to avoid very large losses. "Short squeeze" is the result of a large preponderance of short positions in the market (i.e. contracts to sell allowances) relative to long positions (i.e. to buy allowances) and the belief of most investors that the value of allowances will fall in the near future.

[3] at the weekly closing prices.

CHART 1. DAILY CLOSING PRICES OF EUA SPOT MARKET TRANSACTIONS IN 2023 (UNTIL DECEMBER 18TH) WITH A DELINEATED TRIANGLE FORMATION AND MARKED RESISTANCE AND SUPPORT LINES [IN €].



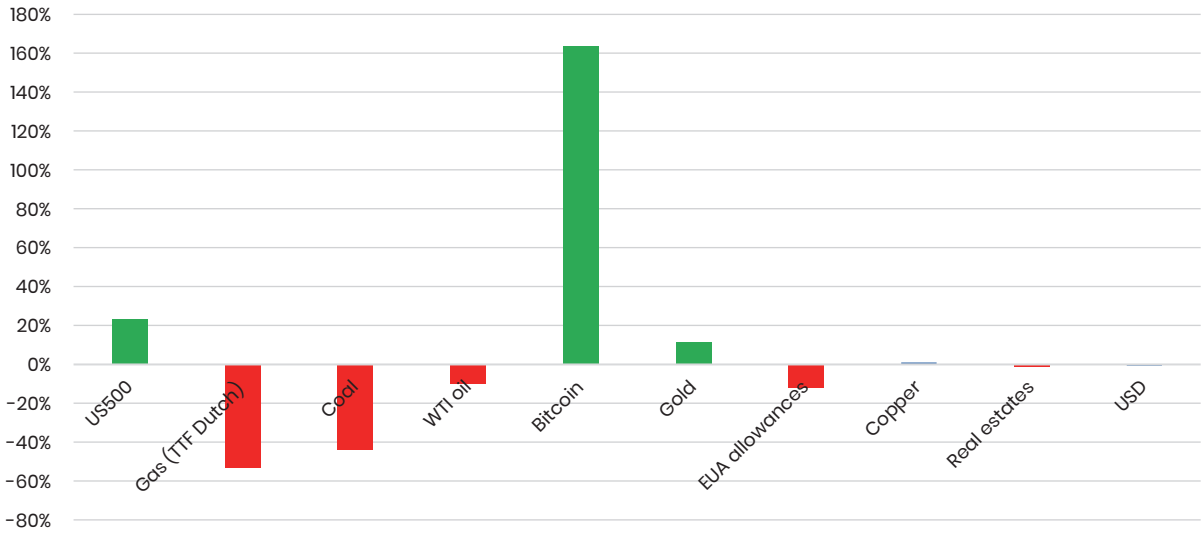
Sources KOBiZE own elaboration based on ICE i EEX data (accessed: 19 December 2023)

Additionally, EUA prices were affected by the supply side. It is likely that investors have already factored in a significant increase in the volumes of allowances to be auctioned to finance the REPowerEU plan. Based on data from the European Commission, the auction volumes may increase by up to 270 million EUA's from 2023 to 2026. This increase could offset the decrease in allowance supply from 2024 due to the implementation of the Fit for 55 package. The package envisages tightening the emissions cap and a stricter MSR reserve parameters in the EU ETS.

> According to data provided by the EC, auction volumes could be increased by up to around 270 million EUA's between 2023 and 2026. This could offset the decrease in the supply of allowances from 2024 related to the implementation of the Fit for 55 package, which envisages a tightening of the emission cap in the EU ETS and a stricter MSR reserve parameters.

How the valuations of emission allowances looked against other assets in 2023 is shown in Table 1. The declines in EUA prices in 2023 (-12%) followed the prices of most energy commodities, i.e. gas, coal and oil (-53%, -44% and -10% respectively). The large reductions in coal and gas are not surprising due to the increasing use of RES in the EU and the industrial energy crisis. This significantly affected the prices of EUA's, which, due to the decline in EU ETS emissions, also lost value. Copper and gold were the exceptions in the mix, with their quotations on global markets rising by around 1% and 12% respectively. Copper may be of particular interest to investors, as it is often taken as an indicator of the current trend in global markets (copper is used in the production of many commodities). Copper's slightly positive performance may suggest that the global economic situation in 2023 is still challenging. US equity markets, positively correlated so far with EUA prices, this time posted solid gains in 2023 (+23%), a recovery from last year's slump, factoring in future interest rate cuts by the US central bank (FED). The downward

CHART 2. PERCENTAGE CHANGE IN PRICES OF DIFFERENT ASSET CLASSES BETWEEN 30 DECEMBER 2022 AND 18 DECEMBER 2023.



*The above % price changes represent: S&P500 (US index, futures), gas (TTF Dutch futures), coal (API2 Rotherdam futures), EUA (ICE futures), WTI oil (futures), copper (futures), gold (futures), ETF reflecting global real estate prices (Xtrackers International Real Estate ETF), Bitcoin in USD, US Dollar Index in futures market.

Source: KOBiZE own elaboration based on investing.com and ICE Futures Europe (accessed 19 December 2023).

trend from the previous year continued with the real estate market, whose valuations were lower in 2023, but only by around 1%. Cryptocurrencies, on the other hand, surprised with a price increase of more than 163%.

Possible price-driving factors affecting EUA prices in 2024

SUPPLY FACTORS

Structural changes in the EU ETS

Reducing the emission cap in EU ETS

The main change imposed by the fit for 55 package on the EU ETS reform is the increase of the emissions reduction target from the current 43% to 62% by 2030 compared to 2005. This will accelerate the pace of reduction of allowances within the cap starting from 2024. As a result, the annual emission reduction factor (LRF) will be increased from the current 2.2% to 4.3% between 2024-2027 and 4.4% between 2028-2030. Two additional absolute reductions will be included in the LRF coefficient as part of the so-called "rebasing". The original proposal by the European Commission suggested a one-time rebasing of 117 million allowances in a single year. Ultimately, it was decided that this would be spread over two years, namely 2024 and 2026, during which 90 million and 27 million EUA allowances will be respectively subject to reduction. The LRF and rebasing have been calculated to reflect the linear reduction of emissions from 2021 and to take into account the 2030 reduction target.

MSR adjustment

The most significant change in the functioning of the MSR reserve is the maintenance of the doubled (24%) intake rate of allowances from auctions to the MSR reserve until 2030 (under the 'old' rules, it was supposed to decrease from 24% to 12% from 2024). The purpose of this provi-

sion is to quickly reduce the EUA market surplus, i.e. the Total Number of Allowances in Circulation (TNAC). According to the EC publication from May 2023, the EUA surplus in 2022 was approximately 1.135 billion and decreased by about 314 million compared to 2021, significantly approaching the upper MSR threshold set at 833 million allowances (beyond which there would be no intervention). However, EC has decided to mitigate the effect of the increased intake rate by introducing an additional MSR threshold with a different intake rate. The additional threshold should work on the principle that if the surplus of allowances is between 1096 million and 833 million, the difference between TNAC and 833 mln will be transferred to the reserve. This means that fewer allowances should be transferred to the MSR than the basic intake rate, which is 24% of the MSR surplus[4]. Introducing an additional MSR threshold should mitigate the price effect, as fewer allowances will be directed to the MSR reserve than would result from maintaining the double intake rate alone.

For the first time in its publication on TNAC, the EC also specified the number of allowances that have been invalidated from the reserve since 1 January 2023 (so-called "invalidation mechanism"). According to the EC publication, out of over 3 billion allowances accumulated in the reserve so far, approximately 2.5 billion have been invalidated. This figure was determined based on the number of allowances sold at auction last year (approximately 490 million allowances). It should be noted that invalidated EUA's are unlikely to return to the market. Additionally, the EUA's would be off the market whether they were invalidated or not. The information about the invalidated EUA's did not seem to affect their prices, as it has been known for several years. However, invalidated EUA's may affect the EUA prices in later years, specifically after 2030. From 2024, the low has been changing to maintain a fix number of 400 million EUA allowances in MSR. Leaving such a small number of allowances in the reserve may pose a risk of unsuccessful market interventions in later years. This is because it would only allow double the volumes to be transferred from the reserve if the surplus threshold was below 400 million allowances (maintaining the 24% intake rate changes the size of transfers from the reserve from 100 to 200 million). It should also be remembered that allowances from the reserve also feed into the Article 29a EU ETS Directive mechanism.

> Each year, EUA allowances will be invalidated in the MSR reserve to achieve a fixed number of 400 million EUAs which will always be there. Leaving such a small number of permits in reserve may pose a risk of unsuccessful market interventions in later years.

Increasing the responsiveness of the mechanism of Article 29a of the EU ETS Directive

Article 29a of the EU ETS Directive is, by design, intended to safeguard the market against excessive allowance price spikes. However, it has failed in its current formula, as it did not respond

[4] The introduction of an additional threshold of 1096 million is mainly intended to prevent the so-called 'threshold effect', i.e. a situation in which the level of surplus could balance just above the upper threshold of the MSR (833 million). As a result, a situation could arise where the surplus of allowances in one year would be just above the threshold (and there would be a transfer of a large number of allowances to the MSR) and in the following year just below the threshold (and there would be no transfer). This could be a shock to the market in terms of auction volumes and spikes in allowance prices. The effect of the introduction of an additional MSR threshold should be an increasingly lower transfer of EUAs to the reserve as the surplus approaches the upper threshold of 833 million. In practice, going below 1096 million in the surplus will result in an intake rate well below 24% from that point onwards. For example, if the TNAC is 1 000 million the following year, only 167 million allowances (the difference between the TNAC and the upper threshold of 833 million) will be placed in the reserve, which will mean that the intake rate for that year will not be 24%, but 16.7% (167mln/1 000 million).

to exponential increases in allowance prices in 2020, which increased several times that year. It was therefore decided to reduce the average price multiplier from the current "3.0" to "2.4", which is assumed to lead to a much faster response to unexpected EUA price spikes than was the case previously. When this condition is met[5], the mechanism is to "automatically" release 75 million EUA allowances from the MSR reserve. Market intervention will therefore not depend on political decisions, as has been the case so far[6].

Other elements

- Free allowances in sectors subject to the CBAM are to be gradually phased out between 2026 and 2034, with a 48.5% reduction by 2030.
- The aviation sector is to be subject to full auctioning of allowances from 2026.

Increasing the supply of allowances to finance the REPowerEU plan

The REPowerEU plan for the EU ETS was adopted in February 2023 and aims to generate €20 billion in EU ETS revenue by 31 August 2026[7]. The amendments introduce a new Article 10e to the EU ETS Directive, which deals with the auctioning of allowances up to a revenue of €20 billion for the RRF (Recovery and Resilience Facility) under RePowerEU until a maximum of 31 August 2026 (the auctions will be conducted in accordance with the rules listed in Article 10(4) of the EU ETS Directive).

Auction revenue for REPowerEU is expected to come from the sale of:

- allowances from the Innovation Fund (FI), by way of derogation from Article 10a(8) of the EU ETS Directive, until the amount of revenue generated reaches €12 billion by 31 August 2026 (new Article 10e(2) of the EU ETS Directive)[8].
- allowances that would otherwise be auctioned by Member States under Article 10(2)(a) of the EU ETS Directive from 1 January 2027 to 31 December 2030 until the amount of revenue raised reaches €8 billion by 31 August 2026 (so-called frontloading).

The amendment to the EU ETS Directive regarding RePowerEU entered into force on 1 March 2023. To ensure the smooth auctioning of the additional allowances, the EC published a draft amendment to the Auction Regulation in October.

From 3 July to December 2023, the RePowerEU monetised for the Reconstruction and Resilience Facility (RRF):

- 19.126 million allowances from the Innovation Fund (FI). No additional allowances will be sold in 2023 over and above the number scheduled to be sold under the FI for 2023.
- 16.199 million additional frontloaded allowances that would otherwise be auctioned by Member States between 2027 and 2030.

Further allowances dedicated to the RRF will be sold between 2024 and 2026, until a total revenue target of €20 billion is reached for 2023-2026. According to the new auction regulation, the frontloading of 2027-2030 volumes will allocate a total of approximately 267 million EUA allowances between 2023 and 2026 (EC assumptions). The likely

[5] The price algorithm is triggered, if over a period of 6 months, the allowance price increases 2.4 times above the average price of the previous 2 years.
[6] Depends on the Climate Change Committee.
[7] Additional allowances for the RRF will be auctioned by the EEX exchange on a common auction platform. The European Investment Bank (EIB) will act as auctioneer for the sale of RRF allowances.
[8] 27 million allowances from the MSR reserve in a number that would otherwise be cancelled will be used to contribute to the IF referred to in the first subparagraph of Article 10a(8) of the EU ETS Directive.

TABLE 1. OVERVIEW OF KEY ELEMENTS WITHIN THE EU ETS REFORM (AS PART OF THE FIT FOR 55 PACKAGE) THAT WILL COME INTO FORCE IN 2024.

Selected elements		"Fit for 55" package
EU ETS emission target	Reduction target	62%
	LRF	4,3% in 2024-2027 & 4,4% in 2028-2030
	Rebasing	2024 (90 mln) & 2026 (27 mln)
MSR reserve	Intake rate (IR)	24% x TNAC to 2030
	Main MSR tresholds	833 mln - 400 mln
	Additional treshold	1096-833 mln (IR = TNAC-833 mln)
	Invalidation mechanism	Up to 400 mln in MSR
Free allowances	Benchmarks	min 0,3%
	CBAM sectors (phasing out)	-2,5% (2026- 2027), -5% (2028), -12,5% (2029), - 26% (2030), -12,5% (2031-2033), -14% (2034)
Safeguard mechanisms	Art. 29a EU ETS directive	Reduction of multiplier from "3" to "2,4"; trigger the mechanizm = 75 mln from MSR (automatic)
	Participation of financial institutions	Unchanged
Aviation	Full Auctioning	from 2026

Source: Own elaboration of KOBiZE

timetable for the sale of these allowances is set out below.

- 2023 - 35 million allowances
- 2024 - 87 million allowances
- 2025 - 87 million allowances
- 2026 - 58 million allowances.

Given that the equivalent of €20 billion must be obtained, the above figures may yet change. At prices of around €80, around 250 million allowances may additionally come onto the market in the coming years. The key question in terms of the impact on EUA prices in 2024 is whether investors have already started to discount this additional supply at current prices or will do so gradually once the volume in question has been added to the auction volumes in a particular year. Another question is how investors will approach the subsequent consequences of the current increase in the supply of allowances under the RRF, which will result in a reduced supply of allowances between 2027 and 2030 (as there will be a shift in allowances). To what extent will this factor be relevant for the current allowance prices and for their formation in 2024. Perhaps it will be a key factor that will not allow prices to fall below a certain level.

DEMAND FACTORS

Risk of a continuation of the economic slowdown in Europe

After strong economic growth in 2021-2022, there has been a weakening in the growth rate of the EU economy. Real GDP declined slightly in the fourth quarter of 2022 and increased slightly in the first three quarters of 2023. Higher living costs proved to be a heavier burden on the economy than expected. On the external factors side, global trade did not provide significant support for GDP growth. The restrictive monetary policy used by the ECB to combat high inflation had its effects on the economy.

The EC forecast for the autumn is for GDP growth in 2023 to 0.6% in the EU[9]. This is 0.2% points lower than forecast in the summer and a larger reduction (0.4% points) compared to the EC's spring forecast. EU GDP growth is forecast to rise to 1.3% in 2024, with an acceleration to 1.7% in 2025. Mild GDP growth in the future is expected due to a rebound in consumption and real wages, as well as investment and external demand. The magnitude of GDP in future years is extremely important from EUA's point of view.

Emission volumes in the EU ETS and so-called hedging

According to EC data, emissions from stationary installations in EU ETS amounted to 1 313 million t/CO_2eq in 2022[10]. This was 1.8% lower than in 2021. Emission reductions from stationary installations were supported by reductions in the industrial sector of 6.5%, mainly through production shutdowns due to the energy crisis. Significant decreases were observed in the production of cement clinker, crude iron and steel, bulk chemicals, lime and dolomite/magnesite calcination and ammonia. In contrast, increases in emissions were recorded in the oil refining sector. On the other side were emissions in the energy sector (electricity and heat generation, including some industrial heat), which increased by about 2.4% (due to increased fossil fuel consumption caused by the crisis in Europe).

According to Carbon Pulse[11], fossil fuel energy production in the EU ETS fell by 21% in the first nine months of 2023 (January to September 2023) compared to the same period in 2022. Production from coal and lignite combustion recorded the largest decreases of 29% and 28% respectively (down to 492 TWh), while energy production from gas decreased by 18% (down to 433 TWh). Such a large decrease was compensated by an increase in energy production from RES sources: from the sun by 18%, from hydropower by 11% and from wind by 6%. This made it possible to achieve a total increase

[9] Autumn 2023 Economic Forecast: A modest recovery ahead after a challenging year, (https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/autumn-2023-economic-forecast-modest-recovery-ahead-after-challenging-year_en, access: 22.12.2023)

[10] Report from the Commission to the TO European Parliament and the Council on the functioning of the European carbon market in 2022 pursuant to Articles 10(5) and 21(2) of Directive 2003/87/EC (https://climate.ec.europa.eu/system/files/2023-10/COM_2023_654_1_EN_ACT_part1_CMR%2BSWD.pdf, access: 22.12.2023).

[11] EU fossil power generation slumps 21% over first nine months of 2023, Carbon Pulse, October 2, 2023 (https://carbon-pulse.com/226320/, access: 02.10.2023).

FIGURE 1. PROJECTED CHANGE IN KEY ECONOMIC INDICATORS FOR THE EU AND EUROZONE BETWEEN 2023 AND 2025, INCLUDING CHANGES IN GDP LEVELS.

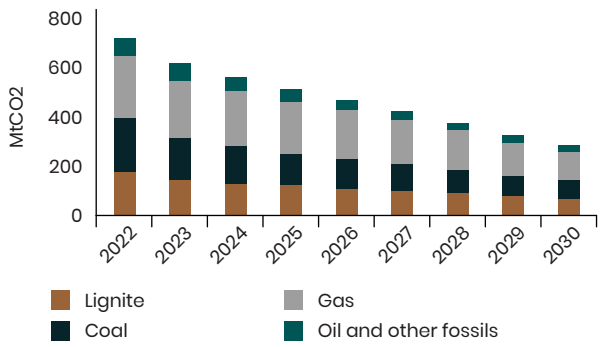
GDP	Inflation	Deficit	Unemployment
EU: 2023: **0.6%** 2024: **1.3%** 2025: **1.7%**	*EU:* 2023: **6.5%** 2024: **3.5%** 2025: **2.4%**	*EU:* 2023: -3.2% 2024: **-2.8%** 2025: **-2.7%**	*EU:* 2023: **6.0%** 2024: **6.0%** 2025: **5.9%**
Euro area: 2023: **0.6%** 2024: **1.2%** 2025: **1.6%**	*Euro area:* 2023: **5.6%** 2024: 3.2% 2025: **2.2%**	*Euro area:* 2023: -3.2% 2024: **-2.8%** 2025: **-2.7%**	*Euro area:* 2023: **6.5%** 2024: **6.5%** 2025: **6.3%**

Source: European Commission

of 8% in total energy production from RES (down to 761 TWh). Overall, energy production in the first three quarters of 2023 decreased by around 5%. The reasons for this included a reduction in energy demand and an increase in the use of low-carbon energy. In particular, the reduction in industrial energy consumption was significant in 2023 than in 2022. The economic downturn, inflationary pressures and the war in Ukraine forced many plants to close or reduce production activities due to high production costs.

The decrease in energy consumption has translated into a decrease in emissions in 2023 in the EU ETS. Estimates indicate that emissions in the energy and industrial sectors (most of which are in the chemical and steel sectors) in the EU ETS may have fallen in 2023 by around 25% and 7% respectively compared to 2022 (Veyt and Refinitiv estimates). The downward trend in emissions volumes could continue in future years. This is shown in the projections of Vertis, which expects emissions in the EU ETS to fall by an average of around 11% y/y by 2030 (Chart 3). If these estimates are confirmed, we should expect lower demand for allowances in the following years and a decrease in hedging volumes.

CHART 3. PROJECTED EMISSIONS IN THE EU ETS ACCORDING TO VERTIS -11% YEAR-ON-YEAR.



Source: Vertis

The decrease in energy consumption has translated into a decrease in emissions in 2023 in the EU ETS. Estimates indicate that emissions in the energy and industrial sectors in the EU ETS could fall by around 25% and 7% respectively in 2023 compared to 2022.

Hedging as a risk management tool is used by energy producers to reduce risk in long-term contracts for commodities such as coal, gas, but also CO_2 allowances in the EU ETS. Currently, hedging is used for a period of about 3-4 years, i.e. a proportion of allowances is bought out of the market a few years ahead of the base year. With the steadily increasing share of RES in the power sector and the decline in the use of fossil fuels (mainly carbon-intensive coal), the demand for EUA allowances from the power sector (hedging) is likely to decrease in the coming years. Data from August 2023 shows that hedging volumes in the power generation sector fell by around 100 million y/y. (Veyt data). On the other hand, hedging in the industrial and aviation sectors may increase due to the gradual phase-out of free allowances in the EU ETS. A big unknown is the demand that will be generated by financial institutions, but the growing number of them (especially ETFs and ETCs) and the influence they currently have on EUA prices (correlation of short positions with decreases in prices[12]) allows us to assume that their market share will steadily increase.

[12] According to Commitment of Traders (COT) data from 8 December 2023, there was a record increase in investment funds' positioning on allowance price falls (short positions) - net positions on futures contracts increased to around 42 million allowances.

A technical look at the CO_2 market – possible scenarios[13]

Since the end of 2021, EUA allowance prices have been consolidating between €65 and €100. However, by the end of 2022, this range had narrowed to around €75, which was permanently broken by the end of 2023, leading to a return to the lower support line at €65.

Therefore, it can be concluded that EUA allowances have been in a short-term downtrend since mid-August 2023. This change in market sentiment was confirmed by several technical factors.

- In mid-August 2023, the faster moving average (red) intersected with the slower one (green), forming a "death cross" on the chart.
- There were increasingly lower lows and highs.
- The red moving average began to act as a resistance line for the EUA prices.
- In mid-October 2023, there was a breakout from the triangle formation (yellow in Chart 4).
- In late November 2023, there was a breakout of the first important support at €75.
- The RSI indicator shows that the price has entered the oversold zone, which is supported by a very negative reaction of the MACD indicator.

As a result of these market trend, EUA prices have fallen to €65, where the local support line is located. A significant drop in EUA's occurred when the €75 level was strongly broken earlier, as clearly visible in Chart 4 (two very large red candles indicating a decrease in supply). We are now seeing a rebound, but it may not be sufficient to reverse the current downward trend. It is important to note that this trend is supported by the February-March price collapse (in closing prices) in 2022 due to the Russian aggression against

[13] This is purely the author's subjective view and should not be taken as a recommendation to invest in emission allowance assets.

CHART 4. CANDLESTICK CHART WITH PRICE QUOTATIONS FOR DECEMBER EUA FUTURES CONTRACTS ON A WEEKLY BASIS.

Source: Own elaboration of KOBiZE via investing.com (accessed 19 December 2023).

Ukraine and the September-October 2022 bottom, which ended the bull market in equities from a technical analysis perspective. Therefore, it is possible that many people at this level are willing to buy allowances. The question is whether market participants have already factored weak fundamental factors into prices.

Defending the support level at €65 does not yet indicate a reversal of the current downtrend. To achieve this, several additional conditions must be met:

- Breakout from the bottom of both moving averages of the permit prices (first the red one, then the green one).
- Formation of a so-called "golden cross" on the chart, which is the intersection of the slower (green) moving average with its faster counterpart (red) from below.
- Return of prices above the support line of €75.
- Breaking the descending trend line (red color in Chart 4).

Fulfilling all above technical factors could be a signal for a potential reversal of the downward trend and a possible price increase towards the upper resistance level of €100. An example of such a reversal is shown in Chart 5. However, if the support level at €65 is permanently broken, it may lead to a further decline in prices to around €57 and then to approximately €50. The price of €47 is determined by the Fibonacci retracement levels of 50% and 61.8% of the last strong upward movement that began in March 2020. Currently, the more likely scenario appears to be the formation of a bear market bottom in the rights and a change in trend to an upward one. The market is already oversold, and the price of €65 may be attractive to operators of installations operating in the EU ETS. It is possible that if the trend changes to an upward trend, most market participants will start to focus on future fundamental factors, such as an increase in emissions caused by an economic recovery or a decrease in the supply of allowances in the EU ETS in 2026, when the financing of the REPowerUE plan ends, full auctioning in aviation or the period of phasing out free allowances in CBAM sectors begins. The only question is when market participants will start pricing in these elements.

Currently, the scenario of forming a bear market bottom in EUA's and a change in trend to bullish seems more likely. The market is already oversold, and a price of €65 may be attractive to EU ETS operators.

Summary

In 2023, spot EUA prices oscillated in a broad consolidation range of €65 - €97. Already in mid-February 2023, a downward trend started, which has continued until today. The systematic sell-off of EUA's may have been the result of several fundamental factors such as a reduction in energy consumption through greater use of RES for power generation and relatively lower gas prices than coal motivating producers to choose less carbon-intensive gas as a fuel for power generation. The economic slowdown and accelerated decarbonisation, which affected the hedging levels of energy producers, were also important factors driving down the value of EUA's in 2023. Investors may also have taken into account the supply side by pricing in future increases in the EUA supply at auction. Overall, the decline in the value of 2023 EUA's was in line with the general downward trend prevailing in energy commodities, in contrast to the positive performance of equity markets or the significant increase in cryptocurrency prices.

CHART 5. EXAMPLE SCENARIO FOR A REVERSAL OF THE DOWNWARD TREND IN EMISSION ALLOWANCES IN 2024 (DAILY PRICES).

Source: KOBiZE own compilation via investing.com (accessed 21 December 2023).

In the context of EUA prices in 2024, the key question will be whether market participants have already priced in all current and future negative fundamental factors. This is primarily about emissions, the pace of which is decisive for the EUA demand. A continuation of the downward trend in emissions in 2024 implies a further weakening of the demand for allowances. While a further decline in hedging by energy producers can be expected, there is no such certainty when it comes to the buying needs of industrial operators and financial institutions. The former may buy allowances from the market in advance due to the tightening of reduction targets in the EU ETS and the phasing out of free allowances in the CBAM sectors. Financial institutions, on the other hand, may start speculatively buying allowances out of the market, e.g. under the end of REPowerEU allowance sales in 2026. The key question remains whether the continuation of weak fundamental factors in 2024 (e.g. continued decline in emissions, realisation of REPowerEU allowance sales) will outweigh (or not dwarf) the decline in allowance supply in 2024, due to the implementation of the Fit for 55 package (e.g. tightening of the cap and stricter MSR for 2030). If it prevails, the negative market sentiment should also persist in 2024. Conversely, a shift to an upward trend could occur due to the scarcity of allowances on the market.

Technical analysis suggests that the most likely scenario for allowance prices in 2024 is an upward scenario. The realisation of this scenario technically allows prices to rise towards the upper limit of the 2-year consolidation range at around €100. However, several technical conditions need to be met simultaneously to break the downward trend, such as prices returning above €75 breaking the downward line of the triangle formation or the intersection of the moving averages from below. Additional arguments in favour of an upward scenario include a strong market sell-off, prices reaching levels at the start of Russia's aggression against Ukraine and possibly the start of price taking into account the situation in the EU ETS af-

ter 2025, when the sale of REPowerEU allowances ends, full auctioning in aviation comes into effect or a gradual phase-out of free allowances in the CBAM sectors begins. On the other hand, a downward scenario will be supported by a sustained break of the very important support at €65. This could lead to a further sell-off of allowances and price falls to further supports at €57 and €47. This would mean that the market has still not priced in all negative fundamental factors.

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EU ETS strategies and challenges in the face of the Fit for 55 Package: An analysis of the functioning of the MSR and its impact on EUA prices and volumes

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EU ETS strategies and challenges in the face of the Fit for 55 Package: An analysis of the functioning of the MSR and its impact on EUA prices and volumes

Key words: fit for 55 package, MSR reserve, EUA allowances deficit, EU ETS, EUA prices, auction pool (share)


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Abstract

The aim of this article is to review the functioning of the Market Stability Reserve (MSR) since its launch in 2019 and to provide a projection of its future operation in the context of changing market conditions after the implementation of the Fit for 55 package. The article identifies key factors, uncertainties and risks related to the future functioning of the MSR. In addition, the authors assess the impact of EU ETS revision on EUA prices and the number of allowances available at auctions and available under the Modernisation Fund (FM) for Poland in the 2030 perspective. The article also presents projected EUA deficits for Poland in the Fit for 55 implementation scenario, together with changes introduced in the functioning of the MSR in 2021-2030.

The first part of the article presents the most important changes in the EU ETS as the effect of introduction the Fit for 55 package, i.e. concerning, inter alia, an increase in the reduction target and emission cap in the EU ETS, an extension of the scope of the EU ETS to the maritime sector and the adjustment the MSR parameters. These changes will affect the number of allowances auctioned by Member States and available to EU ETS installations and, consequently, the EUA prices in the current trading period (up to 2030).

The second and third part of the article is based on simulations of the Centre for Climate and Energy Analysis (CAKE) showing the future effects of the operation of the MSR (EUA surplus in the EU ETS), annual EUA transfers to the MSR or EUA volumes to be withdrawn from the market in the period up to 2030, auction pool and the allowances under the Modernisation Fund available to Poland in the 2030 perspective. All these simulations were carried out on the basis of a set of models: the CarbonPIE simulation model[1] reflecting the functioning of the MSR and key changes in the EU ETS caused by the Fit for 55 package, and the general equilibrium (CGE) CREAM model[2] enabling analysis of macroeconomic effects, in particular presentation of projections of EUA prices for 2025 and 2030.

[1] Carbon Policy Implementation Evaluation Tool (CarbonPIE) – simulation model for the analysis of changes to the EU ETS developed at CAKE/KOBiZE.

[2] Carbon Regulation Emission Assessment Model (CREAM) - is a global, multi-sector general equilibrium model, i.e. Computable General Equilibrium (CGE) developed at CAKE/KOBiZE.

The estimates presented in the article indicate that 3.6 billion EUA's will be invalidated in the MSR by the end of 2030, a significant number in the context of total emissions in the EU ETS. In contrast, the issue of EUA scarcity will become a key challenge in the second half of the next decade. This is when the EU ETS may lose one of its most important functions to date, i.e. ensuring the supply of allowances in the primary market. The MSR in its current form and with its current limitations to provide the allowances liquidity may contribute to extremely high EUA prices and destabilising the market. The establishment of a European Central Carbon Bank (ECCB), which could manage the EUA liquidity and support the EU ETS stability as a key element of EU climate policy, could be a response to these problems.

Projected EUA prices according to CAKE simulations could range from €169 to €236 in 2030, which is much higher than indicated by projections (around €150) from major market analyst firms such as Refinitiv, ICIS, Bloomberg. The changes in the size of the auction pool, in addition to the operation of the MSR, will be most influenced by the changes in the EU ETS implemented between 2024 and 2030, i.e. increasing the scope of the EU ETS to include the maritime sector, increasing the reduction ambition through a higher LRF and the introduction of rebasing, or increasing the supply of allowances as a result of the need to finance the REPowerEU plan with EU ETS revenues. All of the above will also have a significant impact on EUA prices in the run up to 2030. In the period 2021-2030, Poland will have a total of approximately 1 143 million allowances available in 2021-2030, i.e. a total of approximately 173 million from the Modernisation Fund, approximately 626 million from the auction pool and approximately 345 million free allowances. However, given the volumes of projected emissions, we foresee a significant deficit of allowances, ranging between 273 and 655 million EUA's.

Introduction

To achieve climate neutrality by mid-century, the EU has committed to reducing emissions by at least 55% below 1990 levels by 2030. In July 2021 The European Commission presented a "Fit for 55" package of policy reforms to achieve this goal, including reform of the EU ETS. By June 2023 The European Parliament and Member States in the Council of the EU had approved key legislative acts related to changes to the EU ETS that will take effect from 2024 and beyond. The most important changes from the point of view of the current EU ETS concern the revision of the EU ETS Directive, the MSR reserve and the introduction of a carbon border tax mechanism (CBAM). A key element will be the increase of the reduction target in the EU ETS from the current 43% to 62% by 2030 compared to 2005, which will definitely translate into an acceleration of the rate of reduction of available emission allowances in the system. Among other important changes, it is worth mentioning the inclusion of maritime transport in the EU ETS, the increase in the number of allowances available under the Modernisation Fund, phasing out of free allowances in CBAM-taxed sectors, full auctioning in aviation from 2026, an increase in the supply of allowances by 2026 to fund the REPowerEU plan, and finally changes to several key parameters of the MSR. All the above-mentioned elements may contribute to a change in the market balance, i.e. the EUA's available in the EU ETS, or the operations (EUA's transfers) in the revised MSR, which will affect the size of the pool of allowances available for auction. Furthermore, the extension of the EU ETS to new sectors or the gradual phasing out of free allocation in aviation and CBAM sectors

will determine the demand for allowances, the size of hedging[3], and ultimately the future EUA price formation. A similar effect will be on the pace and scale of decarbonisation of the industrial and energy sectors, which will affect, inter alia, the amount of emissions in the EU ETS.

Changes to the EU ETS introduced as part of the Fit for 55 package

Key legislation

Significant amendments to the EU ETS regulatory framework were adopted in the first half of 2023, as part of the Fit for 55 package and as the European Union's response to the energy crisis (REPowerEU). The following are the most important pieces of EU ETS reform legislation adopted by the end of June 2023:

- Reform of EU ETS directive – adopted May 10, 2023
- Adjusted MSR decisio – adopted April 19, 2023
- Directive (EU) 2023/958 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC as regards aviation's contribution to the Union's economy-wide emission reduction target and the appropriate implementation of a global market-based measure – adopted May 10, 2023
- MRV regulation from maritime transport – adopted May 16, 2023
- Social Climate Fund regulation – adopted May 10, 2023
- CBAM regulation – adopted May 10, 2023

[3] Hedging in the context of the EU ETS refers to a strategy to hedge the risk associated with fluctuations in the EUA prices. Companies participating in the EU ETS may use hedging to limit potential losses arising from changes in the value of allowances. Hedging can include, among other things, the use of financial instruments such as futures contracts or buying allowances on the spot market to hedge the future need to account for emissions.

Tightening of the reduction target and emission cap in the EU ETS

Under the revised EU ETS Directive, the emission reduction cap was tightened to reduce emissions in line with the EU's 2030 climate target - from 43% to 62% by 2030 compared to 2005. Thus, the Linear Reduction Factor – LRF, was also increased. From the current rate of 2.2%, it will increase from 2024 to 4.3% and then from 2028 to 4.4%. Under the current rules, the total number of allowances in the system was reduced annually by 43 million allowances in the period 2021-2023. However, as a result of the change in the LRF factor and the inclusion of emissions from shipping, the rate of annual allowance reduction will increase to 84 million allowances/year in the 2024-2027 period and to 86 million allowances/year in the 2028-2030 period. In addition, a one-off emission reduction (so-called "rebasing") has been introduced as part of the CAP reduction, which has been spread over two years, i.e. 2024 and 2026. In these years, the total number of allowances in the EU ETS (CAP) will be subject to an additional reduction of 90 million and 27 million EUA allowances respectively. The LRF and rebasing have been calculated in such a way as to enable the new 2030 emissions reduction target to be met. The changes to the LRF and rebasing therefore result in a significant acceleration of the rate of allowance reductions in the EU ETS. As shown in Chart 1, in aggregate, at the end of 2030, the total number of allowances in the EU ETS (cap) without the inclusion of shipping would be reduced to around 774 million (with a reduction target of 62%). In contrast, with the inclusion of shipping in the EU ETS, the CAP for 2030 would be 825 million. In comparison, if the Fit for 55 package were not implemented, the cap would be 1 185 million (with a reduction target of 43% and without including shipping).

> In total, at the end of 2030, the total number of allowances in the EU ETS (cap) without including maritime transport would be reduced to around 774 million (with a reduction target of 62%). In contrast, with the inclusion of shipping in the EU ETS, the cap for 2030 would be 825 million.

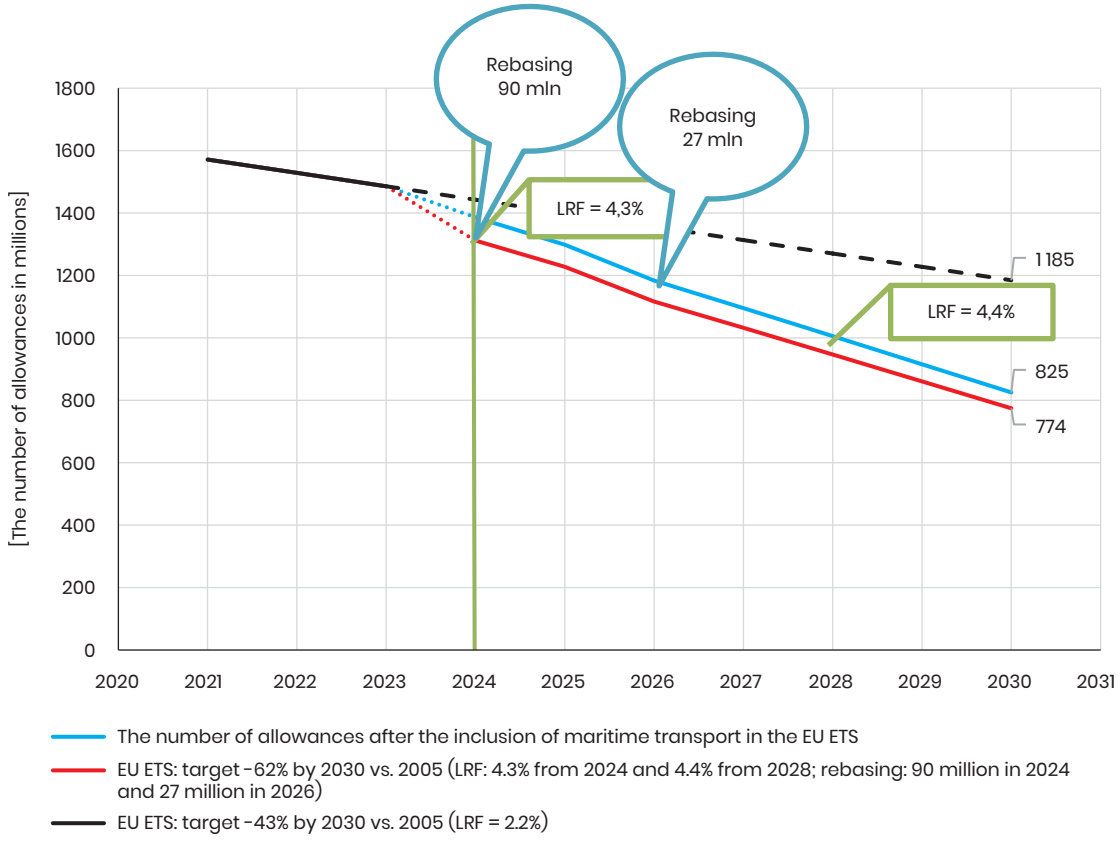
Inclusion of the maritime sector in the EU ETS

From 1 January 2024 the EU ETS will include GHG emissions from maritime transport according to the revised EU ETS Directive. Initially, only CO_2 emissions will be covered, followed by CH_4 (methane) emissions and from 2026 also N_2O (nitrous oxide). Emissions from all large vessels (5,000 gross tons and above) that enter EU ports are included, regardless of the flag they fly, for specific emissions:

- 50% of emissions from voyages starting or ending outside the EU (allowing third countries to decide on appropriate action for the remainder of the emissions),
- 100% of emissions occurring between two EU ports and when ships are in EU ports.

Maritime transport accounts for about 3-4% of total EU CO_2 emissions (over 124 million tonnes of CO_2 in 2021), taking into account all emissions

CHART 1. EU ETS ALLOWANCE REDUCTION (EU-27 + EFTA) RESULTING FROM A CHANGE IN THE LRF ACCORDING TO THE FIT FOR 55 PACKAGE (EXCLUDING AVIATION)



Source: own elaboration KOBiZE

from journeys to and from the EU. EU ETS obligations for the maritime sector will be introduced gradually. During the initial implementation period, ship operators will be required to account for only part of their emissions:

- in 2025: for 40% of their emissions in 2024;
- in 2026: for 70% of their emissions in 2025;
- from 2027: for 100% of their emissions for 2026 and beyond.

Tightening the operation of the Market Stability Reserve (MSR)

Since 2009, the EU ETS has seen the creation of a surplus of Total Number of Allowances in Circulation (so called "TNAC"). The economic crisis of 2007-2008 (decline in production and consequent drop in emissions) and the possibility of using CERs/ERUs in the EU ETS from CDM/JI projects were the main reasons for the past high surplus. The introduction of the so-called backloading in 2014-2016, which removed 900 million allowances from the auctions was not enough to fight against the surplus. EU policymakers therefore decided to introduce the Market Stability Reserve, which became operational in 2019. The mechanism works by regulating the number of allowances to be auctioned depending on the volume of allowances in circulation (TNAC). If this volume is higher than 833 million allowances, the allowances are placed in the MSR, but if the TNAC is lower than 400 million, the allowances are returned to the market and added to the auction pool.

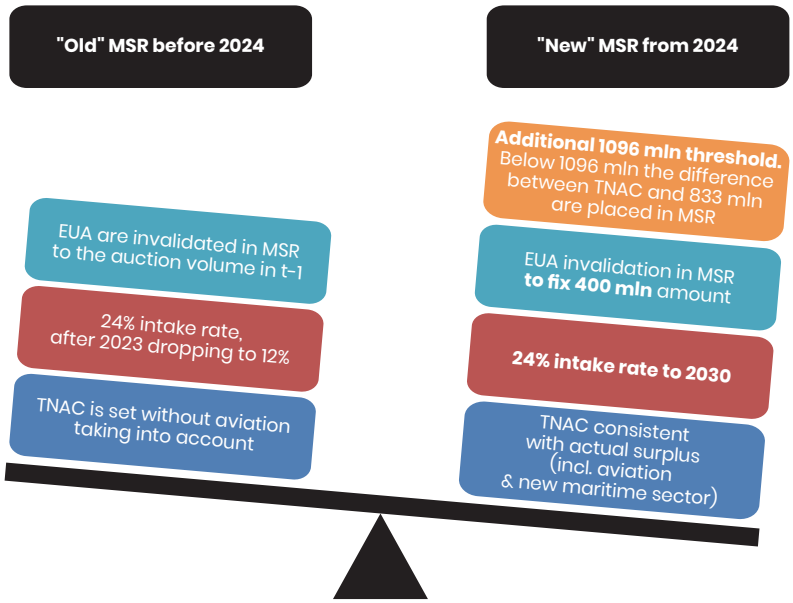
From 2024, the MSR operations have been further tightened as a result of the implementation of the Fit for 55 package. The main changes to the reserve are outlined below and are likely to affect EUA prices quite significantly in the future (this is also illustrated in Figure 1):

- Inclusion of the aviation sector and the maritime sector in the calculation of the surplus (TNAC).
- The main MSR thresholds of 833-400 million remain unchanged, but a future MSR review may change this[4].
- The MSR intake rate remains at a higher level of 24% until the end of 2030 (it was to return to 12% from 2023).
- An additional threshold beyond which intakes from the auction pool to the MSR will change (changes in the so-called intake rate) - if TNAC is in the threshold of 1096-833 million - the difference between TNAC and the threshold of 833 million is placed in the reserve.
- Invalidation mechanism - from 2023 onwards, the reserve will "automatically" be reduced to the size of the lower MSR threshold, i.e. 400 million EUA allowances. All allowances in the reserve above 400 will be invalidated. Under the previous rules, only a proportion of allowances up to the amount of the previous year's auction volume was invalidated in the MSR from 2023.

The MSR revision introduces an additional MSR threshold set at between 1096 and 833 million allowances. The aim of this measure is to avoid the so-called "threshold effect", which could cause the level of surplus allowances to oscillate around the upper MSR threshold of 833 million. In a situation where the surplus is between 1096 million and 833 million, the difference between the current level of surplus and the threshold of 833 million will be placed in the reserve. It is worth noting that this additional threshold will in practice mitigate the impact of the increased intake rate under the Fit for 55 package to 24%. This means that

[4] Thresholds can become dynamic and change in proportion to the linear reduction factor of the LRF.

FIGURE 1. COMPARISON OF THE KEY ELEMENTS OF THE 'NEW' MSR SINCE 2024 AND THE ELEMENTS, THE 'OLD' MSR IN PLACE BEFORE 2024.



Source: own elaboration KOBiZE

less than 24% of surplus allowances will be placed in the reserve if the surplus is below the additional threshold.

Other important elements of the Fit for 55 package for the EU ETS

Other very important elements for the development of demand and supply of allowances in the EU ETS that should have a greater impact on the size of the available auction pool and the EUA price than operations in the MSR are, e.g. the gradual phasing out of free allowances towards auctions in sectors subject to the CBAM mechanism. EU policymakers have started from the premise that the CBAM tax is to be an alternative to this type of allowance allocation. Consequently, free allowances are to be gradually reduced to zero between 2026 and 2034, with this reduction to 48.5% by 2030. In a similar manner, full auctioning is to be introduced in the aviation sector. Only slightly faster than in the CBAM sectors, as full auctioning of allowances in aviation is to be introduced from 2026.

The last major change is to increase the supply of allowances by mid-2026. This is to take place under the REPowerEU plan for the EU ETS, which was adopted in February 2023. The increase in the supply of allowances in the EU ETS is intended to generate €20 billion in revenue from the EU ETS between 2023 and 2026, to feed into the Recovery and Resilience Fund (RRF). In order for the above plan to be realised, it is planned to raise EUR 12 billion from the Innovation Fund and EUR 8 billion from so-called frontloading, i.e. postponed auctions from the period 2027-2030. It is estimated that the additional supply of allowances associated with the need to feed the RRF with EU ETS allowances could reach between 250 and 270 million EUA allowances over the period 2023-2026. At the same time, this means that the supply of

allowances at auction and sales within the Innovation Fund will be reduced accordingly over the period 2027-2030.

Impact of the Fit for 55 package[5]

Impact of the Fit for 55 package on the operation of the MSR

Can the current functioning of the MSR be considered effective?

History shows that the MSR mechanism fulfils one of its main objectives of reducing the surplus of allowances in the market in the EU ETS. The first adjustments of auction volumes due to the MSR mechanism started in 2019. According to our estimates, by 2030 a total of around 1.8 billion emission allowances from auction volume transfers alone could be placed in the reserve. It should be recalled that the EC had already attempted to reduce the surplus by withdrawing from the market under the so-called backloading 900 million allowances in 2014-2016, which ultimately ended up in the MSR. The same fate befell allowances that were not issued for free in the EU ETS until 2020. In total, there were around 3 billion EUA allowances in the reserve in 2023. The functioning of the MSR with the support of other factors (falling emissions, EU ETS reforms, etc.) meant that the level of surplus allowances between 2013 and 2022 fell by around 48%. Despite this significant reduction, it should be noted that the surplus is still above the MSR upper threshold (833 million).

> **The functioning of the MSR supported by other factors (falling emissions, further EU ETS reforms, etc.) has resulted in the level of surplus allowances falling by around 48% between 2013 and 2022. Despite this significant reduction, the surplus is still above the MSR upper threshold (833 million).**

It is necessary to note the price rally in the CO_2 market started in 2018. The MSR mechanism, together with other interventions in the system, such as the previously mentioned backloading, the tightening of the rules on surrounding the emissions with CERs, and then proposed changes to the LRF as part of the EU ETS reform, most likely played an important role in this process. It is worth noting, however, that the increase in the EUA price in 2018, i.e. even a year before transfers to the MSR were triggered, may also have been the result of market participants anticipating future shortfalls in allowances, which influenced their earlier valuations.

Another purpose of the introduction of the MSR reserve was to counteract, so-called "market shocks", and the reserve was intended to ensure market stability in the event of such a shock. The first test of this function to be performed by the MSR was the COVID-19 pandemic in 2020, which contributed to a drastic reduction in emissions in the EU ETS and a decline in energy consumption, industrial production and aviation activity in the EU. This was reflected in a significant drop in demand for allowances (emissions) causing a one-off increase in the surplus of allowanc-

[5] The analysis of the size of the auction pool, the operations that take place in the MSR reserve and the future prices of emission allowances was performed according to the 'Fit for 55' scenario reflecting all changes in the EU ETS Directive according to the 'Fit for 55' package, i.e., among others, the EU ETS reduction target by 2030 was assumed. - 62%, LRF from 4.3% p.a. in 2024-2027 and up to 4.4% in 2028-2030 and rebasing (90 million and 27 million in 2024 and 2026), inclusion of the maritime sector, MSR intake rate - 24% by 2030, an additional threshold of 1096-833 million, leaving 400 million allowances in the MSR reserve as part of the allowance surrender mechanism from 2023, moving away from free allowances in the CBAM and aviation sectors, and increasing supply by 267 million allowances to fund the REPowerUE plan. In addition, an increase in FM of 2.5% from the 2024-2030 pool (in addition to 2% from the 2021-2030 pool) and an increase in the Innovation Fund pool are included. The necessary magnitude of change (reduction) in emissions from the Global Energy and Climate Outlook (GECO) 2020 baseline due to a change in the supply of EU ETS allowances determined for the Fit for 55 scenario was derived from the Carbon-PIE model and was approximately -12% in 2025 and approximately -23.5% in 2030, respectively.

es in 2020 and resulting in larger transfers to MSR in subsequent years (the reserve operates with a 1-2 year lag[6]). These transfers contributed to a significant reduction in the surplus of allowances in 2021-2022. In this way, the MSR mechanism responded to one of the largest market shocks to date caused by the COVID-19 pandemic.

The values of the average allowance price shown in Chart 2 demonstrate that the MSR reserve contributes to reinforcing price pressure after 2020 by neutralising the effects of the market shock (COVID-19) by changing participants' expectations of the future supply of allowances in the EU ETS[7]. It is evident that reductions in auction volumes occur gradually over time, but participants are likely to anticipate this future reduction in allowance supply.

The 2018 revision of the MSR decision introduced an allowance invalidation mechanism, which allows allowances to be permanently removed from the market rather than just temporarily withdrawn. These significant changes make the operation of the MSR reserve even more influential in the implementation of the EU's ambitious climate policy. This mechanism became operational from 2023, leading to the permanent removal from the market of around 2.5 billion of the 3 billion allowances accumulated so far in the MSR. Although invalidated EUA's do not directly affect the current supply of allowances, the market may react with a price increase as a result of invalidations, as they have the effect of reducing the number of allowances that could one day return from the MSR reserve to the auctions.

The 2018 revision of the MSR decision introduced an invalidation mechanism, which allows EUA's to be permanently removed from the market rather than just temporarily withdrawn. These important changes make the operation of the MSR even more influential in the implementation of the EU's ambitious climate policy.

What could be the impact of the Fit for 55 package in terms of the future functioning of the MSR?

The key change in the operation of the MSR is to maintain a very high rate of transfer of allowances to the MSR (intake rate) of 24% until 2030, as opposed to the previous legislation which envisaged this rate falling to 12% from 2024. The intention of this change was to maintain a rapid rate of allowance drawdown from the market in order to accelerate the achievement of the upper threshold by TNAC, and significantly reduce the surplus of allowances[8]. Between 2019 and 2023, transfers from the auction pool resulted in between 300 and 400 million allowances going into the reserve each year. With that said, the number of allowances transferred to the MSR could be reduced in the future by the introduction of an additional threshold in the Fit for 55 package with a moving but lower than 24% intake rate.

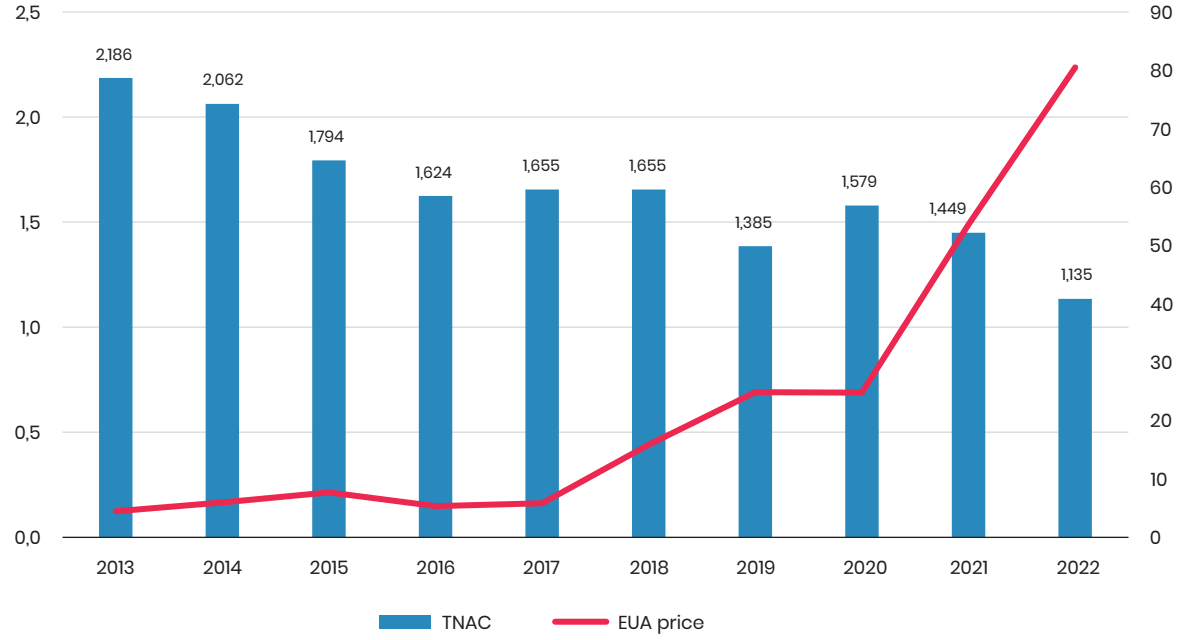
In May 2023. The EC published the surplus of allowances for 2022, which was calculated at 1.135 million allowances, very close to the level of the additional threshold of 1.096 million. CAKE's

[6] The initial response of the MSR to a given market shock is delayed and partial, as the MSR requires several years of adjustment after the shock occurs. The basis for calculating the transfer of allowances to the MSR is the TNAC calculation, published in May of the year following a given market shock, and transfers of allowances to the MSR take place from September to the end of August of the following year.

[7] The magnitude of this effect is likely to depend on the extent to which operators of installations in the EU ETS, financial institutions and other market participants look ahead and consider the impact of MSR on the future supply of allowances in the system.

[8] It should be recalled that once the threshold of 833 million is crossed, the MSR remains in a certain inactivity as it does not perform any market operations.

CHART 2. HISTORICAL SURPLUS OF EMISSION ALLOWANCES AND THE EVOLUTION OF AVERAGE EUA PRICES IN THE EU ETS



Source: own elaboration KOBiZE

estimates indicate that this threshold will already be reached in 2023, with a surplus estimated at 1 billion allowances. Consequently, we are seeing a decrease in the number of allowances transferred to the reserve as a result of a lower intake rate[9], set below 24%. In effect, the upper threshold of the MSR (833 million) will not be reached until 2028, when the surplus falls to 790 million allowances. Due to the lag with which the MSR operates, EUA's transfers will still continue in 2028 and 2029, pausing only in 2030. According to CAKE's calculations, a total of some 2.5 million allowances will be placed in the MSR due only to market intakes. In contrast, the number of invalidated allowances in the reserve itself will be much higher, as the reserve has previously been replenished by backloading allowances (900 million) and a pool of unused allowances from the 3rd EU ETS period (around 700 million). Given that a fixed number of 400 million EUA's must remain in the reserve from 2024 onwards, this means that some 3.6 billion EUAs we should expect to be invalidated. To better illustrate the situation, the number that will be moved from the market and never return is roughly comparable to the 3-year volume of emissions in the EU ETS and more than 2 times the number of CERs that were used in the EU ETS in the 2013-2020 trading period (amounted to approximately 1.5 billion). It should be recalled that one of the main reasons for the MSR was the "fight" against the surplus, among other things, by the excessive number of CERs and ERUs used in the EU ETS. This effect, according to the CAKE results, will be more than double what it was before.

The real impact of EUA invalidations in the MSR will be felt when the total number of allowances (TNAC) falls and maintain below the 400 million threshold for an extended period of time. While increases in EUA prices may be anticipated earlier in

[9] Once the TNAC exceeds the threshold of 1096 million allowances, the number of allowances placed in the MSR reserve is determined by the formula: TNAC - 833 million (upper threshold).

TABLE 1. OPERATIONS IN THE MSR RESERVE ACCORDING TO THE FIT FOR 55 SCENARIO

Category	2022	2023	2024	2025	2026	2027	2028	2029	2030
TNAC in mln EUA	1 135	1 000	894	990	968	840	790	815	845
Annual transfers to MSR in mln EUA	368	322	237	132	92	15	92	5	0
Cumulated annual transfers to MSR in bln EUA	1,465	1,785	2,024	2,156	2,248	2,398	2,490	2,495	2,495
Cumulated invalidated volumes of EUA's in bln EUA	x	2,515	3,140	3,271	3,364	3,514	3,607	3,611	3,611

Source: Own elaboration KOBiZE

the functioning of the EU ETS, CAKE's analysis suggests that the MSR will begin to return allowances to the market around 2035, meaning that after 2040 the EU ETS will face a significant shortage of allowances that will only be offered on the secondary market[10]. With a maximum of 400 million allowances available in the MSR, it is easy to calculate that there will only be enough allowances for two or four years, depending on whether the 24% intake rate continues to apply after 2030[11]. Following the implementation of the Fit for 55 package, the validity of the doubled intake rate (changing from 12% to 24%) has been extended until 2030, so it is likely that as a result of the revision of the MSR, the duration of the doubled intake rate will be extended further. Such a situation could mean that, with a very limited supply of EUA's and very high EUA prices in the future (the analyst firm LSEG - London Stock Exchange Group, predicts prices in the order of €400 in 2040[12]), the MSR reserve, which is supposed to ensure market stability, may not fulfil this function. There will simply not be enough allowances in the reserve, making it impossible to continue supplying them to the market. It should be mentioned that the EU reduction target for 2040 is still on the horizon. It is very likely to be set jointly for the EU ETS and non-ETS sectors at a very high level of about 90-95% net (i.e. including removals). Typically, a higher reduction target is assigned to the EU ETS sectors, due to their lower reduction costs. This means that the EU ETS sectors may face the challenge of achieving very large emission reductions by 2040. In contrast, the remaining emissions in the EU ETS, so-called 'residual emissions', will need to be surrounded by, e.g. allowances from previous periods and/or additional emission reduction credits, known as "removals".

> From projections made by CAKE, the MSR will start returning allowances in a limited amount around 2035, meaning that after 2040 the EU ETS will face a significant shortage of allowances, which will only be offered on the secondary market.

[10] According to CAKE projections, the EUA pool in the EU ETS (the so-called cap counted with the newly included maritime and aviation sectors) will run out after 2040. However, the impact on the market and the price of emission allowances will be observed several years in advance.

[11] If the intake rate is 24%, 200 million EUA allowances will be released from the reserve; if the intake rate is 12%, 100 million could be released to the market.

[12] EU Carbon price to hit €400 mark with 90% climate goal; analysts, (https://www.euractiv.com/section/emissions-trading-scheme/news/eu-carbon-price-to-hit-e400-mark-with-90-climate-goal-analysts/, access: 22.12.2023).

What elements should be looked at in the next MSR review planned for 2026?

It will therefore be extremely important to ensure that there are sufficient number of allowances in the system, either by increasing the number of EUA's available in the MSR or by allowing emission reduction units (so-called "removals") to enter the market in the EU ETS. Modification of the much talked about MSR thresholds will not solve the allowance scarcity problems after 2040. It may even exacerbate the problems, as lowering the upper MSR threshold would mean faster and larger transfers of allowances to the reserve, which would then be invalidated in even greater numbers. There are also proposals in various expert forums[13] to introduce a price corridor into the MSR mechanism, which could stabilise the market if necessary. However, this still does not solve the problem of a shortage of allowances in the future and could further complicate the current mechanism.

Can the European Central Carbon Bank be an alternative to the MSR?

As a consequence of the problems mentioned above, and in order to maintain the EU ETS as the main climate policy mechanism, one option that should be seriously considered is the idea of creating a special bank (European Central Carbon Bank, ECCB), which could potentially play a dual role, i.e. regulate the number of emission allowances in the EU ETS and manage the introduction of removals. The idea of creating an ECCB already emerged several years ago and has recently been pushed mainly in the context of the management of removals units in the EU ETS at various expert forums organised, e.g. by The European Roundtable on Climate Change and Sustainable Transition (ERCST[14]). It is only recently that CAKE experts have proposed to increase the scope of the institution's tasks to matters related to the management of emission allowances in the EU ETS[15, 16]. Similar to the role of central banks in monetary policy, the ECCB could control the supply and demand of EUA's and removals in the EU ETS to provide market liquidity and stabilise prices when necessary. The effect of the ECCB will be to mitigate instances of market speculation and sudden spikes in EUA prices. Decisions under the ECCB could be taken collectively by the Council of Member States, reflecting the principles of central bank governance and thereby increasing transparency in the decision-making process. The ECCB could therefore replace existing mechanisms in the EU ETS, such as the MSR discussed earlier and the ineffective Article 29a of the EU ETS Directive.

> Similar to the role of central banks in monetary policy, the ECCB could control the supply and demand of EUA's and removals in the EU ETS to provide market liquidity and stabilise prices when necessary.

[13] Among others at the closed meeting 'MSR through 2030: impact on market liquidity and considerations for the 2026 reform', organised by the Potsdam Institute for Climate Impact Research (PIK), Independent Chemical & Energy Market Intelligence (ICIS) and the Ecologic Institute on 6 December 2023.

[14] Expert Stakeholder Consultation: European Carbon Bank, ERCST (https://ercst.org/event/expert-stakeholder-consultation-european-carbon-bank/,access: 22.12.2023).

[15] R,. Jeszke, S. Lizak, Why a European Central Carbon Bank would help stabilise EU climate policy, Euractiv.com, 29 august 2023, (https://www.euractiv.com/section/emissions-trading-scheme/opinion/why-a-european-central-carbon-bank-would-help-stabilise-eu-climate-policy/, access: 22.12.2023).

[16] Why we need a European Central Carbon Bank within the EU ETS framework, EnergyPost, 20 November, 2023, (https://energypost.eu/why-we-need-a-european-central-carbon-bank-within-the-eu-ets-framework/, access: 22.12.2023).

EUA price forecast for 2025 and 2030 r.[17]

After the implementation of the Fit for 55 package, the average EUA price in 2025, as predicted by CAKE, could reach around €98. The dominant drivers of the EUA price increase in 2025 are the operations in the MSR (transfers of allowances from the auction pool to the reserve) and the tightening of the reduction target, i.e. the change of the LRF to 4.3% together with a one-off cap reduction of 90 million EUA in 2024 (i.e. rebasing). All measures result in a deficit of allowances and an increase in their price. With that said, the effect of the average price increase is partially mitigated by the additional sale of around 260 million auction allowances between 2023 and 2026, earmarked to feed into the Recovery and Resilience Facility (RRF) within REPowerEU.

At the end of the projected period in 2030, the average allowance price rises to around €188. With that said, the operation of the MSR will no longer have a major impact on the auction pool. The supply of allowances is mainly driven by the adopted reduction target, reflected in the value of the LRF. In 2030, the auction pool is further reduced as a result of the frontloaded and monetised by 2026 a part of Member States' auction and Innovation Fund allowances feeding the RRF.

The sensitivity analysis performed by CAKE, i.e. the low and high scenarios, indicates that the average value of the EUA price will depend significantly on the behaviour of market participants. The low and high scenarios were created to replicate low and high, respectively, so-called hedging, i.e. buying and banking of allowances in accounts to meet future emission needs by participants. In order to replicate the observed behaviour of installations (EU ETS market participants), an exogenous parameter was introduced into the model to scale the intensity of purchasing strategies[18]. The intensity of these strategies can also replicate the buying and banking of allowances by investors who do not need to account for emissions. It should be noted that the EU's ever-tightening climate ambitions, encourage financial institutions to buy and hold allowances for future financial gain.

The price of EU ETS allowances forecast by CAKE shows considerable volatility, depending on the intensity of market participants' purchasing strategies. In 2025, it is projected that the average price could range between €77 and €130, depending on the scenario adopted, taking into account both low and high hedging conditions. By contrast, in 2030, the range of uncertainty is even greater, with the average price oscillating between €169 and €236 for the low and high scenarios, respectively. CAKE estimates indicate that the average price of emission allowances could be in the range of €77 - €130 in 2025 and €169 - €236 in 2030.

> **CAKE estimates indicate that the average price of emission allowances could be in the range of €77 - €130 in 2025 and €169 - €236 in 2030.**

[17] EU ETS allowance price projections were made based on the EU ETS simulation model (CarbonPIE) and the CGE Carbon Regulation Emission Assessment Model (CREAM) for the nodal years 2025 and 2030.

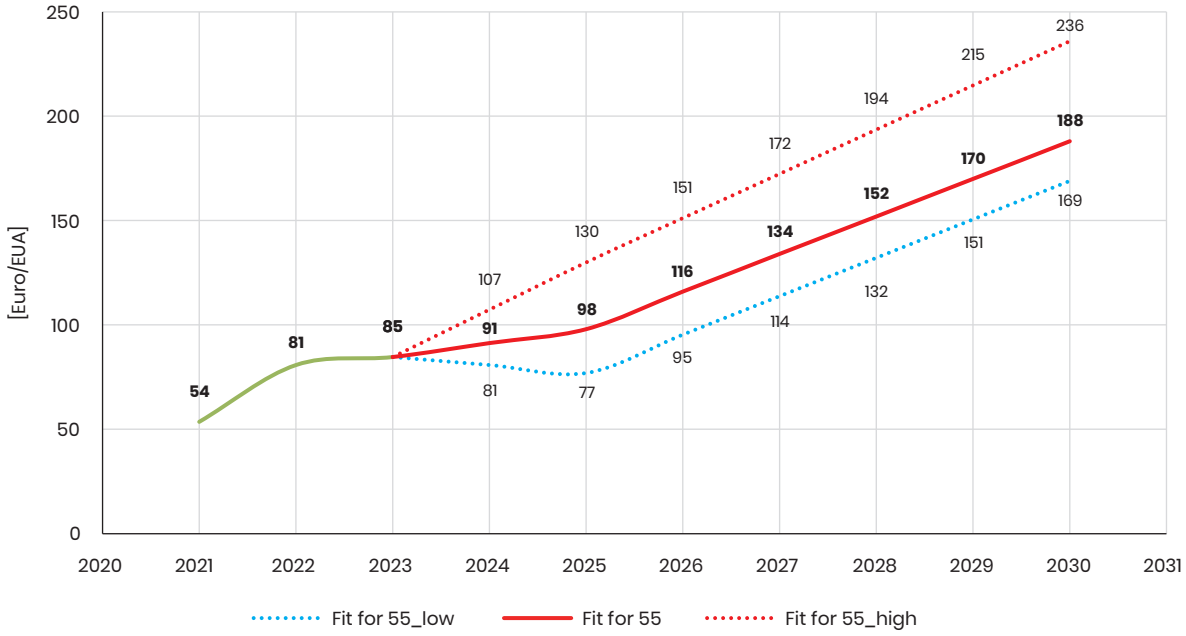
[18] The parameter reflecting the intensity of purchasing strategies is defined as a value determining how many years ahead installations will secure their emission needs (purchase allowances), taking into account the number of allowances already in their accounts (banked from previous years) and the anticipated average annual emissions over the next four years minus the average amount of free allocation in this period.

Fit for 55: 1.69 - average value of the index determined for 2016-2022.

Fit for 55_low: 1.46 - the lowest annual average value of the indicator observed between 2016 and 2022 is assumed.

Fit for 55_high: 2 - the highest annual average value of the indicator observed between 2016 and 2022 was assumed.

CHART 3. HISTORICAL EUA PRICE AVERAGES TO 2023 AND CAKE PRICE FORECAST TO 2030 IN SCENARIO „HIGH", „LOW" AND „MEDIUM".



Source: own elaboration KOBiZE

TABLE 2. EUA PRICE FORECAST TO 2030 PROVIDED BY SEVERAL MARKET INSTITUTIONS

Category	2024	2025	2026	2027	2030
Average EUA price forecast by institution* (in €)	89,2	93,9	109,0	121,9	150,7

*BloombergNEF, Brannvoll ApS, Carlton Carbon, Commerzbank, CRU Group, Energy Aspects, Engie EnergyScan, Kakubi, Macquarie, Morgan Stanley, Pact Capital, LSEG/Refinitiv, Vertis, Veyt, Volue Insight

Source: own elaboration KOBiZE based on projections from Carbon Pulse, dated 16.10.2023.

Comparing the results of CAKE's projection of the average EU ETS allowance price to the projections of other institutions (Table 2), one can see a fairly high convergence in 2025. CAKE's projected price is €91, while the average projected price by other institutions is around €94. This means that, CAKE's estimate remains slightly lower than the forecasts of other market experts.

However, it is worth noting that in the longer term, i.e. in 2030, the situation changes. CAKE's projected price reaches a value of €188, a clear increase compared to 2025. By contrast, the average projected price by other institutions in 2030 is around €151, meaning that CAKE's price projections in the longer term are towards the upper limits of the projections, even taking into account the low scenario for which the average EUA price reaches €169.

EUA allowances available to Poland in EU ETS

Modernisation Fund (MF)

The Modernisation Fund (FM) is a key tool to support less prosperous EU countries in their transformation in line with EU climate targets. Modifications introduced by the Fit for 55 package include an increase in the fund from 2% of the total number of allowances in the EU ETS from 2021-2030 to an additional 2.5% of the total number of allowances from 2024-2030. That is, the value of the fund increases from the original 310 million to 438.60 million EUAs. It should be noted that the allowances provided for the FM are not additional allowances in the EU ETS, but reduce the auction pool of the Member States. Thus, as a result of the FM increase, the number of available allowances does not change, only the way they are redistributed.

The income from the sale of FM allowances is specifically intended to help modernise energy systems and improve energy efficiency. The list of priority areas of the fund includes more actions than those mentioned above, but it should be emphasised that the fund is essentially intended to serve the transformation of the energy sector.

Poland's share in the current 2% pot is 43.41%, while the pot itself covers 10 Member States with a GDP per capita below 60% of the 2013 EU average. By contrast, in the additional 2.5% pool, Poland's share will be lower, at 34.8%. The additional pot covers 13 countries, including Greece, Portugal, Slovenia.

TABLE 3. MEMBER STATES' SHARE OF THE 2% AND 2.5% FM SHARE ACCORDING TO THE "FIT FOR 55" PACKAGE*

MS	MS's share of 2% in 2021-2030		Additional 2.5% in 2024-2030 period		Sum of EUA's in MF
	%	mln	%	mln	mln
BG	5,84%	14,36	4,90%	9,44	23,80
CZ	15,59%	38,33	12,60%	24,28	62,62
EE	2,78%	6,84	2,10%	4,05	10,88
HR	3,14%	7,72	2,30%	4,43	12,15
LV	1,44%	3,54	1,00%	1,93	5,47
LT	2,57%	6,32	1,90%	3,66	9,98
HU	7,12%	17,51	5,80%	11,18	28,68
PL	**43,41%**	**106,74**	**34,20%**	**65,91**	**172,65**
RO	11,98%	29,46	9,70%	18,69	48,15
SK	6,13%	15,07	4,80%	9,25	24,32
SI	0,00%	-	2,00%	3,85	3,85
EL	0,00%	-	10,10%	19,46	19,46
PT	0,00%	-	8,60%	16,57	16,57
EU+EFTA	100%	245,89	100%	192,71	438,60

*Without taking into account the voluntary transfer of some Member States' allowances to the FM from their auction pool.

Source: own elaboration KOBiZE

The new part of the Fund is allocated to Member States whose GDP per capita is below 75% of the EU average for the period 2016-2018.

The MF part of the 2% may still be increased by an additional 0.5% if there is no need to use the part of the auction pool that has been earmarked for a possible increase in the free allocation for the purpose of not applying the cross-sectoral correction factor (CSCF), in accordance with Article 10a(5a) of the EU ETS Directive. The CSCF is designed to reduce the free allocation at sub-installation level to match the maximum pool of free allowances. It is worth noting that 3% of auction allowances have been withdrawn from the market for a possible increase in the free pool. As the need for free allowances at sub-installation level in 2021-2025 did not require the application of the CSCF, there is a chance that the FM will be increased further, but we will only find out about this once the EC has determined the need for free allocation for 2026-2030. It will then be possible to compare the total amount of free allocation at sub-installation level with the total allowance pool allocated for this purpose in 2021-2030.

Member states also have the possibility to voluntarily increase their share of the FM by transferring part of their auction pool to the fund. According to the EU ETS Directive, they can transfer to the FM parts of the auction allowances coming from both the solidarity component of the auction pool distribution key (i.e. 10%) and the 40% part based on historical emissions (i.e. 90%). The Czech Republic, Croatia, Latvia, Romania and Slovakia decided to use this option by declaring a total of approximately 315 million of their auction allowances to be transferred to the MF.

Auction pool and EUA deficit

The numbers of available allowances under the auction pool and FM in 2021-2030 in the scenario of full implementation of the Fit for 55 package for the EU ETS are presented below (Table 4). According to the simulation, Poland will have about 591 million allowances available in the auction pool and about 173 million allowances from the FM, giving a total of about 764 million allowances foreseen for the 2021-2030 period. In addition, the number of auction allowances for Poland has been increased by more than 34 million EUAs sold in 2021 and coming from the unallocated free allowances in the 2013-2020 derogation period (under Article 10c of the EU ETS Directive). In total, CAKE simulations indicate that Poland will have more than 798 million EUA allowances available in the 2021-2030 period (taking into account FM), of which 233 million were auctioned in 2021-2023.

TABLE 4. NUMBER OF ALLOWANCES AVAILABLE FOR POLAND UNDER THE AUCTION POOL AND FM IN 2021-2030 (IN MILLIONS)

Category	Modernisation Fund	Auction pool for 2021-2030 period*	Additional EUA's from derogation (art. 10c) from 2013-2020 period	Sum
EUA volumes	173	591	34	**798**

*The number of auction allowances for PL takes into account the operation of the MSR reserve.

Source: own elaboration KOBiZE

> CAKE simulations indicate that Poland will have more than 798 million EUA allowances available in the 2021-2030 period (including FM), of which 233 million were auctioned in 2021-2023.

Table 5 presents the projected allowance deficits in the Fit for 55 implementation scenario in relation to projected emissions over the 2021-2030 period. The results indicate a significant allowance deficit, estimated at around 655 million in the extreme scenario. There are several factors contributing to this deficit. Firstly, the small share of Poland in the auction pool, compared to the projected emissions, and the reduction of the auction pool as a result of the operation of the MSR. These are the main reasons for the significant deficit in allowances. Secondly, the relatively small increase in the number of allowances available to Poland in the FM after the implementation of the Fit for 55 package. Another factor influencing the size of the deficit is the projected reduction of domestic emissions in the EU ETS up to 2030, which is small in the NAP-compliant scenario and in the EU reference scenario 2020, Energy, transport and GHG emissions - trends to 2050.

An analysis of the balance of future emissions and the number of available allowances, shows Poland's situation to be particularly difficult, even when compared to more ambitious emissions projections, such as those presented in the CAKE report "VIIEW on EU ETS 2050: Changing the scope of the EU ETS' from 2023". Using this emissions projection, it can be seen that Poland will face a deficit of emission allowances, estimated at around 273 million. This situation highlights the challenges Poland faces in terms of future EU ETS requirements and the need to reduce emissions.

> The projected allowance deficit in the Fit for 55 implementation scenario in relation to projected emissions in 2021-2030 according to various emission projections could range from approximately 273 million to 655 million EUA allowances.

The analysis of the deficit of emission allowances at the Polish level indicates the need to consider this issue in more detail as part of future reforms of the EU ETS. The need to ensure a fair distribution of the burden between Member States in order to

TABLE 5. EU ETS ALLOWANCES DEFICIT FOR POLAND IN 2021 - 2030

Emission scenarios	Aggregated emissions*	Auction pool + MF	Free allocation	Deficit
KE - EU Reference Scenario 2020	1756	798	345	613
PL - NECP	1798			655
KE - Fit for 55 MIX scenario 2030	1478			335
CAKE/KOBiZE - VIIEW on EU ETS 2050: Changing the scope of the EU ETS	1416			273

*The presented aggregate emissions figures take into account historical emissions from the EU ETS from 2021-2022. For the remaining periods, a linear interpolation of projections between the nodal years, i.e. 2022-2025 and 2025-2030, was used to determine aggregate emissions.

Source: Own elaboration KOBiZE, based on emission projections: EU Reference Scenario 2020, NAPE, Fit for 55 MIX scenario 2030, CAKE/KOBiZE - VIIEW on EU ETS 2050: Changing the scope of the EU ETS.

avoid the need to transfer funds for the purchase of emission allowances by countries with lower income levels, such as Poland. This issue relates to the need for installations within a country to purchase additional allowances (taking into account allocated free allowances), which exceed the revenue generated from auctions and allowances available under the Modernisation Fund (FM).

Conclusions

The functioning of the MSR reserve, analysed from a historical point of view, has shown to be effective in reducing the surplus of allowances in the market and eliminating market shocks, i.e. the COVID-19 pandemic. Thanks to the MSR reserve, the surplus of allowances in the market (TNAC) has been reduced by about 48%, although it is still above the upper threshold of the MSR (833 million). The COVID-19 pandemic in 2020 caused a decrease in emissions in the EU ETS and an increase in the surplus of allowances, but the reserve neutralised this effect through higher transfers of EUA's to the reserve. Although there is no direct impact on the supply of allowances, the invalidation mechanism contribute to a permanent reduction of available allowances in the EU ETS, which increases the EUA price and affects the EU's higher climate targets.

Faced with a future scarcity of allowances in the EU ETS, various solutions will need to be considered, including increasing the number of allowances in the MSR or introducing emission reduction units ("removals") into the market. These issues could be a key part of the review of the MSR reserve in 2026. Proposals for changes to the MSR mechanism, such as the introduction of a price corridor or the concept of a European Central Carbon Bank (ECCB) to replace the mechanism, appear to be considered as potential ways to manage liquidity relating to emission allowances and removals units and as new instruments to ensure the stability of the EU ETS and the allowances market as a key EU climate policy tool.

The analysis shows that Poland will be a country that will experience a deficit of allowances in the period 2021-2030. A deficit in one Member State means that its installations have to buy allowances, which in turn contributes to the budgets of other countries in the EU ETS. Due to Poland's high dependence on fossil fuels, significant investments will be required to transform the economy. Poland's financial capacity is limited due to the level of affluence of society. The increase in the Modernisation Fund introduced as part of the Fit for 55 package will not be sufficient to finance significant changes and will not cover the allowance deficit. The analysis conducted indicates that the deficit problem needs to be addressed in more detail in order to minimise the need to transfer funds for the purchase of emission allowances outside Poland.

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A new component of the emissions trading system for road transport and buildings sectors – legal frameworks of the ETS2

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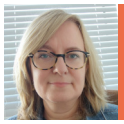
Key words: parallel emissions trading system, ETS2, ETS2 sectors, the construction, transportation and ancillary sectors, fiscal measure, covered entities regulated, allowing fuel consumption, emissions monitoring and reporting, emissions accounting, social effects of ETS2



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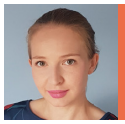

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Abstract

The amendment to Directive 2003/87/EC adopted in May 2023 has expanded the scope of the EU ETS's functioning to the greatest extent in the history of the system. One of its most important elements was the establishment of a parallel emission trading system (ETS2), which is to cover emissions from fuel combustion in the road transport and buildings sectors (including heat production in households and the municipal and domestic sectors) as well as from the so-called additional sectors outside the EU ETS that use fossil fuels for energy production. In the article, the Authors present the regulatory frameworks of the new component of the emission allowance trading system adopted in the amended Directive, show its specificity in the context of the existing legal solutions on which the ETS is built, and also draw attention to the challenges that Member States face in connection with the introduction of these regulatory assumptions on a national basis.

Amendments to the rules on the functioning of the emissions trading system under Directive 2023/959

On May 16th 2023, an amendment to Directive 2003/87/EC (ETS Directive)[1] was published, which made the largest to that date extension of the greenhouse gas emissions trading system (EU ETS)[2] to new sectors of economy. Not only has the scope of the existing Annex I of the ETS Directive been changed in such a way, that through changes to the threshold criteria of the EU ETS, it will cover further groups of installations, but also new types of activities[3], such as maritime transport, have been included in this system.

[1] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/6swwww1/EC, *OJ L 275, 25.10.2003, p. 32 with amendments.*

[2] Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system, *OJ L 130, 16.5.2023, p. 134.*

[3] The threshold criteria were lowered in areas of activities carried out in the field, of e.g. hydrogen production, drying or calcination of gypsum, or without an entry threshold, e.g. in the production of primary aluminum or alumina. The lowering of the threshold criteria means that the EU ETS will include additional groups of installations that have so far been outside the system due to non-compliance with the criteria for installed capacity, production capacity, etc.

A breakthrough change was the establishment of a parallel emissions trading system, which covered emissions from sectors previously covered by Regulation 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement (so-called effort-sharing Regulation)[4]. Regulation 2018/842 established another emission reduction mechanism in which each Member State in the period 2021-2030 is obliged to reduce its greenhouse gas emissions by the percentages indicated in Annex I of that Regulation in relation to the 2005 emissions level (Article 4(1))[5]. Member States' individual greenhause gas reduction targets are based on annual carbon budgets. Emission reduction shall be carried out in compliance with additional requirements specified in Regulation 2018/842 (reduction trajectory, possibility of using flexibilities, etc.). Compliance with individual reduction commitments is under the control of the European Commission, and a Member State that fails to meet these commitments is obliged to develop a corrective action plan that includes additional actions it will take, using national policies and measures, in order to regain compliance with its reduction commitments. It is important to note that greenhouse gas emission reduction remains within the relative regulatory freedom of the Member State, which, in fulfilling its obligations, may apply various types of activities, and legal and economic instruments aimed at reducing greenhouse gas emissions from specific categories of sources (indicated in Article 2(1) of the ESR)[6]. This Regulation remains in force and binds Member States with obligations resulting from it with regard to emissions from the buildings and road transport sectors. Thus, the current regulatory freedom of Member States to constitute the means by which reduction targets are achieved in sectors covered by the ESR has been partially limited. However, the entry into force of Directive 2023/959 did not result in shifting the burden of reducing emissions from the ESR to the mechanisms established in the ETS Directive (so-called BRT ETS or ETS2), because the emission reduction achieved under ETS2 will be counted towards the reductions in the existing non-ETS. In the literature, it is defined as the overlap of various regulatory, economic, etc. instruments creating the EU climate policy[7]. This policy, by tightening its course by setting increasingly stringent goals, must not only take into account ongoing climate change, but also support a comprehensive socio-economic transformation, which requires the use of multi-level regulatory tools.

> A parallel emission trading system for the buildings sector, the road transport sector, and the so-called additional sectors (Building and Road Transport ETS, hereinafter referred to as ETS2), is to be implemented in stages starting from January 1, 2025, and will become fully operational from 2027.

[4] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013, OJ L 156, 19.6.2018, p. 26 with amendments.

[5] The EC was additionally authorized to determine, by way of an implementing act, annual emmission limits for the period 2021-2030 in tones of CO_2 equivalent for each Member State using designated linear paths and taking into account requirements specified in Article 4(3) ESR. The decision on this matter was issued in June 2023 (Commission Implementing Decision (EU) 2023/1319 of 28 June 2023 amending Implementing Decision (EU) 2020/2126 to revise Member States' annual emission allocations for the period from 2023 to 2030, OJ L 163, 29.6.2023, p. 9).

[6] See e.g.: S. Romppanen, Targets, timetables and effort sharing as governance tools: emergence, scope and ambition (in:) Handbook on european union climate change policy and politics, (eds.) T. Rayner, K. Szulecki, A. J. Jordan, S. Oberthür, Edward Elgar Publishing Limited, Cheltenham, UK, Northampton, MA, USA, 2023, s. 217. http://dx.doi.org/10.4337/9781789906981.

[7] See, e.g.: S. Oberthür, I. von Homeyer, From emissions trading to the European Green Deal: the evolution of the climate policy mix and climate policy integration in the EU, Journal of European Public Policy 2023, vol. 30 no. 3, p. 445-468 and the literature cited therein.

The mentioned parallel emission trading system is to be implemented in stages starting on January 1, 2025, and will become fully operational from 2027[8]. The ETS2 has been designed as a system separate from, but intended to be linked to, the current EU ETS[9]. At first, both systems will operate in parallel.

The solution of creating a separate mechanism (i.e. ETS2) aimed at reducing greenhouse gas emissions in sectors outside the EU ETS is intended to eliminate the risk of disruptions in the existing emission trading system, which involves stationary installations, the aviation sector and maritime transport[10]. Indeed, the risk of such disruptions is difficult to question, especially if we take into account the dependencies that exist between EU ETS installations and fuel purchasers belonging to certain ETS2 sectors (mainly the buildings sector and the so-called additional sectors). Of particular importance here is the factor related to high prices for emission allowances, which for the last 2 years have had a significant impact on production costs in EU ETS sectors. Rising production costs cause some installations, reducing their production capacity, to leave the EU ETS and move their production outside the system[11]. This situation reduces the pressure to reduce emissions in the current EU ETS, and at the same time, leads to distortion of competition on the market because avoiding the obligation to surrender allowances by installations operating outside the EU ETS may be a source of competitive advantages.

Regulatory frameworks

Subject scope of the system

ETS2 was designed in a completely different formula than the existing EU ETS, while maintaining certain similarities regarding the obligations of participants in both systems. The differences are visible primarily in the sphere of entities that participate in the system, the rules of distribution of emission allowances, and the allocation of funds from the auction of emission allowances. These differences fundamentally affect the nature and specificity of ETS2. It can even be said that ETS2 has the features of a fiscal measure, unlike the model that characterizes the existing ETS in which greenhouse gas emitters participate.

> ETS2 has the features of a fiscal measure, unlike the model that characterizes the existing ETS in which greenhouse gas emitters participate.

[8] The EU ETS Directive provids in Article 30k postponement of certain obligations related to participation in the ETS2 until 2028 in the event of exceptionally high energy prices on the market. In Article 30k(1), the premises for the application of the above-mentioned postponement were formulated. They are verified based on changes in the gas price index on the spot market (average TTF gas price) and the Brent crude oil price index.

[9] In its legislative proposal, the Commission assumed that the two systems (ETS2 and EU ETS) would be integrated into one in the future. The integration of both emission trading systems will be preceded by an assessment of the feasibility of introducing such solutions, which the Commission is to present by October 31st 2031. It seems that the integration of the systems will take place primarily at the level of exchange of emission allowances issued under the EU ETS and ETS2, which can be used for purposes of surrendering allowances by participants of both systems. A similar mechanism, although within the same EU ETS, was previously applied to allowances issued to aircraft operators, i.e., allowances for these EU ETS participants could not be used by operators of installations for the purposes of surrendering allowances. This mechanism was intended to maintain an appropriate level of supply of allowances available on the market for aircraft operators and to prevent extraordinary allowances price increase. It was annulled in the fourth trading period (2021-2030).

[10] Maritime transport became part of the EU ETS with amendments to the ETS Directive introduced in 2023. See Directive (EU) 2023/959 of the European Parliament and of the Council.

[11] The rapid increase in the prices of emission allowances in the existing EU ETS (dynamic increase by 200% in the first 3 quarters of 2021 and subsequent stabilization of the price at the level of EUR 80-90) has resulted in an intensification of the trend aimed at searching for solutions that will allow to reduce production costs. The solution quite often used by operators was to limit the production capacity of the installations, as a result of which they no longer met the criteria for inclusion in the system and left the EU ETS. ETS2, by introducing the obligation to surrender allowances corresponding to emissions arising from fuel combustion processes outside the EU ETS (thereby increasing the cost of fuel purchase), is intended to tighten the current EU ETS, reducing the attractiveness of this type of undesirable solutions.

The EU ETS was designed as a market mechanism intended to stimulate the entities included in it (currently operators of installations, aircraft operators, and, from 2024, shipping companies) to take actions aimed at reducing greenhouse gas emissions. ETS2, on the other hand, is a completely different solution, which is closer to a carbon tax with a maximum price level of EUR 45/tonne[12]. ETS2 is based on the assumption of imposing fiscal burdens on fuels offered for sale (motor fuel or fuel for combustion) as defined in Article 3 letter af) of the ETS Directive. Therefore, it is a form of indirect taxation of the consumption of a specific type of fuel, the payers of which are ETS2 participants (the so-called regulated entities defined in Article 3(ae)).

The institutions of the new EU ETS component, including regulated entities, fuel categories, and the moment when the obligation to surrender emission allowances in ETS2 sectors arise, are determined in accordance with the excise duty system provided for in Council Directive (EU) 2020/262[13], together with the necessary adjustments, resulting from the fact that on the basis of this Directive a system has already been established to record the quantities of fuels released for consumption for the purposes of excise tax collection. ETS2 participants are, as mentioned, regulated entities, meant as natural or legal persons (exccept for any final consumer of the fuels) that conduct activities in the field of releasing for consumption fuels used for combustion in ETS2 sectors. These entities may be:

1. entities running a tax warehouse[14];
2. intermediaries obliged to pay excise duty (e.g. intermediary gas entities, intermediary coal entities);
3. entities subject to the registration obligation in order to cover themselves with the obligation to pay excise tax for releasing for consumption of the above-mentioned fuels as well as persons exempt from the obligation to pay this tax;
4. other entities liable for payment excise duty for releasing for consumption of the above-mentioned fuels.

This parallel shows that, contrary to the current practice related to the participation of aircraft op-

[12] S. Göss, Understanding the new EU ETS (Part 2): Buildings, Road Transport, Fuels. Energy post EU, Understanding the new EU ETS (Part 2): Buildings, Road Transport, Fuels. And how the revenues will be spent - Energy Post [access on 31.07.2023]. Although one should agree with the assessment made by the Author regarding the nature of the ETS2, which is a solution close to indirect taxes (it has many similarities to excise duty), the Author does not make an accurate assessment of the importance of the mentioned price criterion (EUR 45/t CO_2). In fact, it is not a maximum price limit, but rather a level that triggers stabilization measures (the release of additional allowances from the reserve) to prevent extraordinary increases in allowance prices on the market.

[13] Council Directive (EU) 2020/262 of 19 December 2019 laying down the general arrangements for excise duty (recast), OJ L 58, 27.2.2020, p. 4 with amendments.

[14] A tax warehouse is an institution related to the determination of excise duty, marking the place where excise goods are produced, stored, reloaded, to which they are introduced, from which they are taken out - using the excise duty suspension procedure. These are places with a special excise status, allowing the obligation to pay excise tax to be suspended. Suspension of excise duty collection is a situation in which, despite the existence of a tax obligation, no tax liability arises, which in practice means deferment of the payment of excise duty.

erators and operators of installations in the EU ETS, ETS2 does not cover emitters, i.e., entities using the environment, but indirect entities dealing in the supply of fuels for consumption, which do not generate environmental nuisances through that type of activity.

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These entities are obliged to surrender allowances in the future if the fuel released for consumption is used by the final recipient (fuel consumer). Therefore, it is a substitute obligation, instead of factual emitters, surrender of allowances is generally carried out by entities that only participate in fuel trade. It should also be noted that the cost of allowances surrendering is borne by emitters, because the cost of purchasing allowances needed to settle emissions will be added to the fuel price. As a consequence, final consumers of fuels in ETS2 sectors (e.g. natural persons purchasing fuels for heating a residential building or users of motor fuels) will not be directly covered by the system. Taking into account the very large number of final consumers in the buildings and road transport sectors, as well as the administrative burdens associated with imposing on such a large number of entities an obligation to report emissions and surrender allowances, this assumption seems to be rational from the point of view of handling and supervising the implementation of these obligations by the Member State. Establishing a regulatory point at the level of greenhouse gas emitters, as is the case with stationary installations and aviation, or even shipping companies, could lead to system failure in the buildings and road transport sectors. The regulatory point in ETS2 was therefore established at the stage of the fuel supply chain selected by the Member State, before the combustion of these fuels results in the release of carbon dioxide into the atmosphere (Article 30b and Annex III of the EU ETS Directive).

Material scope of the the ETS2 – activities covered by the system

The material scope of the ETS2 is defined in Annex III to the ETS Directive. The basic criterion determining this scope is releasing for consumption fuels used for combustion in ETS2 sectors. At the same time, the EU legislator specified what types of emission sources belong to the ETS2 sectors, as well as what additional criteria determine whether a given fuel stream will be covered by the new system. The emission sources covered by ETS2 have been specified by reference to the source categories used in the 2006 IPCC guidelines for national greenhouse gas inventories, and in particular to the sectoral classification of emission sources[15].

ETS2 in the field of road transport and the buildings sectors include emissions from the production of heat for residential purposes and for the needs of commercial and public services by combined heat and power plants and heating plants, as well as emissions from means of transport using roads. In turn, the so-called additional sectors include a diverse group of activities belonging to the energy, manufacturing and buildings industries that have previously remained outside the EU ETS due to not meeting the threshold criteria set out in Annex I to the ETS Directive.

[15] Classification of activities available at:https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_8_Ch8_Reporting_Guidance.pdf (access on 19.09.2023).

ETS2 in the field of road transport and the buildings sectors include emissions from the production of heat for residential purposes and for the needs of commercial and public services by combined heat and power plants and heating plants, as well as emissions from means of transport using roads. In turn, the so-called additional sectors include a diverse group of activities belonging to the energy[16], manufacturing and buildings industries[17] that have previously remained outside the EU ETS due to not meeting the threshold criteria set out in Annex I to the ETS Directive, and also in this case the emissions will come from the combustion processes of fuels used for the production of electricity or heat. It is worth emphasizing that ETS2 participants are not entities conducting activity in these areas (i.e., additional sectors), but suppliers of fuels used by purchasers in production processes.

At the same time, fuels approved for consumption in EU ETS installations, aviation and maritime transport (activities covered by the EU ETS)[18], municipal and hazardous waste used as fuel, and fuels used to power agricultural vehicles running on paved roads are excluded from the scope defined in this way. At the same time, fuels released for consumption in EU ETS installations, aviation and maritime transport (activities covered by the existing EU ETS), municipal and hazardous waste used as fuel, and fuels used for agricultural vehicles running on paved roads are excluded from the scope defined in this way. The exclusion of the indicated types of fuels means that their release for consumption will not imply the obligation to monitor, report and surrender allowances. The Directive also provides for a general exemption for fuels with a zero emission factor. This exclusion applies to various types of fuels produced from biomass and the combustion of biofuels and bioliquids. This assumption is consistent with previous regulations regarding the emission allowance trading system. The combustion of fuels produced from biomass, as well as the combustion of biofuels and bioliquids, can be treated as „zero emission", provided, however, that these fuels meet the so-called sustainability criteria[19]. Motor fuels used by the military will

[16] Excluding what is already included in the buildings sector, i.e., heat production by combined heat and power plants for residential purposes and for commercial and public services.

[17] Among other industries: iron and steel; non-ferrous metals; chemical; cellulose, paper and printing; food, beverage and tobacco processing; non-metallic minerals; transport equipment; machine; mining and quarrying; wood and wood products; buildings; textile and leather.

[18] The exception is the use of fuels to transport greenhouse gases for geological storage.

[19] The criteria for sustainable development and reduction of greenhouse gas emissions are additional requirements that must be met by fuels constituting renewable energy sources (including biomass, biofuels and bioliquids), so that, among other things, the increase in the share of energy from renewable energy sources in the energy balance of a given state does not take place at the expense of other environmental protection requirements, including the protection of nature and biodiversity. The criteria for sustainable development are specified in detail in Article 29(2-7) of Directive 2018/2001 on the promotion of renewable energy sources. They concern, among others: 1) control of the impact of the production of fuels from biomass produced from waste and residues from agricultural land (Article 29(2)); 2) exclusion from the implementation of the indicative target regarding the use of renewable energy sources (target 32%) of bioliquids, biofuels and biomass fuels produced from agricultural biomass derived from raw materials obtained from areas with high biodiversity value (Article 29(3)); 3) reducing the risk of using fuel produced from forest biomass from production that does not meet the criteria of sustainable development (Article 29(6)); 4) establishing rules on land use, land use change and forestry for forest biomass (Article 29(7)) (LULUCF).

also not be subject to the obligation to monitor emissions and surrender allowances. Although this was not expressed directly in the directive, it results from the analysis of the areas that are subject to the national inventory in the field of road transport based on the above-mentioned IPCC guidelines from 2006.

It is worth noting that the subject scope of ETS2 is based on the regulatory scheme adopted for excise duty. An ETS2 participant is an entity that makes energy products (fuel) available for consumption. In the case of excise duty, the subject of taxation is the release for consumption of excise goods. The taxpayer is, as a rule, an entity participating in the trade in excise products, and the tax itself is a factor that increases the price of the goods and burdens the final purchaser. In the case of ETS2, the cost of surrendering allowances generated in the process of combusting fuels will be borne by the final recipients of these fuels (e.g., natural persons purchasing fuels for heating buildings or recipients of district heating covered by ETS2, purchasers of motor fuels, and operators of installations belonging to the so-called additional sectors). The purchase price of fuels will be increased accordingly by the value of emission allowances purchased due to the need to surrender allowances by fuel distributors.

Allocation of emission allowances in ETS2

The total number of emission allowances created under ETS2 is to be reduced annually in order to create price pressure on allowances through limited supply. High prices of allowances are intended to stimulate faster reductions in the use of fossil fuels and thus aim to achieve the 2030 emission reduction target set by the EU. The contribution of the buildings and road transport sectors is expected to amount to 43% of emission reductions by 2030 compared to 2005.

Reducing the supply of emission allowances is intended to create incentives for consumers (both households and enterprises from the so-called additional sectors) to switch to less-emission fuels used for energy production and to choose low-emission or zero-emission solutions in transport.

Reducing the supply of emission allowances is intended to create incentives for consumers (both households and enterprises from the so-called additional sectors) to switch to less-emission fuels used for energy production and to choose low-emission or zero-emission solutions in transport. On the other hand, ETS2 is to generate high revenues from the sale of emission allowances, which is intended to finance this transformation, as emission allowances corresponding to emissions generated in ETS2 sectors are to be available only through auctions. Entities participating in ETS2 will not receive free allowances.

To ensure a smooth start of trading in allowances in ETS2, and due to the need for regulated entities to secure or purchase these allowances in advance, the Directive provides for an increase in the volume of allowances placed on the market at the start of trading in these units (Article 30d(2)). This solution is intended to counteract extraordinary price increases at the time of the commencement of trade in allowances and to prevent the risk of loss of financial liquidity of entities purchasing them. In 2027, the volume of allowances auctioned is to be 30% higher than the total number of allowances allocated for this year. However, this increase in the volume in 2027 will have an impact on the volume of allowances put up for sale at auction in the following years (from 2028). This additional volume directed to the market in 2027

can only be used for purposes related to the surrendering of allowances. Therefore, it will not be possible to trade these allowances by participants other than entities participating in ETS2.

The main part of the allowances is to be distributed among all Member States on the basis of the average distribution of emissions in the sectors covered by ETS2 in the period from 2016 to 2018.

At the same time, concerns raised regarding the establishment of ETS2 regarding serious social consequences related to, among others, the deepening of energy poverty led to the creation of the Social Climate Fund[20]. The Fund's task is, among other things, to eliminate the negative impact of „taxing" carbon dioxide emissions in ETS2 sectors. Support, including: providing affordable and sustainable heating, cooling and low-emission transport will target vulnerable households, micro-enterprises or transport users. The fund will be supplied with funds from the sale of allowances created under ETS2 at auctions.

Participant obligations and reporting under ETS2

Monitoring, reporting and verification obligations in the ETS2 sectors have been broadly aligned with the mechanisms established for stationary installations and aviation (Article 30f of the EU ETS Directive). Pursuant to the Directive, entities covered by its provisions will have to obtain a greenhouse gas emission permit (similarly to those obtained by operators of stationary installations in ETS1). The Directive specifies formal requirements in this regard. Regulated entities must obtain a permit before January 1, 2025. After this date, they will not be able to conduct activities in the area of releasing fuels for consumption without a greenhouse gas emission permit. This is a relatively serious effect, but it should not be perceived from the perspective of establishing a new form of regulation of the right to conduct business activity, but it undoubtedly fulfills a preventive function aimed at forcing certain entities involved in the fuel trade to fulfill obligations that will include them in the mainstream of regulations related to ETS2.

Along with the obligation to obtain an emission permit, regulated entities will be obliged to monitor carbon dioxide emissions from the combustion of fuels that will be released to the market. Monitoring in ETS2 will have certain differences compared to monitoring emissions in the current EU ETS and will be based mainly on the amount of fuel released for consumption. The methodology for monitoring emissions will vary depending on the type of fuel and, as a consequence, may imply a different level of difficulty in determining emissions. Emissions will be monitored on the basis of a monitoring plan approved by the competent authority, which the regulated entity should submit four months before the start of releasing fuels for consumption, subject to the possibility of setting another date by that authority (new Article 75b(2) of Regulation 2018/2066). Similarly to the EU ETS, ETS2 provides for the obligation to report emissions and verify the report's findings, which will be carried out by independent verifiers. The rules for emissions monitoring in sectors covered by ETS2 are stipulated in an implementing act of the European Commission amending Regula-

[20] As some analyses point out, carbon pricing policies in road transport and buildings have regressive distributional effects, affecting low- and middle-income households the most compared to high-income households. This is because low-income households spend a greater share of their income on energy-related expenses. This may result in greater inequality and an increase in fuel poverty as the costs of surrendering of allowances corresponding to emissions generated by ETS2 will be passed on to consumers. See e.g. J. Cabrita, S. Demetriades, K. Fóti, Distributional impacts of climate policies in Europe, Eurofound, Luksemburg 2021, distributional impacts of climate policies in europe-TJ0221743ENN.pdf [access on 9.10.2023].

tion 2018/2066[21], specifying the monitoring rules for entities regulated in ETS2[22].

The verified emissions determined in the emissions report will constitute the basis for surrendering allowances in the Union Registry. The obligation to surrender allowances involves the need to open and maintain an account in the Registry. On December 30th 2023, amendments to Regulation 2019/1122[23] laying down the rules for the operation of the Union Registry entered into force. Commission Regulation 2023/2904[24] introduced, among others: rules for opening, maintaining and closing accounts for regulated entities. Surrendering of allowances is mainly about reducing the number of allowances corresponding to the verified emission volumes specified in the report via an account in the EU Registry. For the first time, the obligation to surrender allowances will arise in 2028 for emissions from the previous year. Unlike the current EU ETS, no free allocation of allowances is provided for entities covered by the EU ETS Directive. This means that it is necessary to purchase at auction all allowances necessary to fulfill that obligation.

Penalties for participants violating the obligations under the ETS2

Directive 2023/959 also introduces an obligation for Member States to establish a system of penalties for non-compliance with the obligations under the ETS2. What is important to note is the application by the EU legislator of similar sanctions related to non-surrendering of allowances, which have been adopted in the EU ETS for many years. This penalty is established directly in the provisions of the Directive and is related to the setting of a unit penalty rate (at the level of EUR 100) for failure to surrender 1 tonne of carbon dioxide emissions. However, this is where the similarities between the systems regarding this sanction end. Due to the fact that the cost of surrendering allowances in ETS2 sectors will be passed on directly to consumers as a mark-up on the fuel price, regulated entities will be less interested in avoiding this obligation. The burdens related to incurring the costs of surrendering allowances will be similar for all regulated entities that release a specific type of fuel to the market, hence, they will not affect the competitive situation on the market. Therefore, the above-mentioned penalty for failure to surrender allowances may provide them with stronger incentives to fulfill this obligation. Although EU law does not specify what type of sanctions will secure the implementation

[21] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012, *OJ L 334, 31.12.2018, p. 1 with amendments*.

[22] Commission Implementing Regulation (EU) 2023/2122 of 17 October 2023 amending Implementing Regulation (EU) 2018/2066 as regards updating the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council, *OJ L, 2023/2122, 18.10.2023*.

[23] Commission Delegated Regulation (EU) 2019/1122 of 12 March 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry, *OJ L 177, 2.7.2019, p. 3 with amendments*.

[24] Commission Delegated Regulation (EU) 2023/2904 of 25 October 2023 amending Delegated Regulation (EU) 2019/1122 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry, *OJ L, 2023/2904, 29.12.2023*.

of other obligations in the ETS2, it can be assumed that they will involve failure to submit a report on emissions and the obligation to obtain an emission permit. These obligations are important from the perspective of the functioning of ETS2, and their implementation also determines the implementation of the obligation to surrender allowances. A similar regulatory scheme is adopted by the currently applicable provisions of the Act of 12 June 2015 on the greenhouse gas emission allowance trading system[25] (ETS Act), therefore, it can be expected that the violations previously identified in the Act will be adopted in relation to ETS2.

Control of emission allowance prices in ETS2

In order to reduce the risk of supply and demand imbalance related to the start of trading in emission allowances in ETS2 sectors, as well as to make the system more resistant to the risk of excessive price increases, ETS2 will use a market stability reserve mechanism analogous to the EU ETS. The collection and release of emission allowances from the reserve will be based on the market surplus thresholds in the ETS2.

In 2027, 600 million emission allowances created under ETS2 will be placed in the market stability reserve. At the same time, the EU ETS Directive defined the conditions for releasing emission allowances from the reserve, which are generally related to excessive increases in emission allowance prices. They are defined in Article 30h (2) and (3) of the EU ETS Directive. In both cases, the mechanism for introducing additional volumes of allowances to the market is based on an increase in the average price of allowances at auctions, and the aim of the intervention is to stabilize this price.

[25] Consolidated text, Journals of Laws 2023, pos. 589.

> In 2027, 600 million emission allowances created under ETS2 will be placed in the market stability reserve.

Pursuant to Art. 30h (2) of the EU ETS Directive, if the average price of allowances over the next two months exceeds EUR 45 per allowance, 20 million allowances created under ETS2 are released from the market stability reserve. However, if the average price of emission allowances is more than three times higher than the average price of allowances over the previous six consecutive months, 150 million allowances are released from the market stability reserve (Article 30h(3) of the EU ETS Directive). It is worth noting that the threshold related to the increase in the price of allowances indicated in the directive (EUR 45) is primarily a criterion that triggers intervention consisting in increasing the supply of allowances on the market, but it is not a price ceiling for allowances in the ETS2, but rather an action towards its stabilization. Additionally, price control based on the mentioned criterion is to be implemented temporarily, until the end of 2029, which indicates that the price of emission allowances in ETS2 may increase significantly after the end of this period[26].

Summary

The ETS2 complements the EU climate policy in that part that has so far remained the responsi-

[26] In the opinion of the European Commission, the supply of emission allowances assumed in the provisions (limit and possible release of allowances from the reserve) will probably result in the price level in 2030 ranging from EUR 48 to EUR 80 per allowance. Price levels depend in particular on the impact of further climate protection actions under the „Fit for 55" package in the buildings and road transport sectors. In principle, the more effective further measures are, the lower the price becomes (Impact Assessment for the draft directive amending Directive 2003/87/EC, p. 339).

bility of the Member States. By introducing a uniform mechanism for „taxing" carbon dioxide emissions in the ETS2 sectors, the EU legislator limited the competence of Member States to create their own tools for reducing emissions in the transport or municipal, and housing sectors. Apart from the political context of this decision, it must be stated that the implementation of ETS2 will bring positive environmental effects[27]. As part of the EU's strategy for achieving climate neutrality[28] by 2050, ETS2 will be a tool for reducing emissions in sectors previously covered by the so-called non-ETS and will provide an impetus for switching to less-emission fuels (households, additional sectors) or low- and zero-emission solutions in road transport. The introduction of a uniform mechanism forcing emission reductions in some non-ETS sectors may improve the implementation of the reduction obligations of Member States under Regulation 2018/842. However, concerns are raised about the social effects of the introduction of ETS2 and the high administrative costs of implementing this solution.

However, concerns are raised about the social effects of the introduction of ETS2 and the high administrative costs of implementing this solution.

Indeed, the complex nature of the obligations related to monitoring, reporting, and verification of emissions from fuel combustion in the ETS2 sectors, as well as the establishment of an administrative apparatus that will ensure compliance with these obligations, means that the costs of implementing this solution will significantly exceed those associated with the introduction of tax-based solutions. It is worth noting that ETS2, in the initial period of its operation, was designed as an alternative to the carbon dioxide emission tax, which was introduced by some Member States[29]. The scale of social consequences, including the effects on households, that will affect the society of many Member States is even more questionable. The increase in prices of motor fuels and fuels used for heating, which will result from

[27] Various analyses assessing the effectiveness of the EU's climate policy in sectors not included in the EU ETS point to continued stagnation in the reduction of greenhouse gas emissions, lack of sufficient impulses to reduce emissions that affect areas of activity such as transport and energy production outside the EU ETS. See e.g F.C. Matthes, J. Graichen, Emissions trading system for road transport and buildings in the policy mix for achieving climate neutrality in the EU. An assessment of the overarching framework and specific provisions. Study for the Air Pollution and Climate Secretariat (AirClim) and the Life ETX Consortium, Policy Brief, 13.12.2022, Oko-Institute e.V.

[28] The goal of climate neutrality has been established for the entire Union in Article 2(1) of Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), OJ L 243, 9.7.2021, p. 1.

[29] Directive 2023/959 treats ETS2 as an equivalent measure to carbon tax solutions that have been adopted voluntarily by some Member States. Member State authorities may make use of the derogation provided for in Article 30e(3), and as part of this derogation, exempt regulated entities from the obligation to surrender allowances, and thus impose additional surcharges on the unit price of fuel sold, provided that these entities incur national taxes on carbon dioxide emissions.

the introduction of the obligation to surrender allowances in the transport and buildings sectors, will deepen the problem of energy poverty and transport exclusion of certain social groups.

> **Investment costs related to changing heat supply sources, increasing the energy efficiency of buildings or replacing existing means of transport with electric vehicles exceed the capabilities of a significant number of households, especially low-income households. The consequences of the introduction of ETS2 will affect the most, those who are no longer able to invest in suitable alternative solutions.**

Investment costs related to changing heat supply sources, increasing the energy efficiency of buildings or replacing existing means of transport with electric vehicles exceed the capabilities of a significant number of households, especially low-income households. The consequences of the introduction of ETS2 will most affect those who are no longer able to invest in suitable alternative solutions. Therefore, there is a need to mobilize funds to support households and invest in public transport and the thermal modernization of buildings. This mobilization is to be ensured by the Social Climate Fund, supported by funds from the sale of allowances in the ETS2, and revenues of Member States also coming from this source. Certainly, the implementation of the new emission trading component, which is to become fully operational from 2028, will be a huge challenge for the Member States, but the greatest effort will be put not so much into creating the basis for the functioning of the ETS2, but into implementing effective measures and support mechanisms for various social groups exposed to the effects of introducing this solution.

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Impact on households of the new EU Emissions Trading Scheme for the Buildings and Road Transport Sectors (ETS2)

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Impact on households of the new EU Emissions Trading Scheme for the Buildings and Road Transport Sectors (ETS2)

Key words: „Fit for 55" package, ETS-BRT, household budgets, impact on inequality, climate policy, distributional effect

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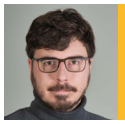

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Abstract

The extension of the European Emissions Trading Scheme (EU ETS) to the road transport and buildings sectors will lead to higher fuel prices, directly affecting the financial situation of households, particularly those with lower incomes. Analysis of household expenditure shows that spending on energy and transport varies according to income and household location. The greatest differences are found in expenditure on transport - affluent households spend much more on this category than non-affluent ones. In the case of expenditure on energy carriers, the differences are much smaller, with both rich and poor households allocating a similar share of income to this category. As regards the spatial aspect, it appears that the introduction of ETS2 will have a stronger impact on the expenditure of households in sparsely populated areas. Against the background of the European Union countries, in Poland expenditure on energy carriers and transport accounts for a rather large share of total expenditure, so the introduction of ETS2 may be met with more resistance.

Introduction[1]

To date, the scope of the European Emissions Trading Scheme (ETS) has focused on regulating greenhouse gas emissions in the energy and industrial sectors. The impact of the scheme on the daily lives of households has been relatively small, mainly limited to the price formation of electricity, heat and some industrial products. However, the current challenges of the climate crisis, in particular the ambitious goals of achieving climate neutrality for the European Union by 2050, are forcing extensions of the impact of climate policy, including the extension of the EU ETS.

In the context of the European Green Deal and the ambitious Fit for 55 package, the European Union is introducing an emissions trading scheme that will regulate buildings and road transport (the so-called BRT or ETS2 sectors). This extension is motivated by the fact that in sectors where the EU ETS is not currently active, reductions in greenhouse gas emissions have been negligi-

[1] The paper is based on data from Eurostat, Household Budget Survey, reference year 2015. The responsibility for all conclusions drawn from the data lies entirely with the authors.

ble and in some countries, such as Poland, have been increasing in recent decades.

Projections prepared by the Centre for Climate and Energy Analysis (CAKE) indicate that ETS2 sectors have relatively high marginal abatement costs (CAKE, 2023). This means that after the introduction of the EU ETS in these sectors (conventionally referred to in this article as ETS2), the prices of fuels used for transport and home or water heating such as gas, petrol or oil, could increase significantly. This will, of course, translate into a significant increase in the cost of maintaining buildings and individual transport costs.

All households will be affected by the price increases, but the distribution of this burden will not be even. Households, whose expenditure on heating and transport accounts for a significant share of their income, will feel the price increases for these products more. This phenomenon raises the risk of increasing social inequalities and poverty, with serious social consequences.

The European Union is aware of these risks and has prepared mechanisms to protect the poorest households. To this end, as part of the Fit for 55 package, a Social Climate Fund will be introduced, to be financed, inter alia, from ETS2 revenues. Its task will be to provide funding and structural support for social groups and regions that are most vulnerable to the negative effects of climate policy change. By investing in projects related to energy efficiency, low-carbon transport and other climate-friendly solutions, the Climate and Social Fund aims to simultaneously support the fight against climate change and safeguard the interests of the poorest and most vulnerable members of society.

The aim of this article is to try to diagnose the challenges and identify which households are most at risk from the effects of the introduction of the ETS2 and how the introduction of this scheme may affect inequalities. It is thus a step towards an analysis that can help develop appropriate social strategies and policies to minimise the potential negative impacts of climate policy. In turn, the legal and regulatory aspects of the introduction of ETS2 are discussed in the article 'A new component of the emissions trading system for road transport and buildings sectors – legal frameworks of the ETS2' found in this issue of GO2'50.

Literature review

In the context of Poland, an analysis of the distributional consequences of carbon pricing was conducted in the article by Antosiewicz et al. (2022). It identifies four channels of redistribution:

- direct price effects (i.e. the effects of increased fuel expenditure by households),
- indirect price effects (the effects of increased prices of energy-intensive products such as building materials),
- behavioural responses to price changes, and
- labour market adjustments.

The study highlights the importance of the latter, i.e. the labour market channel: workers in certain sectors lose their jobs and face falling wages due to the introduction of carbon tax. The results of the analysis indicate that the introduction of the tax can moderately reduce GDP, but that its distributional effects vary significantly depending on the method of allocation of revenues from emission tax. Allocating the revenues to finance direct transfers to households is particularly beneficial for poorer households, while allocating the revenues to finance a tax cut for employees (PIT) favours higher-income households.

An important voice in the discussion on the distributional consequences of emissions taxation is Joseph Stiglitz's article in the journal European

Economic Review (Stiglitz 2020). The author considers the introduction of regulation and more complex pricing policies that would achieve environmental goals, but with fewer adverse distributional impacts. He highlights that regulation, while not always an ideal solution, may be more socially beneficial given the costs of remedying distributional impacts. The analysis shows that, in certain circumstances, regulation can reduce the overall level of carbon price required to meet specific carbon reduction targets and increase the welfare of society.

Another example of a distributional impacts analysis prepared for a large European country is the study by Bureau (2011). It concerns the French government's introduction of a new CO_2 tax. The primary objective of this tax would be to impose an additional levy on fossil fuels consumed by households and companies not covered by the EU ETS. The article analyses the distributional effects of alternative fuel taxation scenarios in the automotive sector in France, using panel data from 2003-2006. In the simulation, the author considers the impact of a CO_2 tax of €31 per tonne of CO_2, which translates into an additional levy of around 7 cents per litre of petrol and 8 cents per litre of diesel. According to calculations, this tax results in an average annual loss of €79 per car-using household or €65 if all households are included. These losses increase with income, amounting to €88 per year for households in the top income quintile compared to €71 for those in the bottom quintile. When the losses are expressed as a percentage of income - the poorest households lose 6.3‰ of their income compared to 1.9‰ for the richest, which, assuming no redistribution of income, makes the CO_2 tax regressive. However, once the redistribution of tax revenues is taken into account, the tax becomes progressive: poorer households stand to gain. These conclusions are thus consistent with the findings of Antosiewicz et al. (2022). In addition, the regressivity of the tax is mitigated if we take into account the congestion reduction benefits: less congested roads bring greater benefits (in terms of income) to less well-off households.

The article by da Silva Freitas et al. (2016) discusses the importance of greenhouse gas (GHG) emissions in global warming and climate change, highlighting their negative impact on Brazil. The authors point out that Brazil is experiencing an increase in annual average temperature that is higher than the projected global increase. The paper analyses the impact of taxing greenhouse gas (GHG) emissions on households. In the short term, projections suggest a significant decrease in emissions, but the burden of this tax is unevenly distributed, with the poorest households being more affected in terms of welfare. As these households are also the most vulnerable to the deeper effects of global warming, this raises the risk of increased inequality. The authors suggest that long-term plans for the design of climate policies are needed, taking into account social and economic impacts and compensatory measures. The authors also note that taxing emissions can stimulate a more sustainable development path for the energy sector.

Sterner (2012) has conducted similar research for a broader geographical scope. The article analyses the effects of fuel taxes, including distributional effects, in seven European countries: France, Germany, the UK, Italy, Serbia, Spain and Sweden. The author highlights that there is strong opposition to raising fuel taxes, often referring to the argument that they are highly regressive. However, as the author notes, recent studies show that regressivity is not the rule and that the results depend on the country and the method of analysis. Fuel taxes are regressive in high-income countries, but progressive in low-income countries. Sterner's

results indicate that there is some regressivity in most of the European countries studied. However, it is so small that the fuel tax can practically be considered to be generally proportional or neutral. In contrast, in the poorest country, Serbia, the tax is progressive. The results also change depending on the method of income measurement used. In doing so, the author points out that the fuel tax has many other effects, such as its impact on pollution, markets and property prices. In the conclusion, the author suggests that the argument against fuel taxes as harmful to the poor is not justified.

Household budget survey data in EU member states

In this article we use data from the Household Budget Surveys (HBS) for European Union[2] member states. The data are made available every 5 years by Eurostat, which harmonises the HBS surveys carried out in the Member States, allowing international comparisons to be made. We used the dataset for the reference year 2015, as data for the next reference year 2020 have not yet been published for all countries.

The HBS database for an individual country contains data on annual expenditure in Euro on consumer goods, broken down into several hundred categories according to the Classification of Individual Consumption by Purpose (COICOP). These data are supplemented by a variety of household information such as income, size, biological type, location and many other socio-economic variables. The survey is unfortunately not conducted using the same methodology in all EU member states. For example, the sample size varies significantly between countries, ranging from 2-3 thousand households in the Czech Republic, Denmark, and Croatia, to 37 thousand in Poland, or 52 thousand in Germany. Consequently, the accuracy of the results obtained differs between countries.

In this article, we show the volume of expenditure on energy goods by different types and groups of households for Poland and other European Union countries. We then analyse the potential impact of the increase in the price of energy carriers resulting from EU climate policy on the financial situation of different types of households. We usually express expenditure as share of total income[3] or in Euro per equivalised household size[4]. In Figure 1, we compile income and equivalised expenditure for the income decile groups for Poland. It turns out that for the first income decile, expenditure is more than 50% higher than income, which justifies the choice of total expenditure as a proxy for income. In the rest of the article we will use the expenditure variable everywhere as a proxy for household income. In this article, we distinguish households by:

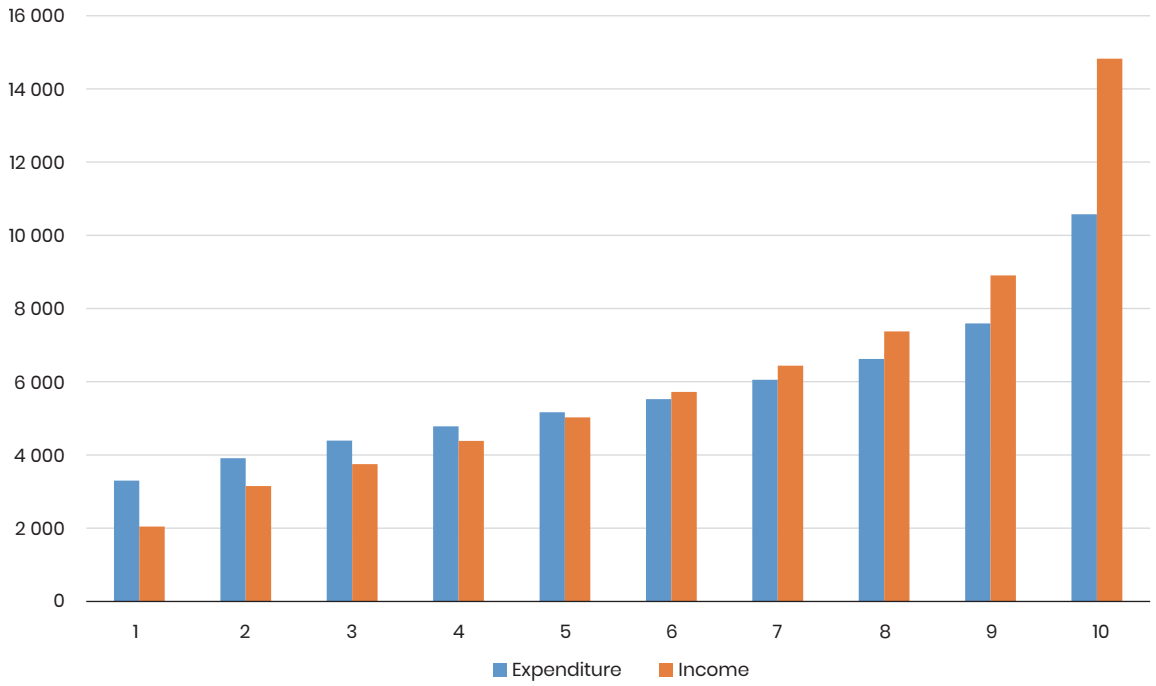
- income level, measured as decile in the distribution of equivalised household expenditure,
- population density.

[2] https://ec.europa.eu/eurostat/web/microdata/household-budget-survey

[3] In the analysis, we use the variable denoting total expenditure as a measure of household wealth, although the survey also reports the variable income. This approach is in line with the research literature and follows the methodology of the HBS survey. In the HBS survey, households are surveyed for one month, during which all its incomes and expenditures are recorded, which are then generalised to the whole year. There is therefore a risk of classifying a rich household, which just happens to have no income in the month of the survey as a result of, for example, short-term unemployment, as poor. In addition, there is an extensive literature on the so-called life-cycle income hypothesis, which provides arguments in favour of this approach. In Figure 1, we show the expenditure and income of households in different income groups distinguished by the variable denoting income. An analysis of this graph, and in particular the first income decile, shows a fundamental problem with the use of the income denoting variable.

[4] The equivalised household size is calculated as follows. The first person in the household is assigned a number of 1, subsequent adults 0.5 and children 0.3. The equivalised household income takes into account the fact that a larger household needs fewer per capita resources to function due to the sharing of certain costs.

FIGURE 1. TOTAL ANNUAL EQUIVALISED HOUSEHOLD EXPENDITURE AND INCOME BY DECILE OF EQUIVALISED INCOME IN POLAND IN 2015 EXPRESSED IN EURO.



Source: Own elaboration based on Eurostat HBS data.

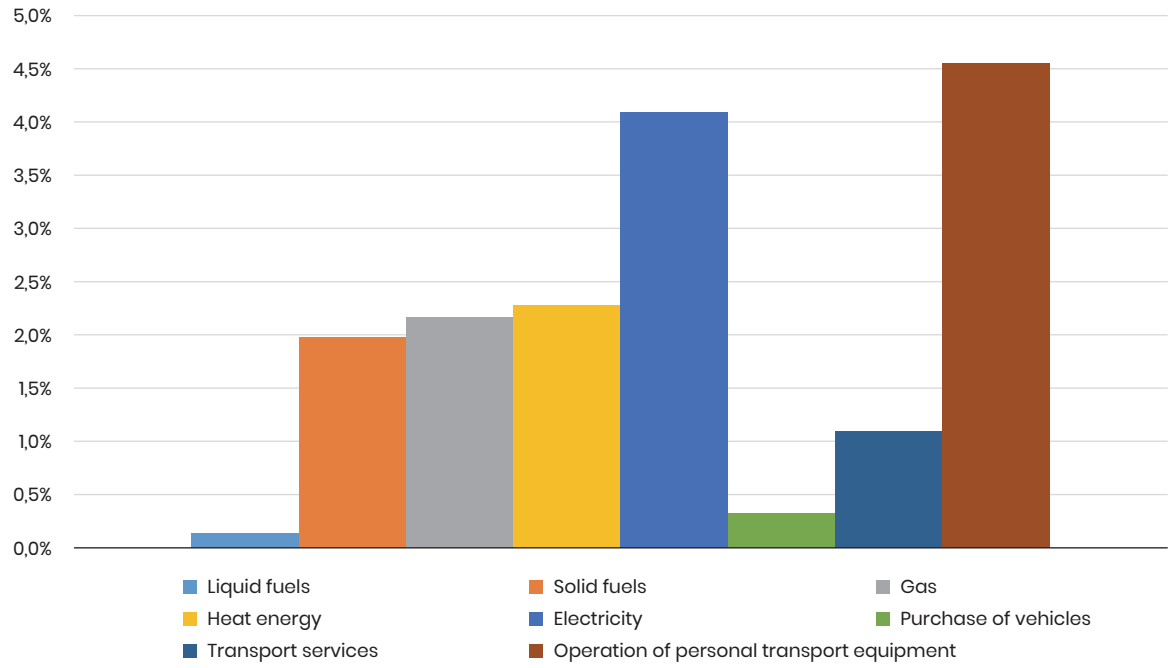
In this article, we mainly analyse household expenditure on energy and fuels, i.e. on those goods that will directly become more expensive with the introduction of ETS2 covering buildings and transport. Below we present the categories of goods from the COICOP classification that we analyse:

- Energy carriers: COICOP_045 with subcategories
- Transport: COICOP07 including subcategories

On average, Polish households spend the most on two categories: electricity and operation of personal transport equipment (which encompasses petrol and diesel)[5], which is shown in Figure 2. Each of these categories accounts for more than 4% of expenditure. The next most important items in household budgets are expenditures on energy carriers: solid fuels, liquid fuels and district heating and hot water, where each of these categories accounts for slightly more than 2% of expenditures. When interpreting the data in Figure 2, it should be borne in mind that the numbers are the average for the entire population of households, and therefore also take into account those households which do not incur expenditure on a given category at all. While every household incurs expenditure on electricity, depending on the choice of heating method, a household will usually incur expenditure on one energy carrier: solid fuels, liquid fuels or district heating. For example, among the approximately 12% of households that incur any expenditure on solid fuels in the HBS data, their average share of total expenditure is 14.7%, compared to 2% for the entire household population. In contrast, the small share of expenditure on liquid fuels for the population as a whole is mainly due to the fact that

[5] Almost all of this category is made up of expenditure on petrol and diesel.

FIGURE 2. SHARE OF EXPENDITURE ON ENERGY CARRIERS AND TRANSPORT FOR POLISH HOUSEHOLDS IN 2015 [%].



Source: Own elaboration based on Eurostat HBS data.

few households use this energy carrier for heating. Polish households spend just over 1% of their income on transport services and less than 0.5% on the purchase of vehicles[6]. However, spending on vehicles is probably underestimated. This may be due to a number of factors, such as failure to report to interviewers the expenses incurred for the purchase of a car, postponing the purchase of a car to a different month than the one in which the household was surveyed. In addition, it should be borne in mind that a significant proportion of cars in Poland are registered to companies, including sole proprietorships, and these expenditures are not taken into account in the survey.

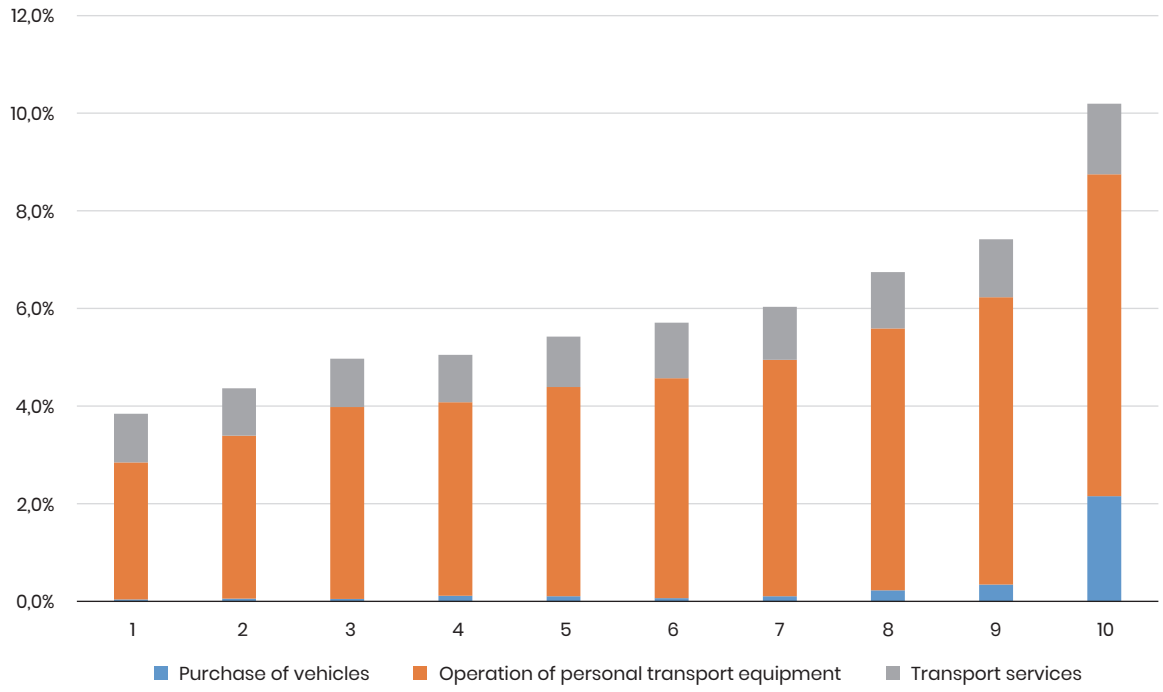
Expenditure on transport

There is quite a lot of variation in terms of expenditure on transport across the cross-section of households surveyed, with the greatest differences occurring for different income groups, as shown in Figure 3. The richest households spend (in relation to their total expenditure) two and a half times more on transport than the poorest. These differences are mainly due to significantly higher expenditure on the operation of transport equipment, i.e. on fuel, and on the purchase of vehicles. The share of expenditure on fuel among the richest is more than twice as high as among the least well-off, while the difference in expenditure on purchase of vehicles is even greater. Note that the figures show the shares of expenditure, so the differences in absolute expenditure are several times greater.[7]

[6] The largest share of this category is for the purchase of new and used cars.

[7] Depending on the methodology adopted, the income of the richest decile is on average at least four times that of the poorest decile, as can be seen in Figure 1. In addition, according to the literature, data from the Household Budget Survey tends to understate the true degree of income inequality.

FIGURE 3. SHARE OF TRANSPORT EXPENDITURE IN TOTAL EXPENDITURE BY HOUSEHOLD INCOME DECILE IN POLAND IN 2015 [%].



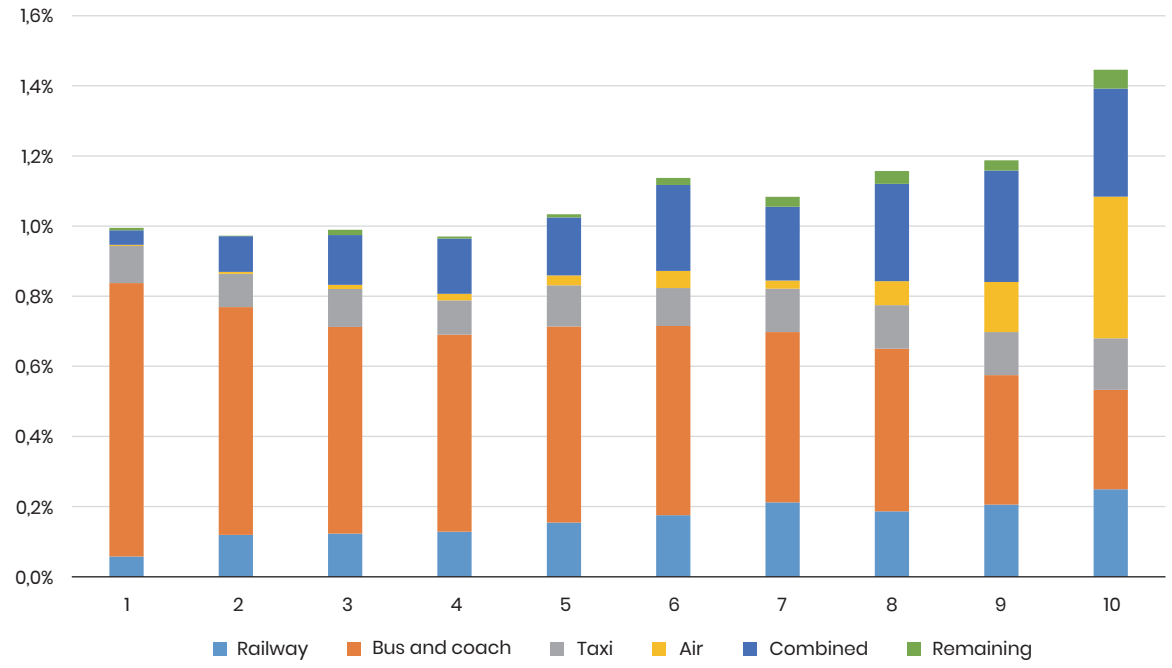
Source: Own elaboration based on Eurostat HBS data.

The total share of expenditure on transport services is less varied among households belonging to different income groups. While the first decile allocates around 1% of its expenditure to this category, the last, richest decile allocates around 1.4%. However, there are fundamental differences in the structure of these expenditures, as shown in Figure 4. It appears that the share of expenditure on the most common forms of public transport, i.e. rail and buses, decreases with income from 0.83% to 0.56%. What distinguishes the more affluent households is the high share of expenditure on air travel, reaching 0.4% of income for the richest income decile.

> The richest households spend significantly more on transport than the poorest households.

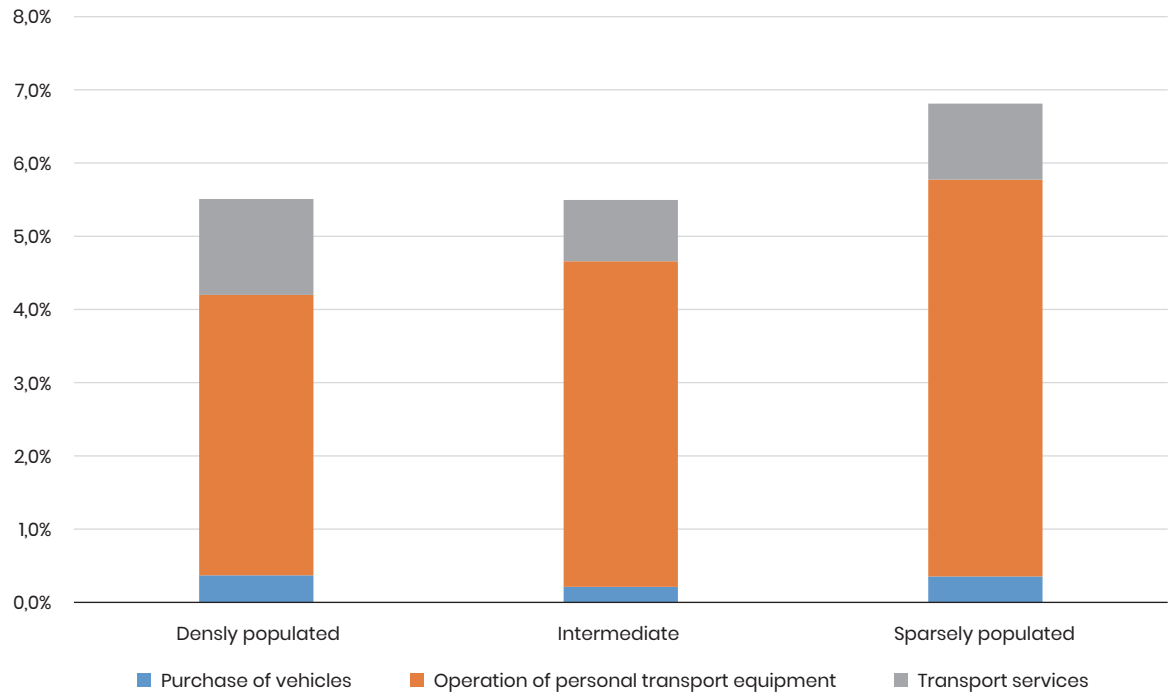
The following conclusions emerge from this analysis. Firstly, the inclusion of the transport sector in the emissions tax will tend to be progressive, i.e. richer households will pay relatively more as they consume significantly more fuel and use more carbon-intensive modes of transport, particularly air transport. It remains to be established to what extent individual household types will be affected by fuel price increases. According to an analysis by the CAKE team (Pyrka et al., 2023), the price of a permit per tonne of emissions could rise rapidly from a level of €35 per tonne in 2030 to as much as €270 per tonne in 2035. To mitigate potential high prices, the European Union has proposed capping the ETS2 emissions price at €45 per tonne through a mechanism which would release an additional pool of derogatory permits. Assuming an emission permit price at this maximum level, the price of petrol and diesel would increase by about 0.50 PLN, which, assuming a starting price of PLN 6 per litre, would mean an 8 per cent increase. As a result of such an increase, the share of expenditure on fuel for the first income decile would increase by 0.2 p.p.

FIGURE 4. SHARE OF EXPENDITURE ON INDIVIDUAL TRANSPORT SERVICES IN TOTAL EXPENDITURE BY INCOME DECILE IN POLAND IN 2015 [%]



Source: Own elaboration based on Eurostat HBS data.

FIGURE 5. SHARE OF TRANSPORT EXPENDITURE IN TOTAL EXPENDITURE BY DEGREE OF URBANISATION IN POLAND IN 2015 [%]



Source: Own elaboration based on Eurostat HBS data.

and for the last decile by 0.5 p.p. If the maximum price of emission permits were not introduced and the emission price was EUR 270 per tonne, these shares would increase by 1.2 p.p. and 3.0 p.p. respectively, and would therefore already represent a significant increase in expenditure.

In the simplified calculations above, we make the rather strong assumption that households do not change their level of consumption following a fuel price increase, which is not necessarily the case in reality, especially in the long term. In fact, households will have a number of opportunities to avoid petrol price increases. Moreover, various actions on the part of the state that can help households adjust to rising fuel prices will be extremely important. For example, the state can actively work to promote and provide a high level of public transport services, which may result in a shift of some transport activity from individual cars to public transport. This will reduce the amount of petrol consumed, reduce the number of cars, with additional positive externalities. Measures to reduce the price of public transport (e.g. bus) will also be progressive, i.e. poorer households will benefit relatively more from such a policy. Proposals for action in the area of promoting public transport are discussed in more detail in the study by Rabiega et al. (2022) and the article by Antosiewicz et al. (2022).

At the individual level, households will be able to avoid rising fuel prices by switching from internal combustion cars to low- or zero-emission vehicles. However, it is important to note that this is not an option available to all households. Buying an electric car is still more expensive than buying an internal combustion equivalent and, moreover, the market for used electric and zero-emission cars is virtually non-existent.

"The increase in the price of transport fuels will hit households living in sparsely populated areas, which additionally have limited access to alternative means of transport, harder."

The above considerations are relevant in the context of spatial variation in transport expenditure, as shown in Figure 5. It turns out that as population density decreases, expenditure on fuel for private means of transport increases strongly. While in densely populated areas the share of this expenditure is 3.8%, for medium and sparsely populated areas it is 4.4% by 5.4% respectively. The larger share of fuel expenditure is to a large extent due to the lack of public transport alternatives. These figures clearly indicate that with the extension of the EU ETS to the transport sector, specific measures should be introduced to ensure mobility for people living in sparsely populated areas.

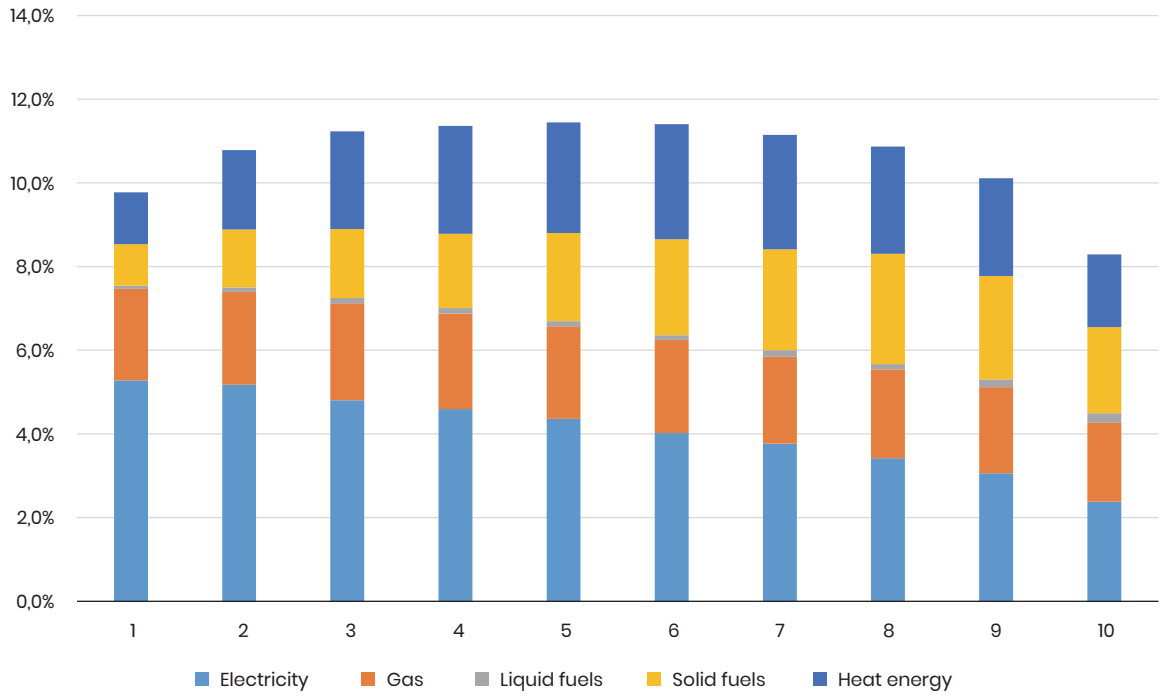
Expenditure on energy carriers

The second major category that will be covered by the new ETS2 is energy carriers for domestic heating, water heating and cooking. The new system will therefore have a direct impact on the price of fuels such as gas, coal or oil, while electricity and district heating will remain covered by the existing EU ETS. In this chapter, we analyse household expenditure on energy carriers (category 045 in the COICOP classification) split into the following categories:

- 0451 - electricity
- 0452 - gas
- 0453 - liquid fuels
- 0454 - solid fuels
- 0455 - heat (district heating)

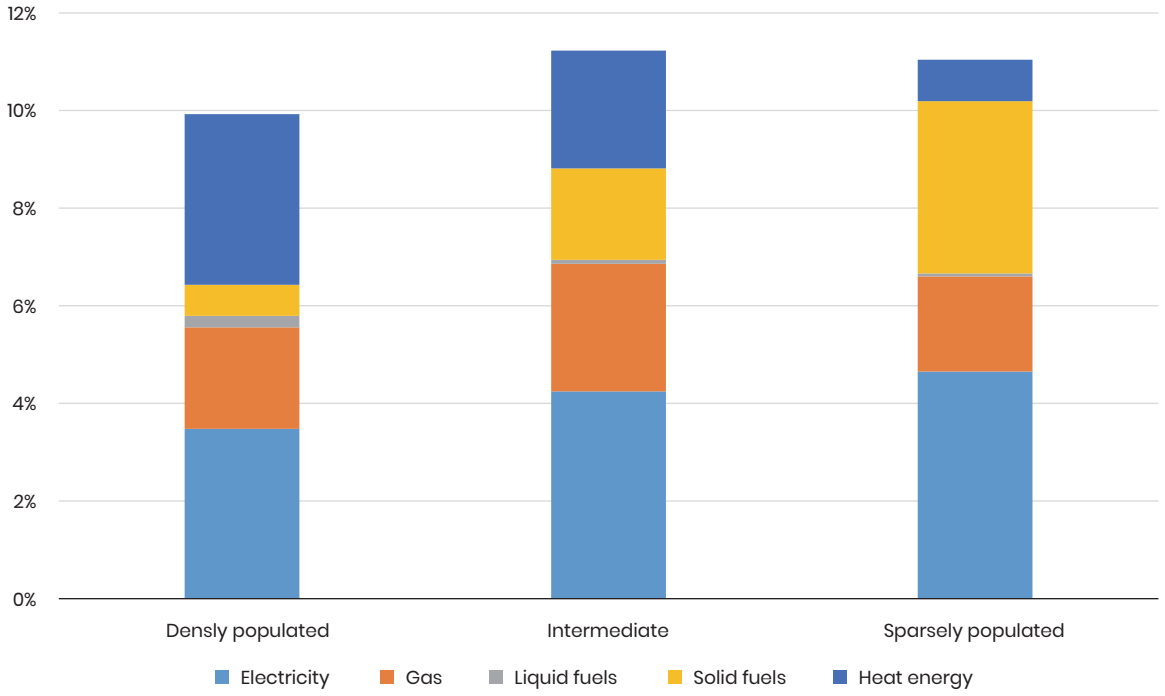
The differences in the share of expenditure on energy carriers between income deciles are not as pronounced as in the case of expenditure on transport, as shown in Figure 6. Households below the median income spend between 9.8% and 11.5% of their income on energy, with the richest decile

FIGURE 6. SHARE OF EXPENDITURE ON ENERGY CARRIERS OF HOUSEHOLDS BY INCOME DECILE IN POLAND IN 2015 [%]



Source: Own elaboration based on Eurostat HBS data.

FIGURE 7. SHARE OF EXPENDITURE ON HOUSEHOLD ENERGY CARRIERS BY DEGREE OF URBANISATION IN POLAND IN 2015 [%].



Source: Own elaboration based on Eurostat HBS data.

spending just over 8%. There are, however, considerable differences for individual energy carriers. Firstly, expenditure on electricity declines sharply with household wealth, and is 5.3% for the poorest households and 2.4% for the richest decile. In contrast, gas expenditure consumes around 2% of income for all households, while expenditure on other energy carriers increases with income, except for the last two income deciles.

> The differences in relative expenditure on energy carriers between households of different income levels are much smaller than for transport expenditure.

The increase in electricity prices as a result of the continued duration of the EU ETS is and will continue to be regressive. This means that the additional cost of purchasing electricity will place a disproportionately higher burden on households in the lower income deciles. Price increases for other energy carriers will not have such an unambiguously regressive effect, but could still be a burden for poorer households, as other studies also point out. The key, therefore, is to implement public policies to counteract the negative social effects resulting from the imposition of emission charges. These measures can take the form of temporary energy price subsidies, but in the longer term, it should also be easier for households to switch to low-carbon heating sources and at the same time, on a state-wide level, decarbonise electricity generation.

An additional challenge is the spatial aspect of energy consumption, shown in Figure 7. It appears that households located in medium and sparsely populated areas spend a larger proportion of their income on energy carriers than those located in urban areas. Moreover, there are large differences in the structure of expenditure on the different types of fuel. While urban households spend the most on electricity and district heating, the others allocate a very large proportion of their income to solid fuels. Given that power and CHP plants are already covered by the EU ETS, the increase in heating prices will affect rural households using solid fuels to a larger extent.

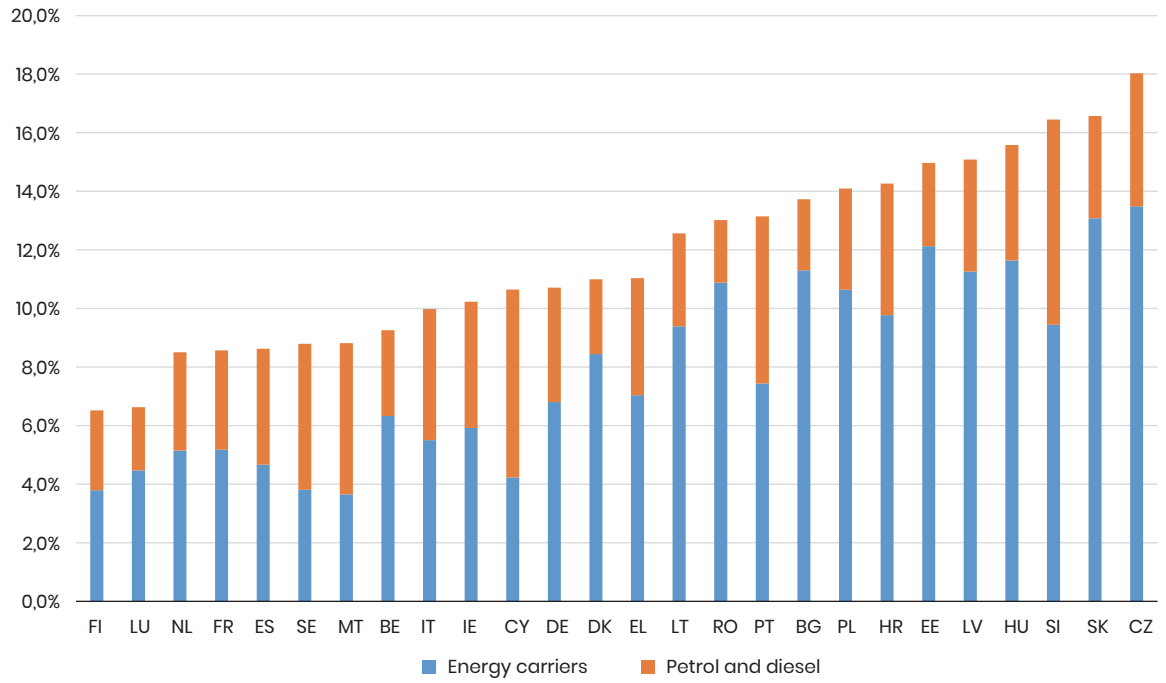
International comparison, Poland vs the EU

Polish households spend 14.1 per cent of their budget on fuels, of which the majority, 10.6 per cent, on electricity and home heating, and 3.5 per cent on fuels for cars. This is 2.3 percentage points higher than the unweighted average for EU countries, and as much as 5.5 percentage points higher than for richer EU countries such as France or Sweden. In terms of shares of expenditure on energy carriers, Poland is similar to countries in the Eastern European region. Households in countries such as Latvia, Hungary or Slovakia spend more than 14% of their budget on energy goods, which means that they will be hit harder by energy price increases.

> Compared to the rest of the European Union, Poland and other CEE countries have a high share of spending on energy goods, which means that households from these countries are more exposed to energy price increases.

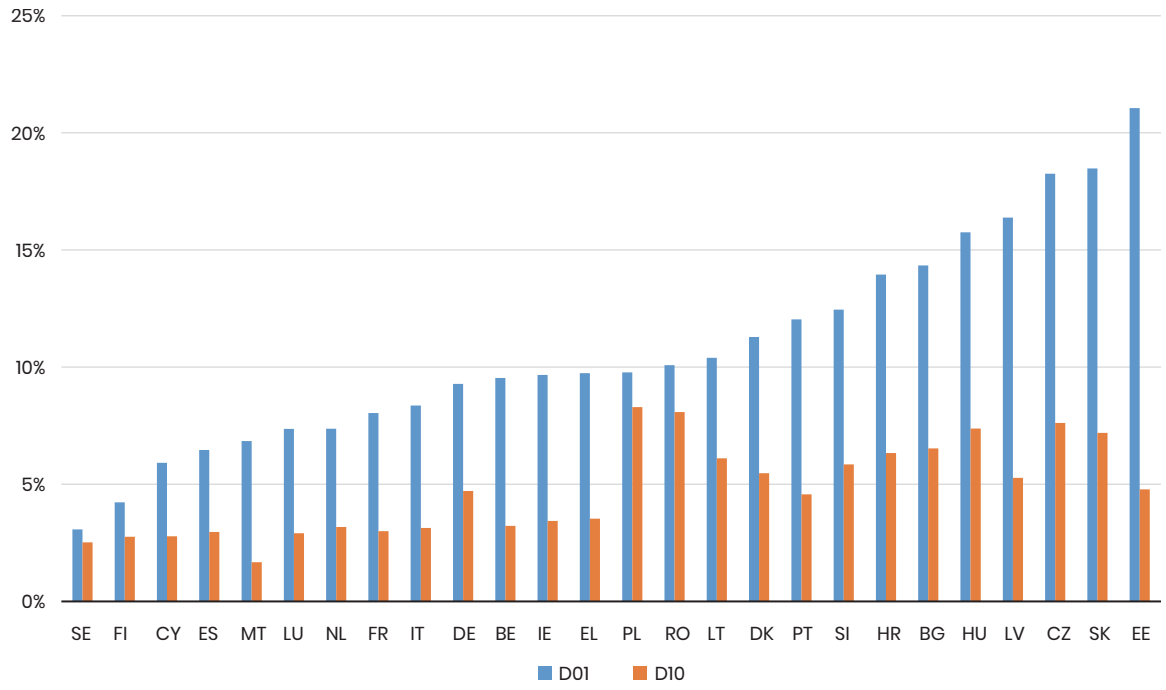
The last two graphs show the shares of expenditure in income for energy carriers (Figure 9) and petrol and diesel (Figure 10) for the first (poorest) and tenth (richest) income decile for European Union countries. In both charts, countries are ranked according to increasing expenditure shares for the poorest households. The share of expenditure of the poorest income decile on energy carriers places Poland in the middle of the set

FIGURE 8. SHARE OF EXPENDITURE IN INCOME ON ENERGY CARRIERS (ELECTRICITY, GAS, AND OTHER FUELS) AND ON PETROL AND DIESEL IN 2015 [%].



Source: Own elaboration based on Eurostat HBS data.

FIGURE 9. SHARE OF EXPENDITURE ON ENERGY CARRIERS IN INCOME FOR THE FIRST (D01) AND LAST (D10) INCOME DECILE IN EU COUNTRIES IN 2015 [%].



Source: Own elaboration based on Eurostat HBS data.

of EU countries. This share is slightly higher than in the largest and richest European economies, but at the same time lower than in other countries in the region such as the Czech Republic or Slovakia. Moreover, the differences in the share of expenditure on energy carriers between the richest and poorest decile are not so significant in the case of Poland compared to other EU countries. Here again, some of the largest differences are found in the CEE countries. Poland's position in the middle of the ranking of EU countries indicates that the poorest households in other EU countries will face a more financial difficulties than the poor households in Poland. On the other hand, the relatively high share of expenditure on energy carriers for the richest households may indicate the potential for large energy savings.

In most EU countries, the richest decile spends a higher proportion of its income on petrol and diesel than the poorest decile, which is the opposite of the situation for expenditure on energy carriers used for non-transport reasons. Poland, which here also ranks in the middle of the pack among EU countries, is no exception to this rule. This means that, in the case of fuel taxation, it will be relatively easy for most EU countries to compensate the poorest households for price increases, as such compensation will be a rather small proportion of the tax revenue raised.

> Differences in expenditure on energy and fuel carriers between the first and last income decile are not as large in Poland as in some other EU countries.

Conclusions

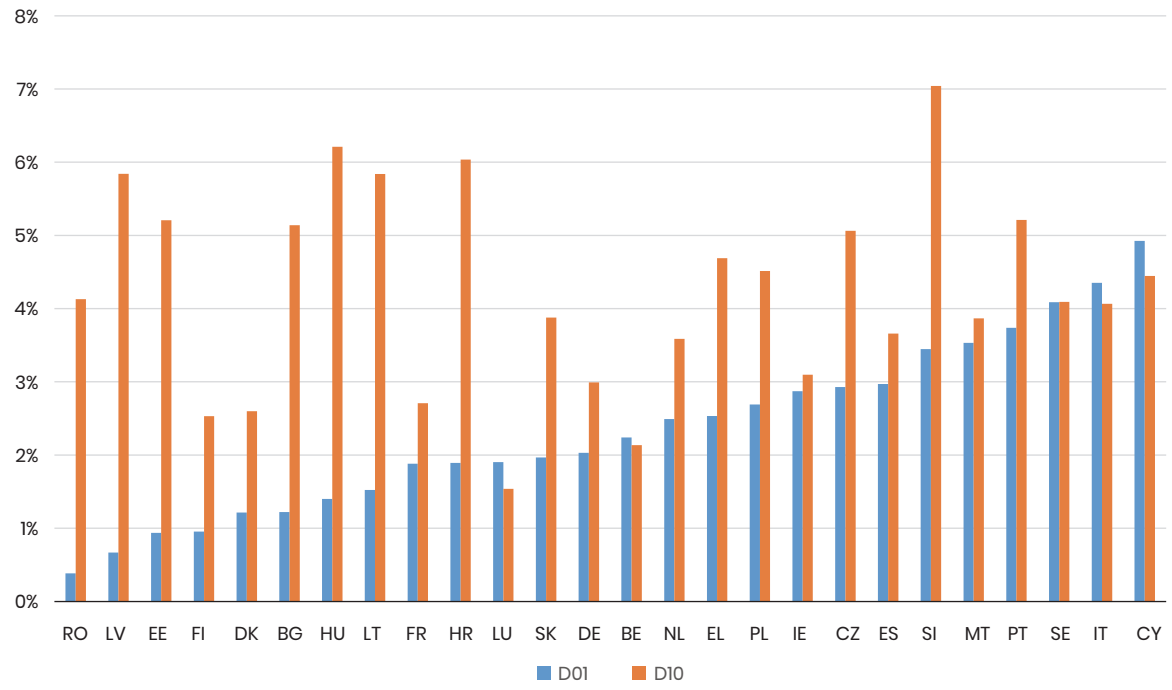
The extension of the European Emissions Trading Scheme to the buildings and road transport sectors, through the introduction of the new ETS2, responds to the challenges posed by the climate crisis and the EU's ambitious 2050 climate neutrality targets. Projections indicate that the introduction of ETS2 could significantly increase fuel prices, which will affect all household groups, but particularly those with lower incomes, creating the risk of increasing social inequality and poverty. A review of the scientific literature suggests that the introduction of fuel taxes may be regressive and that the degree of this regressivity depends on the country context, the method of analysis and how the revenues from the emissions levy are used. Researchers highlight the need to take into account social and economic impacts as well as offsetting measures in long-term climate policy plans. The European Union is responding to these challenges by introducing a Social Climate Fund to support the most vulnerable groups of society and regions.

"Faced with the introduction of ETS2, public policies such as the promotion of public transport and low-carbon heating sources will need to be implemented."

In this article, we have used data from the 2015 European Union Household Budget Surveys (HBS) to carry out an analysis of energy and fuel and transport-related expenditure for different household groups. The analysis points to the following conclusions:

- Expenditure on energy carriers and transport varies according to household income levels. The richest households spend significantly more on transport than the poorest.
- The implementation of public policies, such as the promotion of public transport or low-carbon heating sources, can help poorer households adjust to rising fuel prices.
- The introduction of ETS2 will have a greater impact on the expenditure of households living in sparsely populated areas that have limited access to alternative means of transport.

FIGURE 10. SHARE OF PETROL AND DIESEL EXPENDITURE IN INCOME FOR THE FIRST (D01) AND LAST (D10) INCOME DECILE IN EU COUNTRIES IN 2015 [%].



Source: Own elaboration based on Eurostat HBS data.

- Poland has a high share of expenditure on energy carriers in household budgets compared to other EU countries, which means that households may be more exposed to rising energy prices.
- The differences in spending on energy carriers and fuels between the first and last income decile are not as large in Poland as in some other EU countries.

> The introduction of ETS2 will have a greater impact on the expenditure of households living in sparsely populated areas that have limited access to alternative means of transport.

> Poland has a high share of expenditure on energy carriers in the household budget compared to other EU countries, which means that households may be more exposed to energy price increases.

Finally, it is worth raising some important additional issues related to the ETS2 and the planned measures related to the reduction of greenhouse gas emissions. Firstly, discussions on emission reductions in the agricultural sector have already started. These measures may increase the cost of agricultural production, which in turn may affect the price of food on domestic markets. These effects will be felt particularly painfully by poorer households. Secondly, a key aspect is how to redistribute the budget revenues generated by

ETS2. The introduction of protective measures for the households that will be most affected by the price increase becomes extremely important to ensure the social equity of the transition. In addition, it is necessary to highlight the need to switch to low-carbon energy sources, such as electrification, in order to avoid ETS2-related energy cost increases. It is also worth highlighting the importance of subsidising energy efficiency improvements through thermal modernisation, particularly for the poorest households. Implementing these solutions will be key in the context of combating climate change, while maintaining social and economic sustainability.

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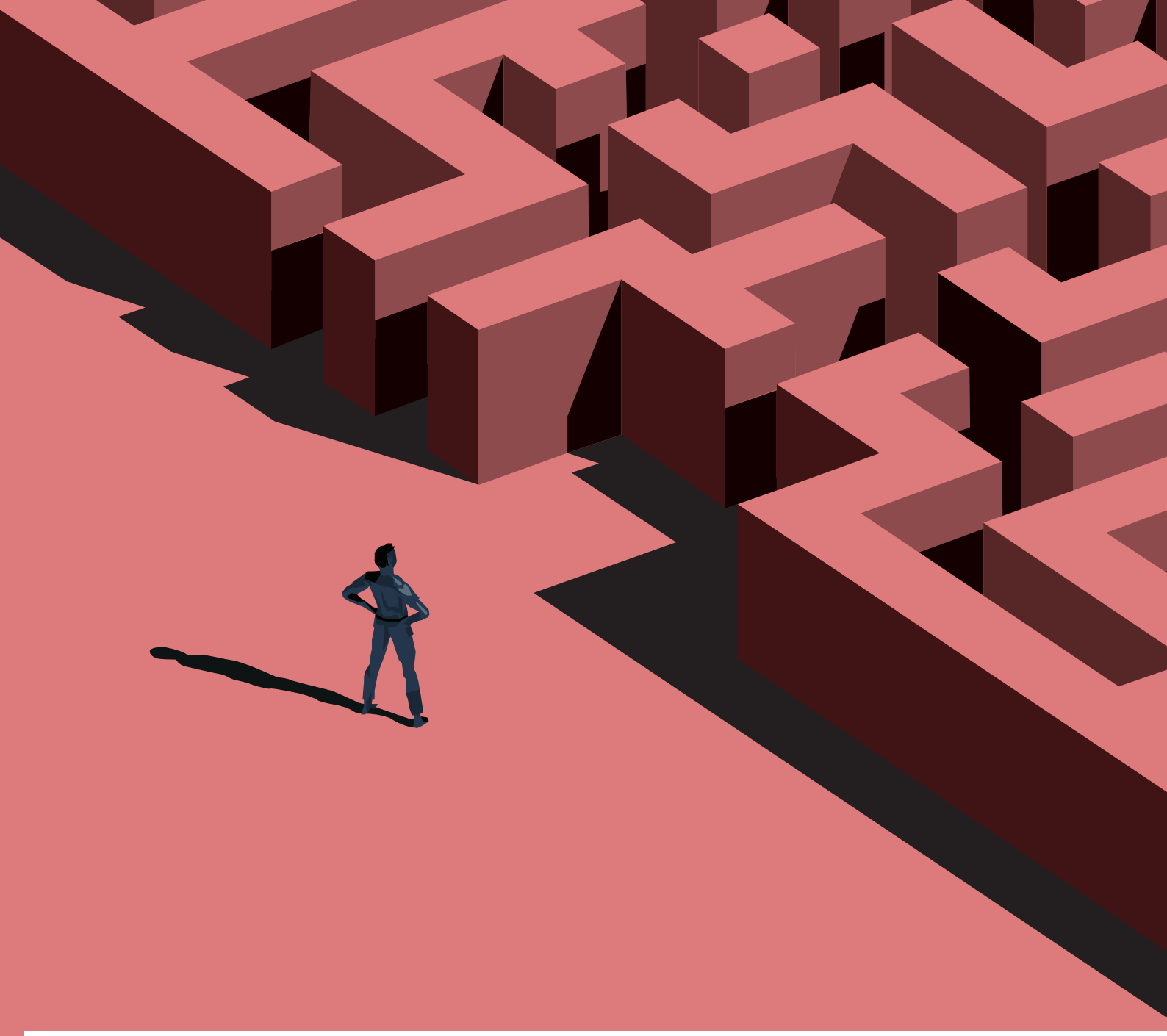

Let’s talk about the Carbon Border Adjustment Mechanism. CBAM

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Let's talk about the Carbon Border Adjustment Mechanism. CBAM

Key words: CBAM, border tax, carbon leakeage, embedded emissions, importer, goods


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Abstract

The article presents the principles of operation of the new Carbon Border Adjustment Mechanism (CBAM), which started its operation on October 1, 2023. The article focuses on the practical aspects of the functioning of the CBAM, by showing the path of conduct and identifying the obligations of individual entities indicated in legal acts. A large part of the article is devoted to the key element of the CBAM instrument, which is the determination of embedded emission. The correct determination of embedded emissions is intended to ensure that goods produced in the European Union and third countries are treated equally in terms of their emissions.

On 1 October 2023, a new instrument established by Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism[1] (hereinafter: Regulation 2023/956), the so-called CBAM mechanism (Carbon Border Adjustment Mechanism). The European Union's industry has been waiting for this instrument for several years, which has become less competitive with industry in third countries when implementing climate policy. The discussion on the introduction and development of a new instrument in climate policy, which, on the one hand, would promote climate action outside the European Union, on the other hand, does not discriminate against the EU's trading partners, requires time and an appropriate concept.

The aim of the CBAM is to change the unfavourable trend in the competitiveness of goods produced in the Union, to level the playing field and to promote climate policy on the international market. The CBAM will stimulate the introduction of similar instruments to reduce greenhouse gas emissions outside the European Union by increasing the use of low-carbon technologies. . "In the light of the above, the main objective of the CBAM is to determine the emissions of goods imported into the European Union and to introduce carbon pricing related to their production, i.e. the introduction of the „polluter pays" principle.

[1] UE L 130, 16.05.2023,p.53.

> In the light of the above, the main objective of the CBAM is to determine the emissions of goods imported into the European Union and to introduce carbon pricing related to their production, i.e. the introduction of the 'polluter pays' principle.

The second not less important task is to create economic conditions promoting investments in innovative technologies based on zero-emission production processes, which in the long term should lead to an equalisation of the production costs of goods within and outside the European Union. It should also be noted that the CBAM instrument may be a prelude to the introduction of a carbon footprint obligation for products, which will be possible once the GHG monitoring methodology is harmonised.

The main element of the solutions introduced is their compliance with WTO[2] rules (World Trade Organisation). The CBAM is designed to ensure the elimination of trade barriers that discriminate against products manufactured in the EU against goods imported into the Union and do not create solutions that favour EU goods.

In order to achieve the objectives set by the CBAM, Regulation 2023/956 established a list of goods covered by this mechanism (so-called CBAM goods). CBAM goods must reflect activities covered by the European Emissions Trading System (EU ETS) to ensure equal treatment of imported products and intra-EU products. To this end, the EU ETS and CBAM are compatible. CBAM goods are goods that are exposed to carbon leakage. Carbon leakage occurs when, due to climate policy costs, companies move production to third countries with less carbon constraints. In order to detail CBAM goods, their relevance in terms of accumulated greenhouse gas emissions, the risk of carbon leakage in the relevant sectors of the EU ETS was analysed, as well as the possibility of reducing the complexity of determining embedded emissions. The selection had to include basic materials and basic products covered by the EU ETS in order to include carbon-intensive products imported into the Union, thus ensuring an equivalent charge applicable to third country products and Union products. Under the EU ETS, Commission Delegated Decision (EU) 2019/708 of 15 February 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the identification of sectors and subsectors deemed to be exposed to a risk of carbon leakage during the period 2021-2030[3] sets out a list of commodities at risk of carbon leakage, while Annex I to Regulation 2023/956 sets out the list of commodities covered by the CBAM. CBAM's goods are cement, electricity, fertilisers, iron and steel, aluminium and hydrogen.

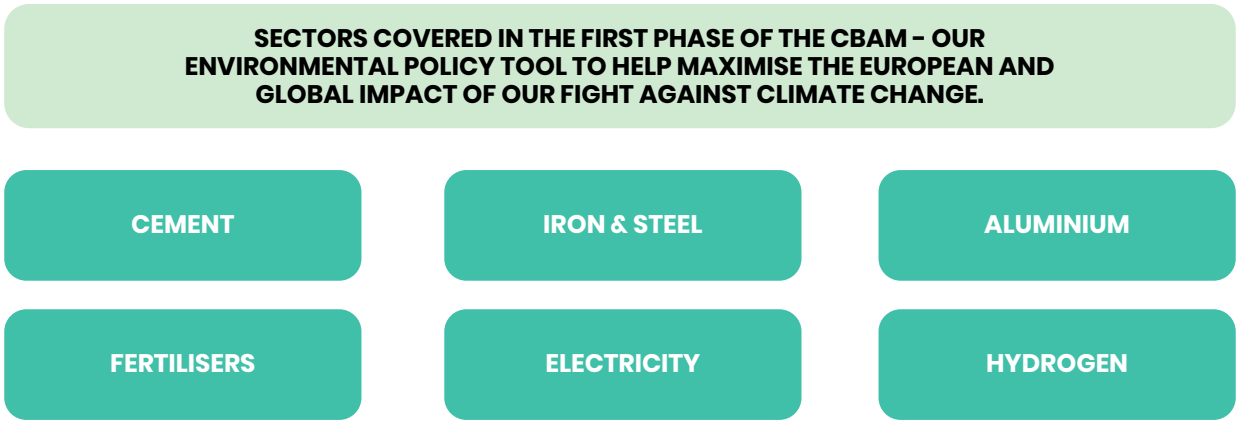
> CBAM's goods are cement, electricity, fertilisers, iron and steel, aluminium and hydrogen.

The CBAM operation is divided into two periods. The first will start in the fourth quarter of 2023 and will last until the end of 2025. This is a so-called transitional period to gather data and experience for the correct determination of embedded emissions associated with the production of goods. During this period, CBAM importers will have no emission accounting obligations but only reporting.

[2] World Trade Organisation.

[3] UE L 120 8.05.2019,p.20.

FIGURE 1. SECTORS COVERED BY CBAM



Source: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

> The first will start in the fourth quarter of 2023 and will last until the end of 2025. This is a so-called transitional period to gather data and experience for the correct determination of embedded emissions associated with the production of goods.

The second period, the so-called target period, will start on 1 January 2026 and will implement all elements of the CBAM instrument, including the cost of settlement of emissions embedded from imported goods through the purchase of CBAM certificates.

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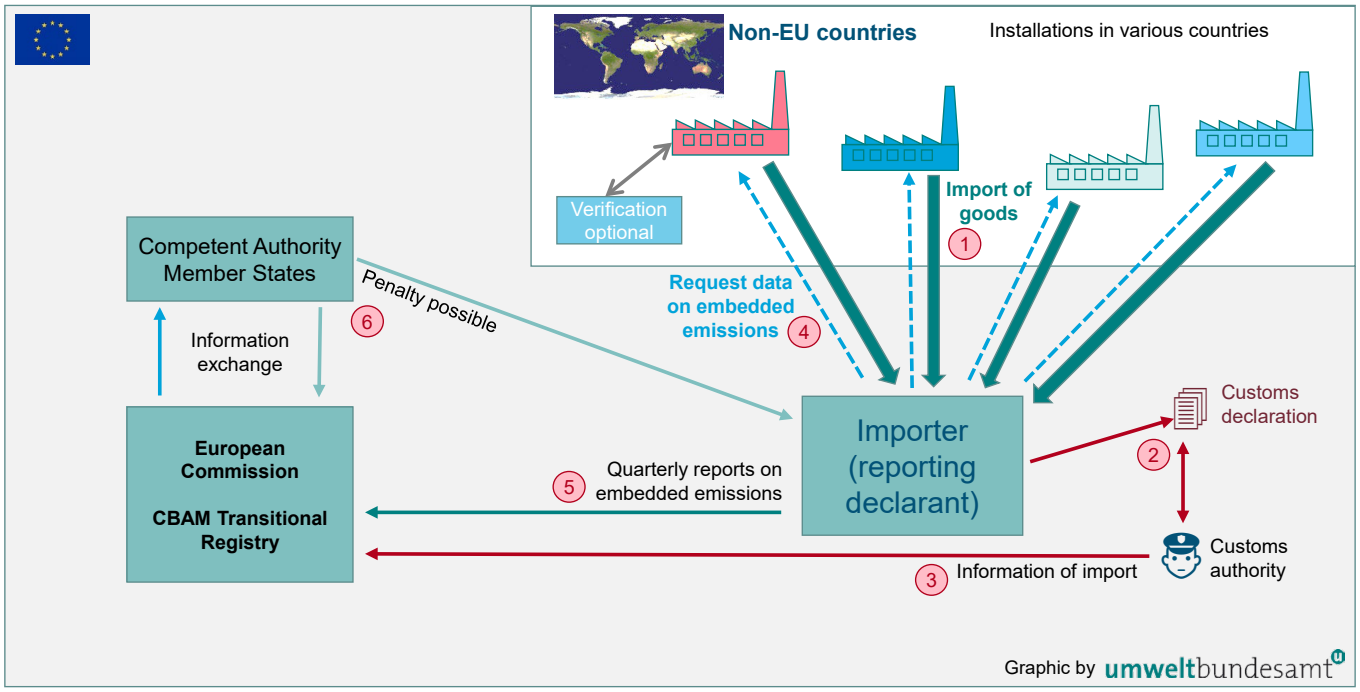
How does CBAM work?

Regulation 2023/956 divided the responsibilities and tasks between the European Commission, customs authorities and CBAM authorities in the Member States, accredited verifiers and importers who must obtain the statutes of authorised CBAM declarant (within the target period). As imports of goods into the EU were covered, it was necessary to link the adopted solutions to customs legislation, inter alia, by defining the entity responsible for monitoring, reporting and accounting for emissions. That operator is defined by law as an importer, which means 'the person lodging the customs declaration for release for free circulation on his own behalf or, where the customs declaration is lodged by an indirect customs representative, in accordance with Article 18 of Regulation (EU) No 952/2013[4], the person on whose behalf that declaration is lodged' in accordance with Article 3(15) of Regulation 2023/956. The primary tool for the monitoring, reporting

[4] Regulation (EU) No 952/2013 of the European Parliament and of the Council of 9 October 2013 laying down the Union Customs Code (EU L 269, 10.10.2013).

FIGURE 2. DISTRIBUTION OF RESPONSIBILITIES AND FLOW OF INFORMATION BETWEEN ENTITIES



Source: Guidance document on CBAM implementation for installation operators outside the EU

and settlement of emissions will be the CBAM registry, which has been set up and will be administered by the European Commission. The CBAM Registry shall contain information that will initiate the obligations of the various entities.

> The primary tool for the monitoring, reporting and settlement of emissions will be the CBAM registry, which has been set up and will be administered by the European Commission. The CBAM Registry shall contain information that will initiate the obligations of the various entities.

During the transitional period, the CBAM will operate in limited functionality that relates to the reporting and monitoring of embedded emissions from goods placed on the Union market without the need for verification by an independent verifier. An essential element of the CBAM concerns the importation of goods into the Union and therefore the customs obligations of the importer, the Importer of goods covered by the CBAM, during the transitional period are defined in Article 2(1) of Commission Implementing Regulation (EU) 2023/1773 of 17 August 2023 *laying down rules for the application of Regulation (EU) 2023/956 of the European Parliament and of the Council as regards reporting obligations for the purposes of the Carbon Border Adjustment Mechanism*[5] *during the transitional period*. The obligation to monitor and report embedded emissions lies with the importer, who has been referred to as 'reporting reporting'.

The customs declaration or declaration for release for free circulation of the goods, the importer of

[5] UE L 228, 15.9.2023, p 94.

CBAM goods, lodged with the customs authority in the Member State shall give rise to the need to take certain measures. The first concerns the customs authority, which is required to periodically and by means of the Surveillance System[6] or by electronic means of data transfer, provide the European Commission with information on imported goods, including products processed under the outward processing procedure, as well as the EORI number of the declarant and importer, the eight-digit CN code, the quantities of goods, the country of origin of the CBAM goods, the date of the customs declaration and the customs procedure. Further tasks are foreseen for the European Commission, which reviews the submitted CBAM reports through the CBAM registry during the transition period (and the CBAM declarations during the target period). The Commission has a supervisory role in the review and will provide the relevant CBAM competent authorities in the Member States with a list of importers who have failed to submit a CBAM report by the deadline. Furthermore, where the Commission considers that the report is incomplete or incorrect, it shall also provide the competent authority of the CBAM in the Member State where the importer is established with additional information on the objections it considers necessary to supplement or correct the CBAM report. At this stage, the CBAM authority enters into the Member State, which is responsible for determining whether the objections raised by the Commission are well founded. If so, the national CBAM authority shall initiate the correction procedure and notify the importer of the need to supplement the CBAM report with the additional information necessary to correct the report. If the importer has not submitted a CBAM report or has not acted to correct the CBAM report, the CBAM authority shall impose an effective, proportionate and dissuasive penalty. During the transitional period, the penalty shall be between EUR 10 and EUR 50 per tonne of undeclared issuance.

CBAM reporting

The identification of the emission reporting obligation for CBAM goods, including processed products resulting from the inward processing procedure, will be made visible through the information provided by the customs authorities in the CBAM register, as indicated. This will allow the Commission and the CBAM body and the importer to identify the obligation to monitor and report embedded, direct and indirect emissions.

CBAM reports containing information on embedded emissions, direct and indirect emissions will be submitted through the CBAM registry, which during the transitional period has been referred to as the CBAM Transition Register. The distinguish-

[6] A system allowing communication between the customs authority of a Member State and the Commission for customs surveillance and the collection of data from the customs declaration for release for free circulation or export of goods.

ing factor between the transitional and the target period is the length of the reporting period. During the target period, CBAM reports shall be submitted annually for the preceding calendar year by 31 May. However, during the transitional period, reports will be submitted more frequently and will relate to the quarter and the deadline for their submission is set by the end of the following month after the end of the quarter in question. The first CBAM report should be submitted by the end of January 2024 for the fourth quarter of 2023, while the last interim report will be submitted in January 2026.

> The first CBAM report should be submitted by the end of January 2024 for the fourth quarter of 2023, while the last interim report will be submitted in January 2026.

An important element of the transitional period is the possibility for the importer to correct the CBAM report submitted within two consecutive months following the submission of the quarterly report and the "flexibility mechanisms", which are however limited in time or quantity. Flexibility mechanisms are provided for in the legislation and concern:

- Until the end of 2024, use different methodologies for determining embedded emissions than those laid down in Regulation 2023/1773 – if they provide a similar range and level of accuracy of emissions data as those listed in that paragraph (Article 4(1)). 2);
- Until 31 July 2024, the possibility of using different methods for determining emissions than those provided for in Annex III to Regulation 2023/1773; these may be default values that will be published by the European Commission. In addition to default values, these may also be estimates of installation operators or benchmarks from other sources (Article 4(1)). 3);
- Up to 20 % of the total emissions of embedded composite goods may be based on estimates made available by installation operators (Article 5 of Regulation 2023/1773).

> The first annual report in the target period, i.e. for the year 2026, will have to enter the CBAM registry by 31 May 2027.

The first annual report in the target period, i.e. for the year 2026, will have to enter the CBAM registry by 31 May 2027.A significant limitation of CBAM functionality during the transitional period is the absence of an obligation to verify the CBAM report by an independent accredited verifier, as well as the absence of an obligation to account for embedded emissions through the surrender of a CBAM certificate.

Embedded emissions as a key component of CBAM

During the transition period and the target period, the correct definition of **'embedded emissions'** is a priority. To this end, it will be necessary to receive relevant data and information from producers of goods from third countries. For this reason, it is possible to register operators of installations from third countries whose goods are imported into the Union in the CBAM register. This approach is intended to ensure the correct demonstration of the actual embedded emissions associated with the production of the CBAM commodity together with a description of the methodology for monitoring emissions. Due to the specificity and manufacturing technologies used, the same commodity can be charged with different emissions. For this reason, when determining embed-

ded emissions, it is necessary to cooperate with operators of the installation where the goods covered by the CBAM were purchased, or such cooperation must be undertaken by a commercial intermediary, in order to obtain data and information on the production processes, the production pathways used to determine the system boundaries for a given commodity. This is to avoid the risk of emissions not related to production processes being counted or, on the other hand, omitting emissions that should be taken into account in the production process of that commodity. Therefore, cooperation between the operator of the installation producing the goods covered by the CBAM and the importer will be a key element for determining embedded emissions.

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In order to facilitate the collection of information on the methods for calculating actual emissions, an appropriate form has been prepared by the European Commission, which contains the information and data necessary for the correct calculation of emissions for the commodity. It is a **form for the exchange of information**[7] between the importer and the operator in a third country.

The introduction of monitoring rules will also allow for their harmonised application not only in the EU, as was the case with the implementation of the EU ETS, but also in third countries. This approach will guarantee the comparability of emissions of goods from third countries and the European Union, which will guarantee equal treatment in terms of emission charges incurred. Embedded emissions shall be distinguished by direct and indirect emissions. Direct emissions shall be determined on the basis of inputs of fuels and raw materials necessary for the production of the commodity, including emissions from generation, heating and cooling during production processes, irrespective of where heat or cooling is generated. Indirect emissions relate to emissions relating to the generation of electricity consumed in the production of goods, irrespective of where the electricity consumed is generated.

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The first is based on calculations that are based on the determination of emissions from source streams (precursor raw materials, fuel) on the basis of activity data obtained from measurement systems and on the basis of additional parameters obtained from laboratory analyses or standard values (default indicators). The calculation methodology can be implemented in the form of a standard method or in the form of a mass balance method. The second methodology is based on measurements, which consist of determining emissions from emission sources by continuously measuring the greenhouse gas concentration in the exhaust gas and the flue gas flow. In order to be able to de-

[7] CBAM communication template for installations – Final Draft 07.11.2023, (https://view.officeapps.live.com/op/view.aspx?src=https://taxation-customs.ec.europa.eu/document/download/2c15cd0e-2447-4ef8-ab70-68b80b66ede8_en, access: 7.11.2023).

termine the methodology for determining embedded emissions, the importer in the contract with the operator of the installation whose goods it wishes to place on the Union market must agree on which method is used by the operator and what information and data is necessary for the calculation of emissions. An important aspect related to the calculation of embedded emissions of a given commodity is the identification and determination in the production process of the significance of the so-called precursors. Whether a precursor is to be regarded as relevant in a given production process derives directly from the rules and Guidelines for the implementation of the CBAM for operators of installations outside the EU[8].

[8] Guidance document on CBAM implementation for installation operators outside the EU, 08.12.2023, European Commission Directorate-General Taxation and Customs Union, Brussels (08.12.2023).

> In a transitional period, the primary task is to gather knowledge and information on the monitoring methodology, the correct determination of the emissions of imported goods and the harmonisation of the methodology for determining the emission of goods.

In view of the above, in a transitional period, the primary task is to gather knowledge and information on the monitoring methodology, the correct determination of the emissions of imported goods and the harmonisation of the methodology for determining the emission of goods. Despite the determination of greenhouse gas emissions by operators of installations from third countries on the basis of international ISO standards, it is necessary to correctly switch from total installation emissions to emissions related to individual commodities produced in the installation with an additional breakdown of direct and indirect emissions. This approach is in some respects consistent with the determination of the carbon footprint of the product. However, a key element in the determination of the carbon footprint and benchmarking of goods is the determination of correct boundaries, in this case defining the system boundaries of benchmarks for processes that are carried out in an installation to produce a given product without processes and steps not carried out in the installation, such as transport, extraction of the raw material, etc. The only exception is emissions related to electricity that can be generated outside the installation. Due to, inter alia, the cognitive objective and the need to identify problem points, the reporting frequency has been increased to four in a given year during the transition period.

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Such an approach will allow for an ongoing response to problems and disruptions in order to reduce them during the target period, which will involve, on the one hand, accounting for embedded emissions within the CBAM through the purchase of certificates and, on the other hand, a reduced free allocation of emission allowances for installations in the EU ETS producing CBAM products. This, as mentioned at the outset, is intended to prevent subsidisation of goods manufactured in the Union, which would be incompatible with WTO rules.

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3. Regulation (EU) No 952/2013 of the European Parliament and of the Council of 9 October 2013 laying down the Union Customs Code (EU L 269, 10.10.2013).
4. Commission Implementing Regulation (EU) 2023/1773 of 17 August 2023 laying down rules for the application of Regulation (EU) 2023/956 of the European Parliament and of the Council with regard to reporting obligations for the purposes of the Carbon Border Adjustment Mechanism for a transitional period (EU L 228, 15.9.2023).
5. CBAM communication template for installations Final draft, 07.11.2023 (https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Ftaxation-customs.ec.europa.eu%2Fdocument%2Fdownload%2F2c15cd0e-2447-4ef8-ab70-68b80b66ede8_en%3Ffilename%3DCBAM%2520Communication%2520template%2520for%2520installations_en_071123.xlsx&wdOrigin=BROWSELINK, access: 7.11.2023).
6. "Guidance document on CBAM implementation for installation operators outside the EU", 17.08.2023., European Commission Directorate – General Taxation and Customs Union, Brussels (30.10.2023).
7. "Guidance document on CBAM implementation for installation operators outside the UE", Brussels, 8 December 2023, European Commission Directorate – General Taxation and Customs Union, Brussels (08.12.2023).

The role of ‘green hydrogen’ in the power system decarbonisation

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The role of 'green hydrogen' in the power system decarbonisation

Key words: green hydrogen, energy transformation, Fit for 55, EU energy and climate policy, national power system, electricity production, zero-emission technologies, renewable energy sources


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Abstract

A key factor determining the need for large-scale use of hydrogen in the electricity sector, both in Poland and in EU member states, is the need to pursue the EU's greenhouse gases (GHG) reduction commitment and energy transition towards a low-carbon economy[1]. The key role that hydrogen will play in the electricity sector in the future is primarily as a source of flexibility in systems with high penetration of RES. The CAKE Team[2] analysis of the development of the energy sector in Poland and the EU shows that, in the 2050 perspective, the installation of large amounts of intermittent RES sources, mainly wind and solar power plants, will be necessary to achieve climate neutrality. In the analysed scenarios, energy generation from wind power plants may reach a level of approx. 210 TWh (Poland) and approx. 3 900 TWh (EU+), and from solar power plants approx. 60 TWh (Poland) and approx. 2 000 TWh (EU+) in 2050[3]. The share of RES in electricity production in 2050 should be about 62-78% (Poland) and about 72-77% (EU+), depending on the scenario (a higher share of RES is found in the scenario with limited development of nuclear power plants). This entails the need to maintain an adequate number of power stations to guarantee energy supply during periods when wind and solar power plants are unable to produce energy. Currently, the role of flexible power system units is mainly played by pumped storage power stations, which tend to have limited expansion options, battery energy storage systems, which are at an early stage of development, and conventional thermal power plants (mainly gas and coal-fired). In the long term, fossil fuel-based units must be replaced by units that do not emit CO_2. Hydrogen fits very well to this vision of transformed system. According to the analyses carried out for the purpose of this article, the demand for "green hydrogen", assuming that climate neutrality is achieved in Poland and the EU+, is expected to be 70-80 PJ/year and 1 100-1 600 PJ/year in the electricity sector, respectively[4]. It means that between 25% and 35% of the total production of "green hydrogen" (depending on the scenario) will be used in this sector as an energy storage and source of flexibility. The remaining hydrogen produced will be used to sup-

[1] Tatarewicz, I.; Skwierz, S.; Lewarski, M.; Jeszke, R.; Pyrka, M.; Sekuła, M. Mapping the Future of Green Hydrogen: Integrated Analysis of Poland and the EU's Development Pathways to 2050. Energies 2023, 16, 6261. (https://doi.org/10.3390/en16176261, access: 1.09.2023.).

[2] CAKE project - an analytical center operating within the National Centre for Emissions Management (KOBiZE).

[3] Pyrka M., Jeszke R., Boratyński J., Witajewski-Baltvilks J., Antosiewicz M., Tatarewicz I., Rabiega W., Wąs A., Tobiasz I., Lewarski M., Skwierz S., Gorzałczyński A., Lizak S., Zborowska I., Chodor M., Kobus P., Krupin V., Cygler M., Mzyk P., Sekuła M. (2023). VIIEW on EU ETS 2050: Changing the scope of the EU ETS. Institute of Environmental Protection - National Research Institute / National Centre for Emissions Management (KOBiZE), Warsaw.

[4] Hydrogen demand for electricity generation, including back-up for RES.

ply other sectors - primarily industry and transport. The article analyses the role of hydrogen in the energy systems of Poland and the EU+, for three scenarios assuming different pathways to reach climate neutrality in the 2050 perspective. The results of the analyses carried out indicate the important role of hydrogen in the energy transition and an indispensable element for achieving the 'Fit for 55' and REPowerEU targets. The article examines the potential for "green hydrogen" production in Poland and the EU+, resulting from the expansion of RES sources in the aforementioned scale. The study also reviewed the needs of the electricity sector for the development of electrolysers, both for Poland and the EU+. The role of hydrogen as an energy storage was also emphasised, highlighting its use in stabilizing the electricity system.

Introduction

The increasing share of RES in the energy systems of the EU Member States will, firstly, entail the need to back them up with flexible sources and, secondly, will result in significant amounts of energy surplus, which should be utilized in the most effective way. This is done through the production of hydrogen by electrolysis, which is then used in the energy sector, or in transport and industrial sectors.

> Complete decarbonization in the transport or industrial sectors, without a prominent role for hydrogen, is practically impossible for technological reasons.

Complete decarbonization in the transport or industrial sectors, without a prominent role for hydrogen, is practically impossible for technological reasons. This is indicated by a number of studies discussing different pathways to climate neutrality in the EU[5,6,7,8]. Hydrogen is set to play a key role in the EU's energy policy. The energy transition towards an economy based on green hydrogen (which is produced by electrolysis from RES electricity) is currently at the very beginning of its development path and requires the creation of an entire supply chain practically from scratch, including production, storage, conversion, transmission and distribution. There are a number of barriers standing on the way to wider use of green hydrogen, the biggest of which is the high cost of production, currently estimated at 4-9 USD/ tH_2[9]. Electrolysis is currently more expensive than reforming-based methods, but this cost is expected to change in the future as the price of electrolysers and the unit cost of electricity generation from RES decreases.

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[5] IRENA (2022). Global Hydrogen Trade to Meet the 1.5 °C Climate Goal: Part I - Trade Outlook for 2050 and Way Forward; International Renewable Energy Agency: Abu Dhabi, United Arab Emirates, 2022.
[6] Oxford Institute for Energy Studies; Institute of Energy Economics at the University of Cologne (2021). Contrasting European Hydrogen Pathways. An Analysis of Differing Approaches in Key Markets. March 2021.
[7] European Commission. Fit for 55 package—EC PRIMES MODEL, MIX H2 scenario. Brussels. E3M Lab, University of Athens, Greece, 2021.
[8] Teske, S. (2019). Achieving the Paris Climate Agreement Goals. Global and Regional 100% Renewable Energy Scenarios with Non-energy GHG Pathways for +1.5°C and +2°C; Springer: Cham, Switzerland, 2019.
[9] International Energy Agency (2021). Global Hydrogen Review 2021.

According to opinion of many experts, investment in the construction of electrolysers has significant potential for reduction - it could be halved over the next decade[10]. The article presents predictions for the development of electrolyser costs, which then provided the basis for determining the role of green hydrogen and its positioning in the Polish and EU+ energy mix. The article also describes current and prospective technological solutions for the use of hydrogen for electricity generation. Such prospective areas for the use of hydrogen and ammonia in power generation are their combustion in gas turbines, combine cycle gas turbines (CCGT) or fuel cells, providing a flexible and potentially low-carbon option for power generation[11]. Hydrogen fuels also offer an alternative for large-scale and long-term energy storage to offset seasonal variations in electricity demand. In this aspect, they are superior to the technical storage capabilities offered by battery systems, which typically operate in short cycles of a few hours.

Production of green hydrogen

The production of green hydrogen takes place through the electrolysis of water, which is a simple electrochemical process that results in a reaction to decompose a water molecule under the influence of an electric current. The products of this process are formed at the electrodes in the form of gaseous elements:

- oxygen at the anode,
- hydrogen at the cathode.

In order for electrolysis to take place, the voltage of the external current source must be higher than the EMF (electromotive force) of the cell in

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Abbreviations:

CAKE – Center for Climate and Energy Analysis

CCGT – Combined Cycle Gas Turbine

CCS – Carbon Capture and Storage

d-PLACE – dynamic version of the CGE model developed in CAKE project

Fit for 55 – a package of EU legal acts implementing the assumptions of the European Green Deal, for this purpose The EU has to make reduction emissions greenhouse gases by 55% in 2030, compared to the 1990 level.

GHG – GreenHouse Gases

KOBiZE – The National Centre for Emissions Management

MEESA – optimization model of the energy system CAKE (Model for European Energy System Analysis)

RES – Renewable Energy Sources

PRIMES – model of the energy system used by European Commission the work on the development of energy systems (Price-Induced Market Equilibrium System)

REPowerEU – EU plan to reduce dependence on Russian fossil fuels and accelerate the green transformation

TR3E – CAKE transport sector model (Transport European Emission Economic Model)

EU – European Union

EU+ – European Union including Great Britain, Switzerland and Norway

which the reaction takes place, which is the reverse of the reaction in the electrolyser[12]. There are currently at least four types of electrolysers: ALK: ALKaline, PEM: Proton Exchange Membrane, AEM: Anion Exchange Membrane and SOEC: Solide Oxide Electrolysis Cell.

The most mature and currently the cheapest is the technology based on ALK electrolysers. However, in view of the use of electrolysers to produce green hydrogen from surplus renewable energy sources, PEM technology appears to be much more attractive, due to its fast start-up and relatively low operating temperature. The disadvantage of PEM electrolysers is their higher price, which is mainly due to the use of precious metals for its production, such as iridium or platinum, while at the same time the high price of the membrane[13]. However, it is anticipated that PEM electrolysers will soon become cheaper and, in the long term, economically unrivalled compared to ALK[14]. This technology has a number of advantages, such as higher efficiency (56-73%) and the ability to produce ultra-pure hydrogen (purity class of up to 99.99%), as well as a more compact design[15]. The investment expenditure for the construction of the aforementioned electrolysers in the 2050 perspective is presented in Table 1. As these table figures show, PEM electrolysers are projected to become half the price as early as 2030.

In terms of operating costs (O&M: Operating and Maintenance), these are very similar for PEM and ALK electrolysers, averaging 2% of capital expenditure (CAPEX) per year. Operating costs for solid oxide electrolysers are slightly higher at 5% for SOEC's[16,17]. These parameters are unlikely to change significantly in the future. These costs, together with the cost of electricity to power the electrolyser, are among the main elements contributing to the total cost of producing green hydrogen. At present, it is relatively high (at the level of 4-9 USD/kgH_2 in Europe). Estimations of BloombergNEF[18] indicate slightly lower values at 2.5 – 6.8 USD/kgH_2, but it should be noted that these are probably for exceptionally attractive locations for RES (the average annual cost of electricity generation in Poland is much higher than, for example, in Portugal or Spain, where the wind conditions and sun exposure are much better).

Technologies for the use of hydrogen in the energy sector

The optimum solution for the production of electricity and heat is cogeneration systems based on fuel cell technology, where the fuel is, among other things, hydrogen. A fuel cell is a device that converts the chemical energy of a fuel (in addition to hydrogen, it can also be, for example, methanol or natural gas) into electricity and/or heat. On the contrary to batteries, they last as long as fuel and oxidant are supplied. Hydrogen can be converted in fuel cells into electricity and heat with high efficiencies, depending on the type of cell. There are currently a few main types of fuel cell, all of which consist of three basic components: two electrodes and a separating electrolyte. The following are the basic types of fuel cells:

- PEMFC: Proton Exchange Membrane Fuel Cell,
- AFC: Alkaline Fuel Cell,

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TABLE 1. COST OF ELECTROLYSERS – CAPEX [USD'2020/KW$_{EL}$]

Type of electrolyser	ALK	PEM	SOEC
2020	1050	1200	1900
2030	850	590	1190
2040	570	380	740
2050	490	320	590

Source: Kupecki J. and others (2021). Analysis of the potential of hydrogen technology in Poland to 2030 (outlook to 2040). Warsaw, 2021.

- PAFC: Phosphoric-Acid Fuel Cell,
- SOFC: Solid-Oxide Fuel Cell,
- PCFC; Protonic Ceramic Fuel Cell,
- MCFC: Molten-Carbonate Fuel Cell[19].

The above classification determines the type of electrochemical reactions taking place in the cell, the type of catalyser used, the fuel and the operating temperature[20]. At the current stage of technical development, PEMFC, AFC and SOFC cells are considered to be the most promising. Alkaline electrolysis is a mature technology for large systems, while PEMFC electrolysers are more flexible and can be used in small, decentralized solutions, what is a desirable feature in the context of their interaction with the grid to which large amounts RES are connected. The conversion efficiency for both technologies is around 60%. (LHV[21])[22]. An important advantage of polymer cells, in addition to the short start-up time, is the high resistance of the electrolyte to gas corrosion. The main disadvantages include: difficulty in maintaining a stable temperature, susceptibility to catalyst poisoning by CO, sulphur compounds and NH_3. Among all available technologies, solid oxide fuel cells (SOFCs) have the highest efficiency in combined heat and power systems, reaching up to 90% LHV. These are high-temperature cells, operating in a temperature range of 600-1000°C[23]. High operating temperatures have their advantages in terms of higher efficiency and the possibility of utilising heat (cogeneration), but it affects negatively on their lifetime. Current work on improving this technology, focuses primarily on cost reduction, as of all types of fuel cells, they are the most expensive (Table 2).

In addition to fuel cells, gas turbines represent an alternative way of producing electricity and heat based on hydrogen fuel. Since around 2015, various manufacturers have been testing hydrogen combustion in turbines ranging from a few to several hundred megawatts of power.

> Unlike biomethane, which can almost immediately replace natural gas in existing gas turbines, the use of hydrogen presents significant technological challenges.

[19] Li, H.; Zhao, H.; Tao, B.; Xu, G.; Gu, S.; Wang, G.; Chang, H. Pt-Based Oxygen Reduction Reaction Catalysts in Proton Exchange Membrane Fuel Cells: Controllable Preparation and Structural Design of Catalytic Layer. Nanomaterials 2022, 12, 4173. https://doi.org/10.3390/nano12234173 (Accessed 8/09/2023.).

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[21] LHV – Lower Heating Value.

[22] https://www.energy.gov/eere/fuelcells/comparison-fuel-cell-technologies , accessed: 6.09.2023.).

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Unlike biomethane, which can almost immediately replace natural gas in existing gas turbines, the use of hydrogen presents significant technological challenges. In terms of mass, the energy density of hydrogen is more than twice that of natural gas, but the energy density per volume is low. The combustion process of hydrogen itself is much faster than that of natural gas. The switch to hydrogen fuel in the power industry therefore depends on the ability to adapt gas turbines (especially existing ones) to burn a completely new fuel. As far as new turbines are concerned, leading manufacturers are already declaring their technical solutions ready to burn hydrogen alone as well as hydrogen-natural gas mixtures in any proportion.

Methodology

The role of green hydrogen in the Polish and EU electricity system was analysed using the MEESA energy model (*Model for European Energy System Analysis*), based on linear programming and combined with a general equilibrium model CGE (*Computable General Equilibrium*), named d-PLACE[24] and the transport sector model TR^{3}E[25]. This approach allows the analysis to be carried out in a comprehensive manner, taking into account all sectors of the economy and the relations and interactions between them. The d-PLACE and TR^{3}E models determine the annual demand for green hydrogen from other sectors of the economy, while the MEESA model optimizes, on a two-hourly basis, both hydrogen generation and hydrogen demand in the energy sector itself. This integrated approach combines an analysis of the demand for green hydrogen across the economy with the complex challenges and opportunities presented by electrolysis hydrogen production. In systems characterized by a high share of RES, the key is to produce green hydrogen from surplus energy. In order to model this, the variability of RES generation and the changing demand over time must be simulated simultaneously.

The key assumption that determines the results obtained is the achievement of climate neutrality by 2050, which is in line with the targets from the Fit for 55 package. Another important assumption is the need to maintain self-sufficiency of resources, which in this particular analysis means that the potential to produce green hydrogen only within the EU+ was investigated (import from third countries was blocked).

The MEESA model in principle is used to analyse the supply side of electricity, district heating and hydrogen produced by electrolysis. The model finds the lowest cost solution for the whole system under given constraints of a technical, resources, legal etc. The models listed above were developed within the LIFE Climate CAKE PL project. For more information about the models and the methodology used in system analyses, see the CAKE project website[26].

Scenarios considered

The article presents results for the development of the electricity sector in Poland and the EU+, for three scenarios:

- **EU Climate Neutrality scenario (fit)** - a baseline scenario assuming approximately 90% emissions reduction in 2050 compared to 1990 and net zero emissions (including removals) across the EU+ economy. This scenario assu-

[24] Boratyński, J.; Pyrka, M.; Tobiasz, I.; Witajewski-Baltvilks, J.; Jeszke, R.; Gąska, J.; Rabiega, W.; The CGE Model d-PLACE, ver.2.0. The Institute of Environmental Protection – National Research Institute/National Centre of Emissions Management (KOBiZE), Warsaw 2022.

[25] Rabiega, W.; Sikora, P.; Gąska, J.; Gorzałczyński, A.; TR3E Model, ver.2.0. The Institute of Environmental Protection – National Research Institute/National Centre of Emissions Management (KOBiZE), Warsaw 2022.

[26] https://climatecake.ios.edu.pl/information-materials-and-publications/toolkit-documentation/?lang=en (Access: 01.09.2023.).

TABLE 2. FUEL CELLS – CAPEX AND OPEX

Technologies	CAPEX (USD'2020/kW)			OPEX (USD'2020/kW)		
	2020	2030	2050	2020	2030	2050
PEMFC - centralised large scale	1610	740	200	49.0	15.0	10.0
AFC – centralised large scale	1265	600	180	28.0	14.0	9.0
SOEC – centralised large scale	3332	1421	600	55.8	36.2	39.0
PEMFC – small, decentralised	2530	1175	350	77.0	34.0	18.0
AFC – small, decentralised	1898	715	300	41.0	17.0	15.0
SOEC – small, decentralised	5331	2921	1100	94.9	63.3	48.8

Source: EU Reference Scenario 2020. (https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en, access: 4.09.2023.).

mes meeting the targets set out in the Fit for 55 package within a defined timeframe (net zero in 2050).

- **EU Climate Neutrality scenario with no new nuclear power plants in the EU+ (no_nuc)** - a scenario for achieving climate neutrality in the EU+ without further nuclear development (no new nuclear power plants will be built and existing plants will operate to the end of their operational lifetime). It address the question of whether the possible abandonment of the wider use of nuclear power would have a significant impact on the potential for green hydrogen production.
- **EU climate neutral scenario with high use of green hydrogen available in the EU+ (hi_hyd)** - scenario assuming a higher potential for the construction of electrolysers in the EU+ compared to the **fit** scenario, and significant subsidies for green hydrogen production between 2025 and 2035. Subsidies were assumed at €15/GJ between 2025 and 2030, falling to €5/GJ in 2035. No subsidies were assumed after 2035. The same level of subsidies was applied in all regions except Poland. In the case of Poland, due to very high electricity prices in 2030, the level of subsidies needed to promote faster development of hydrogen production was about twice as high as in other regions.

The time horizon is defined for the period 2020-2050, with the results of the analysis focusing on 2050 in order to include a key period for assessing the impact of energy and climate policy and the achievement of European GHG reduction targets.

In all scenarios, fuel prices were assumed on the basis of the PRIMES Reference Scenario 2020 projection (hereafter PRIMES_Ref_2020)[27], with the following adjustments:

- over the period to 2025, gas prices were increased by 3 times compared to the PRIMES_Ref_2020 forecast, coal prices by 2 times and oil prices by 1.5 . It was assumed that the fuel price spike observed lately was temporary and that prices remain stabilised from 2023 onwards.
- from 2030, fossil fuel prices return to the path of the PRIMES_Ref_2020 forecast.

[27] Primes Reference Scenario 2020, Final Assumptions, E3-Modelling, Bruksela 2021.

Results

Figure 1 shows the structure of electricity generation in Poland and the EU+ in the 2050 perspective, developed in the MEESA model. Its form is determined by the realisation of the basic assumption of the analysis, i.e. achieving climate neutrality in the considered time horizon and meeting the requirements resulting from the Fit for 55 package by 2030.

Both structures presented here (Poland and EU+), are characterized by a high share of intermittent RES sources. After 2030, onshore wind, offshore wind and solar power, become the dominant generation technologies in the systems analysed and, at the same time, a source of surplus energy that can be used to power electrolysers.

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In the analysed scenarios, in 2050 energy generation from wind power plants reaches a level of approx. 210 TWh (Poland) and approx. 3 900 TWh (EU+), and from solar power plants approx. 60 TWh (Poland) and approx. 2 000 TWh (EU+)[28]. The share of intermittent RES sources in electricity production will reach between 62 and 78% (Poland) and about 72-77% (EU+) in 2050. For both Poland and the EU+, the higher shares of RES concern the scenario without nuclear power plants. For Poland in particular, this means a significant increase in the share of RES in domestic generation. However, in absolute values, due to the limited potential of wind and photovoltaic power plants, the actual increase in generation from these sources is negligible, and the increase in share is mainly due to a reduction in energy demand (as a result of higher energy prices) and an increase in imports.

With regard to EU+, there is an almost complete transition to zero-carbon technologies in electricity generation by 2050. Emission sources, such as waste combustion plants or gas-fired power plants, for example, will account for less than 1.5% of total electricity generation (the latter primarily as peaking units). Similar results were obtained for Poland, except for the scenario assuming no development of nuclear power plants, in which the share of electricity from CO_2 emitting sources (mainly gas-fired power plants) would reach 8%. This does not change the fact that also in this scenario, due to the use of BECCS technology, the balance of emissions in the electricity system is negative.

Based on calculations, the green hydrogen produced in electrolysers is mainly supplied to the industrial, transport and other final consumption sectors. The use of hydrogen for electricity generation does not noticeably increase until after 2040. In Poland, it ranges from around 10 TWh per year in 2050, while in the EU+ it is between 220 and 260 TWh per year in scenarios that include the development of nuclear power.

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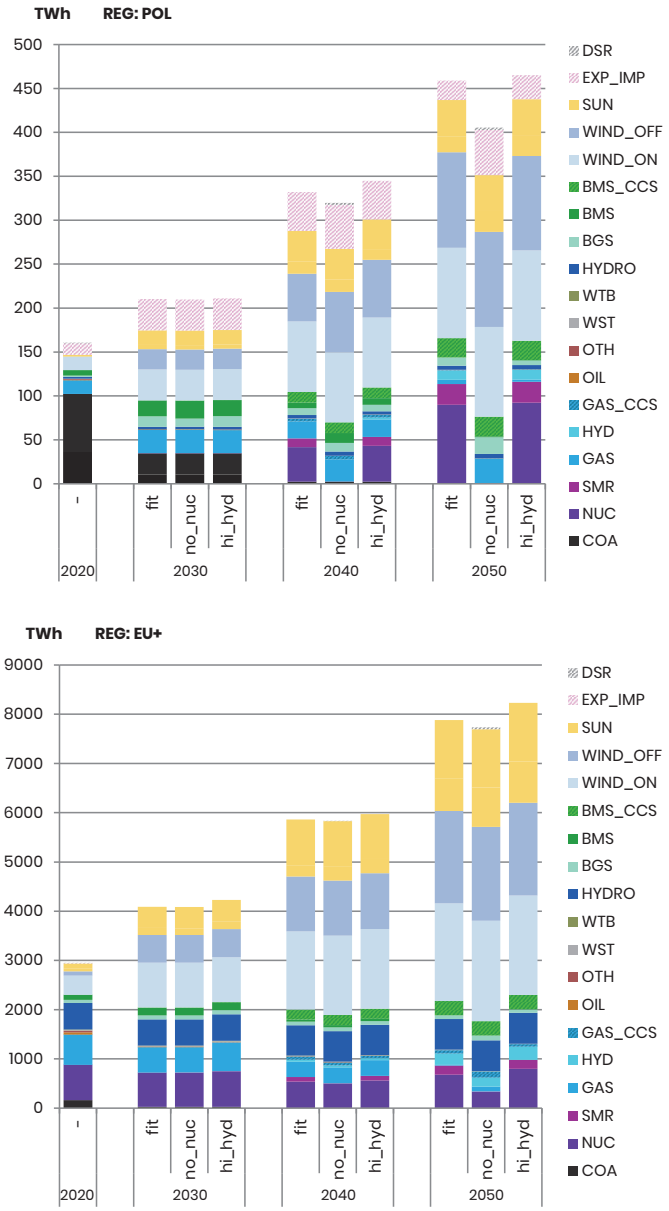
In the scenario without new nuclear power plants, electricity production from hydrogen in the EU

[28] Pyrka M., Jeszke R., Boratyński J., Witajewski-Baltvilks J., Antosiewicz M., Tatarewicz I., Rabiega W., Wąs A., Tobiasz I., Lewarski M., Skwierz S., Gorzałczyński A., Lizak S., Zborowska I., Chodor M., Kobus P., Krupin V., Cygler M., Mzyk P., Sekuła M. (2023). VIIEW on EU ETS 2050: Changing the scope of the EU ETS. Institute of Environmental Protection - National Research Institute / National Centre for Emissions Management (KOBiZE), Warsaw.

FIGURE 1. ELECTRICITY PRODUCTION IN POLAND AND EU+ BY 2050 IN THE CONSIDERED SCENARIOS [TWH]



Legend:

DSR	Demand Side Response
EXP-IMP	Import-export exchange balance
SUN	Photovoltaics
WIND_OFF	Wind offshore power plants (PP)
WIND_ON	Wind onshore PP
BMS_CCS	Biomass with CCS PP
BMS	Biomass PP
BGS	Biogas PP
HYDRO	Hydro run-on-river PP
WTB	Renewable waste PP
WST	Non-renewable PP
OTH	Other fuels PP
OIL	Oil PP
GAS_CCS	Gas with CCS PP
HYD	Hydrogen PP
GAS	Gas PP
NUC	Nuclear PP
COA	Coal PP

Source: Own calculations CAKE/KOBiZE

is significantly lower - about 180 TWh. In case of Poland, the lack of nuclear power plants practically eliminates the use of hydrogen for electricity generation. Although the share of electricity production from hydrogen is not large, it is nevertheless a valuable addition and an element that improves the flexibility of a system with a large share of intermittent RES.

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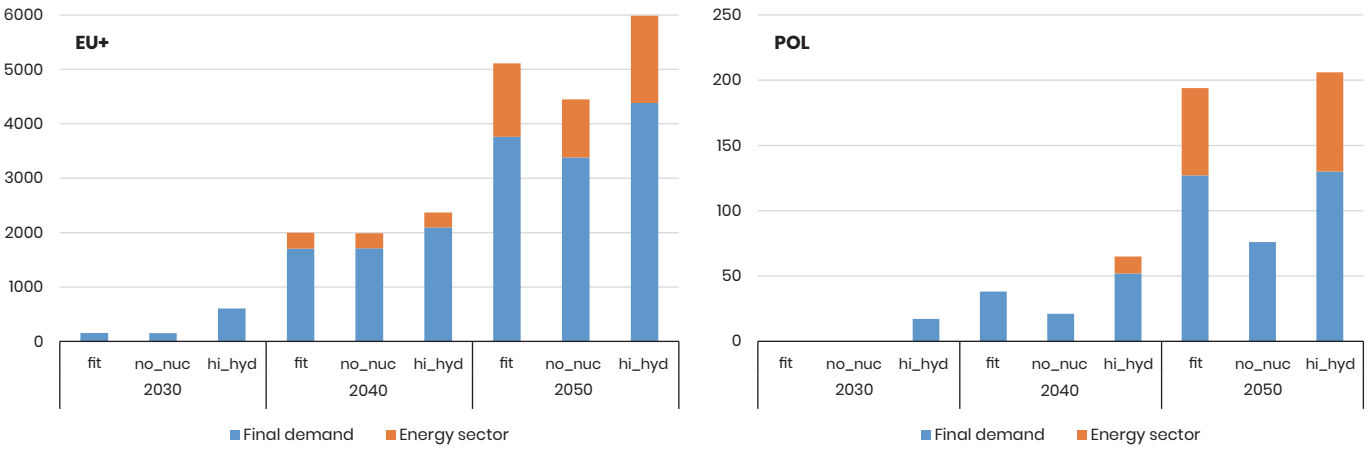
It primarily enables the use of surplus energy during periods of low demand and acts as a long-term energy store - energy is stored in hydrogen, which is then consumed in various sectors. It also allows natural gas to be substituted as the fuel used at times of peak demand.

Figure 2 shows the results of the hydrogen demand projections broken down into energy sector and other final demand sectors. It is worth noting that in scenarios considered, demand equals production, as no imports of hydrogen to EU+ from third countries were assumed, because the only intention of authors was to explore its production potential within the EU+.

In the **fit** scenario, hydrogen production in 2050 is less than 200 PJ in Poland and just over 5,100 PJ in the EU+. In Poland, about 35% of hydrogen is used in power generation and 65% in other sectors. At the EU+ level, the share of hydrogen production for energy use is slightly lower (at around 25%). In the electricity sector, the demand for green hydrogen, assuming the achievement of climate neutrality in Poland and the EU+, will be around 70 PJ/year and 1,350 PJ/year, respectively.

Results for the **no_nuc** scenario indicate significantly lower hydrogen consumption (both in the final consumption and energy sectors). In the EU+, this consumption is about 4,450 PJ of which about 1,050 PJ in the power sector, while in Poland it is about 75 PJ, with hydrogen not being used at all for electricity production. In this scenario, demand for hydrogen appears only in the final consumption sectors, which is significantly anyway reduced due to the higher cost of hydrogen (less surplus results in a higher cost of hydrogen production). this is the most noticeable difference compared to the **fit** scenario, which confirms the importance of nuclear power in the context of the development of the hydrogen economy. With limited RES potential and the lack of other zero-carbon and disposable sources, nuclear power plants guarantee a stable electricity supply, which also affects the availability and price of green hydrogen. The highest hydrogen production volumes were obtained in the **hi_hyd** scenario (for the EU+ it is close to 6,000 PJ of which about 1,600 in the energy sector, while for Poland it is just over 200 PJ of which about 75 in the energy sector), which is the logical consequence, given that this scenario assumes a higher

FIGURE 2. HYDROGEN DEMAND IN POLAND AND IN EU+ BY 2050 [PJ]



Source: Own calculations CAKE/KOBiZE

TABLE 3. ELECTROLYSER CAPACITIES INSTALLED IN EU+ AND POLAND BY 2050 [GW]

	fit	no_nuc	hi_hyd
Poland	14	6	16
EU+	392	388	519

expansion potential for electrolysers. However, the model did not rely on the maximum values of the assumed potential. This is an important observation as it shows that the development of electrolysers may be limited by many other factors than cost, namely: the availability of surpluses from RES production, the shape of the demand curve, the scale of development of energy storage to compete in the market with electrolysers, and even the share of electric cars. These elements will also have an impact on the use of hydrogen in power generation.

The low level of green hydrogen production in 2030 in all scenarios except **hi_hyd** (which assumes a significant level of subsidised green hydrogen production) shows that rapid development of this technology, without support, is unlikely. Especially in the initial forecast period, i.e. 2025-2030, green hydrogen requires significant subsidisation. The production of the given volumes of hydrogen will require the construction of a large number of electrolysers. In Poland, their installed capacity[29] in 2050 is between 6 and 16 GW, depending on the scenario. In the EU+, on the other hand, between 388 and 519 GW.

Summary

Green hydrogen will play a key role in the energy transition of Poland and the EU. In particular, its use will have a significant impact on meeting climate neutrality targets in sectors where, for technological reasons, it is difficult, if not impossible, to reduce GHG emissions. This is particularly true of the industrial and transport sectors. In the electricity sector, hydrogen as a primary fuel is likely to play a minor role, due to the high costs of hydrogen-based electricity production, but it can nevertheless make a significant contribution to improving the stability and flexibility of the energy system. Hydrogen (also in the form of ammonia) can be used, among others, as a fuel in gas turbines (both new and existing), combined cycle gas turbine (CCGT) systems or fuel cells. Integrating nuclear energy into the energy mix could significantly accelerate the development of green hydrogen technologies. Not only it increases economic viability, but also provides the system flexibility required for large-scale hydrogen production.

The potential for direct use of green hydrogen in the electricity sector in Poland and the EU+, assuming climate neutrality is achieved in 2050, is estimated at 70-80 PJ/year and 1,100-1,600 PJ/year respectively. Greater potential for the use of green hydrogen lies on the possibility of large-scale and long-term storage for use in other end-use sectors. The share of hydrogen going to other sectors will be around 65-75% in 2050. The results of the analyses carried out indicate the need to subsidize the production of green hydrogen, especially in the initial period 2025-2035, due to the low competitiveness of hydrogen in relation to other fuels at current costs.

[29] Output power understood as the instantaneous amount of hydrogen production. Maximum electrical power requirement for power supply electrolyzers may be approximately 20% higher than the presented values.

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Proposal on a European framework for the certification of carbon removals and AgETS system for agriculture – new challenges on the way to EU climate neutrality by 2050

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Proposal on a European framework for the certification of carbon removals and AgETS system for agriculture – new challenges on the way to EU climate neutrality by 2050

Key words: CDR, ETS, EU ETS, AgETS, removals, certification of removals, GHG

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Abstract

The European Climate Law sets the goal of achieving climate neutrality of the European Union by 2050. Reducing greenhouse gas emissions (GHG) is not sufficient to achieve this goal, which is why there is more and more talk about the need to capture and remove carbon dioxide from the atmosphere in order to offset emissions that cannot be avoided and, in the longer term, to move towards net-negative CO_2 emissions in the European Union. Carbon dioxide absorbers, also known as CDRs or carbon dioxide removals, have become a popular topic in the European arena. The catalogue of possible activities that lead to carbon dioxide sequestration is very broad.

A very important step towards increasing the role of CDR in the EU's climate policy is the Commission proposal to create an effective carbon dioxide removal system (at the EU level), and its key element is to ensure reliable certification of such activities. The EU is at the beginning of this path, however it will be a complex process with many challenges that will need to be addressed to ensure the credibility of the units generated. An effective and efficient CDR system should build trust among stakeholders, including governments, businesses and the public.

Another potential element of the EU's CDR policy is the creation of an emissions trading system for agricultural sector. In this context, the Commission is exploring the possibility of pricing agricultural GHG emissions across the value chain via a new and separate emissions trading system (AgETS), as well as rewarding farmers and other landowners for climate action through effective carbon farming practices.

Introduction to the issue

One of the key conclusions of the Special Report on Global Warming of 1.5°C (SR15), published by the Intergovernmental Panel on Climate Change (IPCC) on the 8th of October, 2018, is stating that "if the increase in global temperatures temporarily exceeds ('overshoots') 1.5°C, it will be necessary to use techniques for removing CO_2 from the atmosphere to reduce its concentration in the atmosphere and lower global temperatures. [...] The bigger the exceedance is and the longer it lasts, the more we will need to rely on Carbon Dioxide Removals (CDRs)." The report also clearly states that "to achieve net zero CO_2 or GHG emissions, it is inevitable that carbon removal activities will be implemented to offset the residual emissions that are difficult to reduce."[1]

> If the increase in global temperatures temporarily exceeds ('overshoots') 1.5°C, it will be necessary to use techniques for removing CO_2 from the atmosphere to reduce its concentration in the atmosphere and lower global temperatures. [...] The bigger the exceedance is and the longer it lasts, the more we will need to rely on Carbon Dioxide Removals (CDRs). (IPCC, 2018)

While the IPCC recognizes that carbon sequestration will be necessary to meet the goals of the Paris Agreement, there is still debate about how to define "unavoidable" emissions and the scale of necessary sequestration needed to achieve by mid-century. We are currently not on track to meet the Paris Agreement (PA) temperature target. According to the IPCC, the paths of global warming temperature increases are defined by the Representative Concentration Pathways (RCP), which describe different scenarios of GHG emissions and their impact on the climate. We are currently on the RCP 2.6 or RCP 3.4 path, which leads to a temperature increase of about 2°C by the end of the 21st century. To limit warming to 1.5°C, we need the RCP 1.9 path, which requires zero CO_2 emissions by 2100. The situation is similarly unfavourable when it comes to the necessary increase in the scale of application of current or proposed CDR methods in order to close the widening gap – a necessary action, in addition to simultaneous "deep emission reductions in all sectors, a wide range of opportunities to minimize emissions and a significant increase in investing in these types of opportunities". Most global scenarios indicate that several hundred Gt of CO_2 will need to be removed by the end of the century to reach the 2°C PA temperature target, and close to a thousand Gt of CO_2 will need to be removed to reach the 1.5°C PA temperature target. For comparison, the current annual CO_2 emission of approximately 40 Gt illustrates the scale of activities necessary to achieve sufficient removal. These scenarios also indicate that removal will need to start now and accelerate rapidly in the coming decades (see Fig. 1).

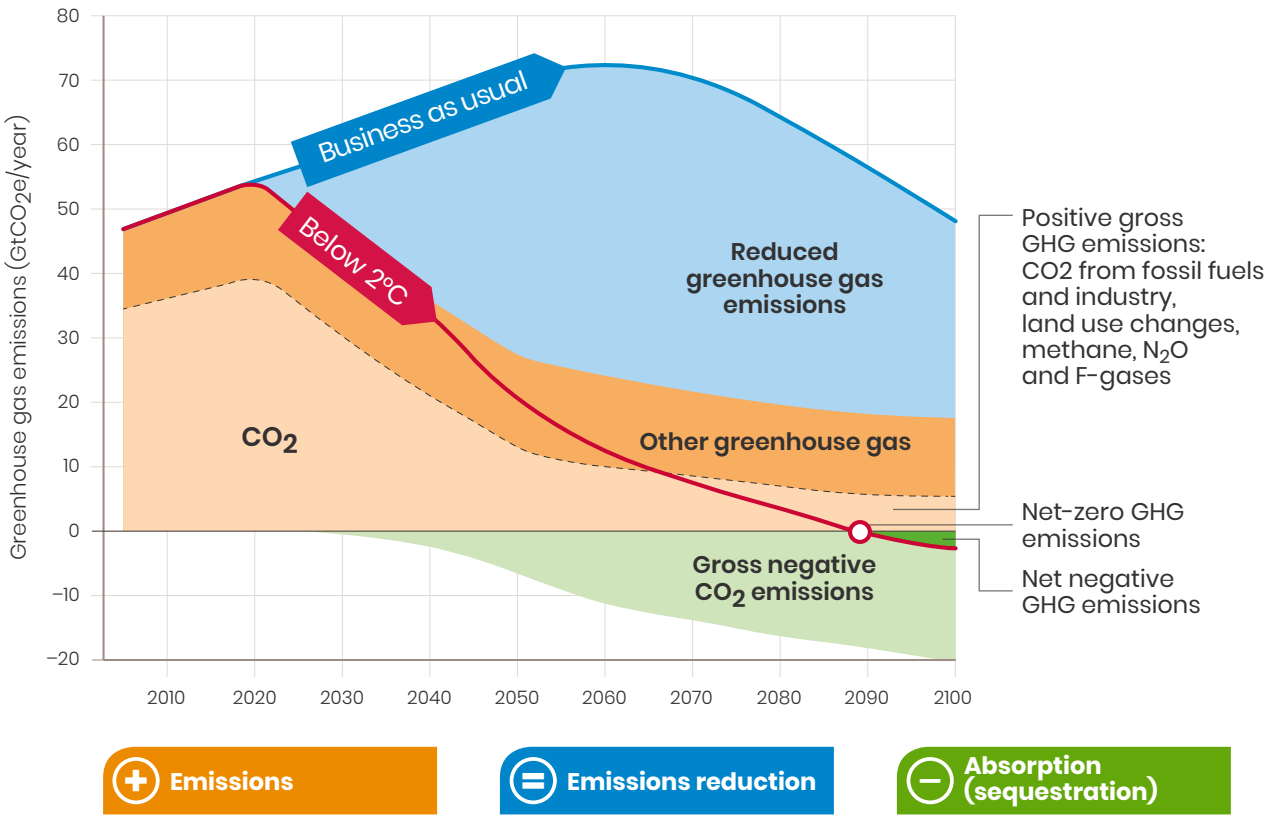
Therefore, while the EU has been quite critical of the inclusion of carbon sequestration in the EU's climate change mitigation strategy in the past, the issue has gained new impetus in the context of the European Green Deal[2] and the European Climate Law[3]. The adoption of a legally binding target of net zero GHG emissions by 2050, and then

[1] V. Masson-Delmotte et al., Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, IPCC (2018).

[2] The assumptions of the European Green Deal have been presented in the Communication from the Commission to the European Parliament, the European Council, the Council, the Economic and Social Committee and the Committee of the Regions, published in December 2019. European Green Deal (COM(2019) 640 final)

[3] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

FIGURE 1. FUTURE GHG EMISSIONS AND REMOVALS



Source: UNEP Emissions Gap report 2018

achieving net negative emissions (not yet quantified), has normalized the need to remove (sequester) carbon dioxide within the framework of the EU's climate and energy policy and the resulting legislation. In recent years, the CDR system has become an integral part of the EU's climate change mitigation policy.

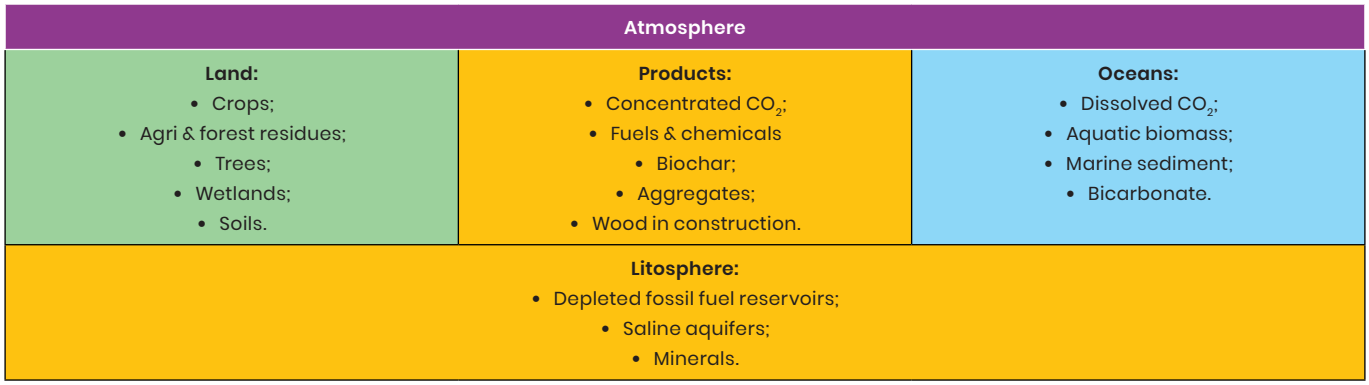
The main goal of the article is to familiarize readers with the issue of CDR and the related opportunities and threats, as well as its potential importance for the effectiveness of the implementation of sustainable development goals.

Carbon dioxide removal (CDR), also known as sequestration, is the process by which carbon dioxide is removed from the atmosphere by intentional human activity and permanently stored in "geological, terrestrial, or oceanic reservoirs or products". CDR is increasingly being incorporated into the EU's climate policy as a new element of its strategy.

In the literature on the subject, there is also a broader term for greenhouse gas removal (GGR), also known as "negative emissions". This is a general term for techniques that capture GHG from the air and store or chemically convert them with some degree of environmental sustainability[4]. Unlike techniques that reduce GHG emissions into the air, GGR techniques work by removing GHG that are already there.

[4] The Royal Society, Greenhouse gas removal, https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf (access: 2.11.2023).

FIGURE 2. GLOBAL CARBON CYCLE IN TERMS OF MAIN CARBON RESERVOIRS AND RESERVOIRS



Source: Smith, S. M. et al. (2023). The State of Carbon Dioxide Removal – 1st Edition, p. 14

The global carbon cycle and its reservoirs

In general, the global carbon cycle consists of five main reservoirs of carbon: atmosphere, land, products (using carbon in various forms), oceans and lithosphere (geological formations). Each of these reservoirs contains different reservoirs (pools) of carbon, indicated below in Fig. 2, whose characteristics differ in terms of storage capacity and durability. CDR methods transfer CO_2 from the atmosphere to other permanent reservoirs as part of the global carbon cycle.

CDR methods (and GGR, more broadly) are also known as negative emission technologies (NET). GHG removal methods involve two main steps: removing GHGs from the atmosphere and then storing them for a long time. Generally, CDR/GGR is achieved using a number of different methods (approaches), including: nature-based solutions (NbS)[5], accelerated weathering of rocks or engineering chemical processes as part of broadly understood climate engineering (Fig. 3).

CDR methods include: afforestation, agricultural practices that sequester carbon in the soil, bioenergy with carbon capture and storage, ocean fertilization – which involves the introduction of micronutrient iron (but also nitrogen or phosphorus) into ocean waters to stimulate the rapid growth of phytoplankton.

Climate technologies can be classified based on their area of application (land, sea, atmosphere), timescale (operating over a year or decades), risk profile (high- and low-risk technologies), as well as effectiveness and efficiency.

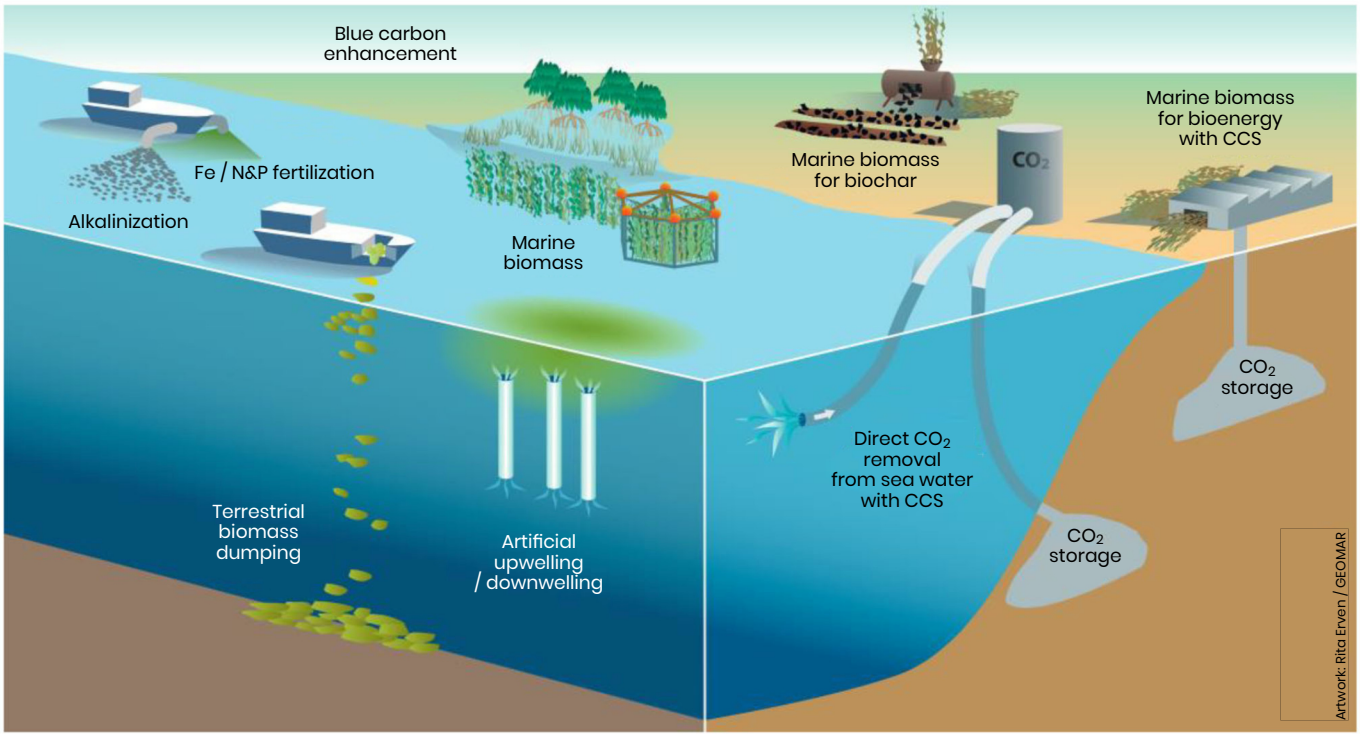
The scientists from The Royal Society and the Royal Academy of Engineering have distinguished the following GGR methods[6]:

- **Afforestation** – planting new trees and improving the management of existing forests. Growing forests absorb CO_2 from the atmosphere and store it in living biomass, dead organic matter and soil;
- **Habitat restoration** – restoring peatlands and coastal wetlands to increase their ca-

[5] Nature-based solutions (NbS) – actions to protect, manage and restore natural or modified ecosystems with an emphasis on the benefits these actions can bring to social adaptation, human well-being and biodiversity. NbS can refer to blue carbon ecosystems such as seagrasses, mangroves and salt marshes.

[6] The Royal Society, Greenhouse gas removal, https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf (access: 02.11.2023).

FIGURE 3. CDR – CLIMATE ENGINEERING OPTIONS



Source: Boettcher M, Brent K, Buck HJ, Low S, McLaren D and Mengis N (2021) Navigating Potential Hype and Opportunity in Governing Marine Carbon Removal. Front. Clim. 3:664456. doi: 10.3389/fclim.2021.664456 Designed by Rita Erven (Kiel Earth Institute), Creative Commons CC BY-SA 4.0.

pacity to store carbon. This action also often prevents the release of carbon from further degradation, providing a number of other additional benefits (e.g. for biodiversity);

- **Soil carbon sequestration** – changing agricultural practices, such as tillage or crop rotation, to improve the soil's ability to capture carbon;
- **Biochar** – introducing partially burned biomass into soils. Biomass is grown and burned in the absence of oxygen (pyrolysis) to produce a charcoal-like product that can stabilize organic matter when added to soil;
- **Bioenergy with Carbon Capture and Storage** (BECCS) – using biomass to produce energy, capturing CO_2 and storing it to ensure its removal throughout the whole life cycle;
- **Ocean fertilization** – introducing nutrients into the oceans to increase photosynthesis and remove atmospheric CO_2;
- **Building with biomass** – using wooden materials in construction extends the storage time of carbon from natural biomass and also enables additional forestry growth;
- **Enhanced terrestrial weathering** (enhanced rock weathering) – spreading of ground silicate rocks on land, which react with CO_2, removing it from the atmosphere;
- **Mineral carbonation** – accelerating the conversion of silicate rocks into carbonates above or below the earth's surface to ensure permanent CO_2 storage;
- **Oceans alkalinity** – increasing the concentration of ocean ions, such as calcium, to in-

crease CO_2 capture in the ocean and reverse its increasing acidification;

- **Direct Air Carbon Capture and Storage** (DACCS) – using of engineering processes to capture atmospheric CO_2 for subsequent storage in geological formations;
- **Low-emission concrete** – changing the ingredients, production or recycling method of concrete to increase its storage of CO_2.

The division of GGR methods based on the criterion of CO_2 removal and storage mechanisms is presented in Table 1. In this table, methods with integrated CO_2 storage are marked in green, while those that require a separate CO_2 storage mechanism are marked in blue.

In turn, the authors of the first report on the state of CDR[7] proposed a division of carbon dioxide removal methods into conventional methods (conventional CDR) and new methods (novel CDR). The first category covers afforestation, reforestation and forest management, while the second covers bioenergy with carbon capture and storage (BECCS), direct air carbon capture and storage (DACCS), biochar, accelerated rock weathering and coastal wetland management (blue carbon). The justification for this division is to show and emphasize the challenge of increasing the scale of individual solutions.

Table 2 presents a summary of CDR methods, their Technology Readiness Level (TRL), cost and global mitigation potential estimated for 2050, as well as key risks and additional benefits, as well as monitoring, reporting and verification (MRV) of net carbon dioxide removal. It should be noted that:

- Technology Readiness Level (TRL) ranges from 1 to 9 (with 9 being the most advanced, proven technologies);
- the assessment of costs of scale and mitigation potential is based on the available literature – it is particularly uncertain in case of methods with TRL around 7 and below;
- MRV is assessed for both capture and storage stages, taking into account the simplicity/

[7] Smith, S. M. et al. (2023). The State of Carbon Dioxide Removal – 1st Edition.

TABLE 1. GGR METHODS CATEGORISED BY THEIR REMOVAL AND CO_2 STORAGE MECHANISMS

		Greenhouse gas removal method		
		Increased biological uptake	**Natural inorganic reactions**	**Engineered removal**
Storage location	**Land vegetation (living)**	Afforestation, reforestation and forest management; Habitat restoration;		
	Soils and land vegetation (dead)	Soil carbon sequestration; Biocha	Enhanced terrestrial weathering	
	Geological	BECCS	Mineral carbonation at Surface	DAC + geological storage DAC + sub-surface mineral carbonation
	Oceans	Ocean fertilisation	Ocean alkalinity	DAC + magazynowanie w głębinach oceanów
	Built environment	Building with biomass		Low-carbon concrete

Source: Smith, S. M. et al. (2023). The State of Carbon Dioxide Removal – 1st Edition, p. 22

precision of quantifying the amount of carbon removed (low/medium/high/very high) and the existence or absence of an MRV methodology in the IPCC guidance on national emissions inventories (yes/no);

- the risks and additional benefits listed below are not complete and often depend on context.

Conventional CDR activities on land will account for 99% (78-100%) of total CDR in 2030, under both the 1.5°C and 2°C global temperature increase scenarios. The use of conventional CDR methods is expected to continue to increase: it will peak around 2050, approximately doubling in the 1.5°C path compared to 2020 levels, and in the 2°C scenario – increasing by approximately 50%. It is expected that the number of new CDR methods will continue to increase over the course of this century[8]. Only a small fraction (approximately 1%) will result from novel CDR methods, including BECCS, biochar, DACCS, enhanced terrestrial weathering and coastal wetland management (blue carbon). Of course, CDR use levels will increase faster in the 1.5°C pathway than in the 2°C pathway, but it is assumed that both types of CDRs will only reach their maximum use in the second half of the century. At all times, conventional land-based CDR methods will have the greatest CO_2 absorption potential. These solutions demonstrate the highest level of technological readiness and the highest cost effectiveness.

EU CDR policy in practice

As already mentioned, CDR has received a new impetus in the EU with the adoption of the European Climate Law and a legally binding target for net zero GHG emissions by 2050. As part of its initiative, on December 15, 2021, the Commission adopted its communication entitled "Sustainable Carbon Cycles"[9], which specifies how the EU intends to increase the removal of carbon dioxide from the atmosphere. The published communication presents EU-wide actions to scale up carbon farming initiatives, as well as industrial solutions for the sustainable capture, storage and recycling of CO_2.

The next step, planned by the Commission in the 1st quarter of 2024, will be the adoption of a communication on carbon dioxide storage technology. This initiative is one of the political priorities of the mandate of Vopke Hoekstra, the successor of Frans Timmermans as EU Commissioner for Climate Action.

Carbon Removal Certification

As mentioned above, there are a number of different methods for removing CO_2 from the atmosphere and storing it. These methods are diverse and evolving over time, and include differences in technology, biophysical limitations, cost, potential side effects of implementation, sustainability of proposed solutions, and levels of social acceptance and risk. It should be noted that some carbon sequestration methods are more permanent and less reversible than others. Certification will therefore be required, based on the need to compare measures against specific evaluation criteria.

Certification is a process that aims to provide a certificate indicating that a particular service or product meets the requirements of a specified standard or other reference document. In the context of carbon sequestration, certification

[8] Op. cit.

[9] Communication from the Commission to the European Parliament and the Council: Sustainable Carbon Cycles, COM(2021) 800 final.

aims to confirm that a specific amount of carbon dioxide has been sequestered by a specific product or service.

> "Today's proposal for an EU certification of carbon removals is a historic step in our fight against the climate crisis. To reach climate neutrality we need to sharply reduce greenhouse gas emissions, but we also need to remove carbon from the atmosphere. With our Fit for 55 package, work is ongoing to turn down the big tap of greenhouse gas emissions as fast as we can. Now, we set the regulatory framework to simultaneously incentivise carbon removals via technologies or natural carbon sinks. This has great potential for biodiversity as well. Certified carbon removals create new business opportunities for farmers, foresters and land managers eager to go the extra mile for climate and environment." (Frans Timmermans, Executive Vice-President for the European Green Deal, 30.11.2022).

An important step towards integrating carbon dioxide removal into EU climate policy was the introduction of a proposal for a Regulation establishing the first EU voluntary high quality certification framework for carbon dioxide removal. The aim of this proposal is to promote innovative CO_2 removal technologies, sustainable solutions in regenerative agriculture and the achievement of the EU's climate, environmental and pollution reduction objectives. The establishment of an EU certification framework aims to ensure high quality carbon dioxide removal in the EU and to create a European certification management system to combat greenwashing[10].

> The establishment of an EU certification framework aims to ensure high quality carbon dioxide removal in the EU and to create a European certification management system to combat greenwashing.

The draft Regulation establishing an Union certification framework for carbon removals[11] aims to facilitate the implementation of carbon removal activities by different entities by:

- Defining quality criteria for carbon sequestration activities to ensure the high quality of certified activities.
- Establishing principles for the verification and certification of CO_2 sequestration activities.
- Defining the principles for recognition by the European Commission and the operation of certification schemes.

The Regulation defines 'carbon dioxide removal' as the storage of atmospheric or biogenic carbon dioxide in geological carbon reservoirs, biogenic carbon reservoirs, durable products or materials and the marine environment, or the reduction of the release of carbon dioxide from a biogenic carbon reservoir into the atmosphere.

Carbon dioxide removal is eligible for certification under the scheme if it meets the quality criteria described in the Regulation and has been independently verified. To ensure the transparency and credibility of the certification process, the draft Regulation sets out principles for the independent verification of carbon removal and the recognition of certification schemes. To ensure quality and comparability, the European

[10] The term was originally coined by Jay Westerveld and derives from a combination of the words 'green' and 'whitewash', meaning whitening, but figuratively understood as 'pulling the wool over the eyes'. It describes the phenomenon of giving customers looking for ecologically and environmentally produced goods the impression that the product (or the company that produces it) is created (or operates) in harmony with nature and ecology.

[11] Proposal for a Regulation of the European Parliament and if the Council establishing a Union certification framework for carbon removals, 30.11.2022 r., COM(2022) 672 final, 2022/0394 (COD).

TABELA 3. KRYTERIA QU.A.L.ITY

QUALITY			
QUantification	**A**dditionality	**L**ong-term storage	**S**ustainabil**ITY**
Carbon removal activities must be measured in an accurate way and deliver unambiguous carbon removal benefits	Carbon removal activities must go beyond standard practices and what is required by law	Carbon removal activities must ensure that the carbon removed is stored for as long as possible and the risk of release of carbon should be minimised	Carbon removal activities must have a neutral impact on, or generate a co-benefit for, other environmental objectives such as biodiversity, climate change adaptation, the reduction of greenhouse gas emissions, water quality, zero pollution or the circular economy

Source: European Commission

Commission's proposed Regulation sets out four quality criteria, known as QU.A.L.ITY (described in Table 3).

Carbon dioxide removal activities are very diverse and require the establishment of different certification methodologies. Therefore, the Regulation empowers the European Commission to adopt delegated acts specifying detailed certification methodologies for different carbon removal activities. Annex I of the Regulation lists the minimum elements that should be considered in these methodologies (e.g. provisions related to baseline calculation, monitoring and risk mitigation for the release of stored carbon dioxide).

The process of developing methodologies is complex, particularly given the wide range of potential activities that may be subject to certification. To address this complexity, the European Commission is assisted by the Expert group on carbon removals[12]. The certification procedures established during its work should ensure a sufficiently high quality of carbon credits. This, in turn, should pave the way for the EU to establish an effective mechanism to assign economic value to carbon removal and long-term storage services, with significant support from agriculture, in particular regenerative farming techniques.

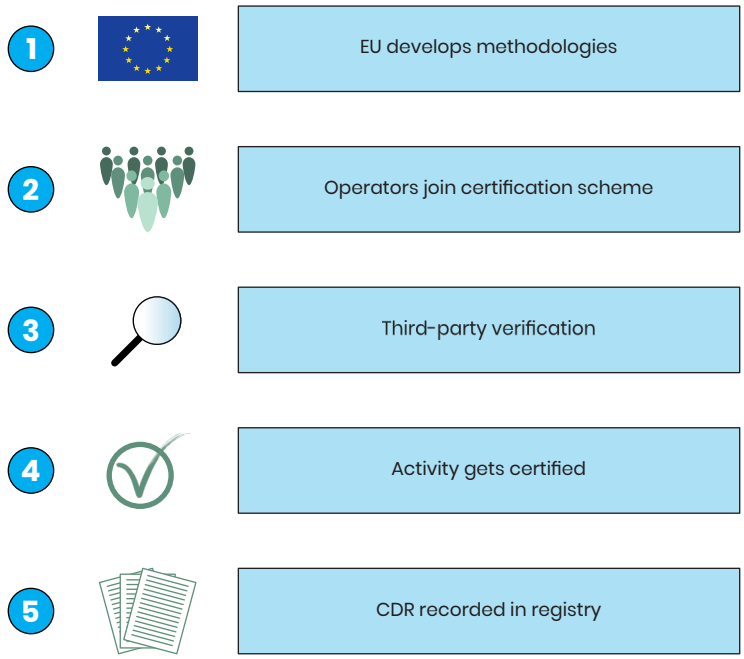
Certification of compliance

In order to demonstrate that CO_2 removal meets the EU quality criteria, entities engaged in CO_2 removal activities must apply to a public or private certification scheme recognised by the European Commission (see Figure 4). The entity will then have to provide the certification body with a comprehensive description of the carbon removal activities, including the methodology used. The activities of these entities will be regularly verified and certified by independent certification bodies.

Certification bodies are independent assessors appointed by the certification scheme and accredited by the national accreditation authority. The certification body will carry out a certification audit and, if the results are satisfactory, will issue a certificate confirming the compliance of the activity with the Regulation and the number of certified carbon removal units (CRUs).

[12] Expert Group on Carbon Removals, (https://climate.ec.europa.eu/eu-action/sustainable-carbon-cycles/expert-group-carbon-removals_en, access: 8.02.2024).

FIGURE 4. HOW THE SYSTEM WORKS



Source: Own study based on Commission SWD Executive Summary of the Impact Assessment Report Accompanying the document Proposal for a Regulation of the European Parliament and of the Council establishing a Union certification framework for carbon removals

Carbon removal unit (CRU) means one tonne of certified net carbon removal benefit generated by a carbon removal activity and registered by a certification scheme. Certification schemes will be required to maintain a registry for public access of information related to the certification process and the quantity of certified carbon removal units.

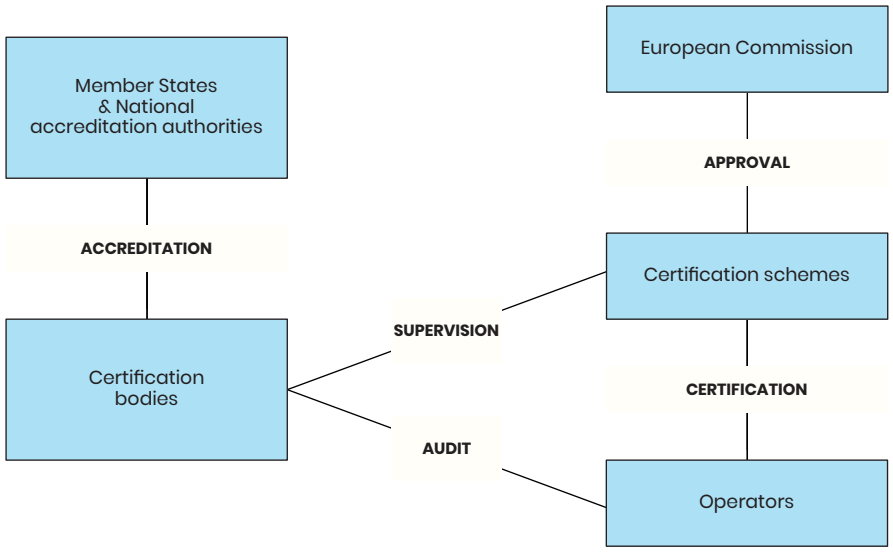
Recognition of certification schemes

According to the draft regulation, an operator or a group of operators can adopt a certification scheme recognised by the European Commission (see Figure 5). The Commission's decision will be valid for a maximum of 5 years. There are two types of schemes: public and private. In the case of a public system, a Member State notifies the Commission of the request for recognition. In the case of a private certification scheme, this is the responsibility of the private body. The details of the notification procedure and any technical specifications may be laid down by the European Commission in implementing acts.

A certification scheme approved by the European Commission must submit annual reports on its activities. In addition, the Commission carries out verifications to ensure that the information provided by organisations has been properly verified.

Each certification scheme is also responsible for publishing, at least once a year, list of the appointed certification bodies, stating for each certification body by which entity or national public authority it was recognised and which entity or national public authority is monitoring it. These schemes will monitor the activities of these bodies and maintain a public register of Carbon Removal Units (CRUs). Detailed guidelines for the schemes will be set out in the European Commission's implementing rules.

FIGURE 5. CARBON REMOVAL CERTIFICATION SCHEME



Source: Own study based on Commission SWD Executive Summary of the Impact Assessment Report Accompanying the document Proposal for a Regulation of the European Parliament and of the Council establishing a Union certification framework for carbon removals

Agriculture – cause or solution to the climate crisis?

The revision of the Regulation on land use, land use change and forestry (LULUCF)[13] establishes a new EU target, understood as the sum of the Member States' targets, to achieve net removals of 310 Mt CO_{2e} by 2030. It is likely to lead to the creation of new support structures and incentives for the implementation of conventional CDR methods on agricultural and forest land in the coming years.

It should be noted that the agricultural sector is the second largest emitter of GHG after the energy sector, the concentration of which in the atmosphere increases as a result of human activity. At the same time, it is the main emitter of GHG other than CO_2. The agricultural sector is primarily an emitter of methane (CH_4) from farm animals. In addition to methane, agriculture also emits large amounts of nitrous oxide (N_2O), which is released when the soil is fertilized with nitrogen fertilizers and when animal excrement decomposes.

The European Commission aims to reduce emissions in the agricultural sector through the implementation (including continuation) of the Common Agricultural Policy (CAP) and national policies. The CAP has long been no longer just a sectoral policy. It is directly or indirectly involved in the implementation of climate policy. In the 2014-2020 programming period, the Commission allocated over EUR 100 billion, or over a quarter of the total CAP budget, to combating and adapting to climate change.

In its Special Report No. 16/2021[14], published in June 2021, the European Court of Auditors (ECA)

[13] Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards the scope, simplifying the reporting and compliance rules, and setting out the targets of the Member States for 2030, and Regulation (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review.

[14] European Court of Auditors, Special Report 16/2021: Common Agricultural Policy and climate: Half of EU climate spending but farm emissions are not decreasing, June 2021 (OJEU 2021/C 266/04).

TABLE 4. ETS OPTIONS FOR AGRICULTURE (AgETS) AND THEIR CHARACTERISTICS

AgETS		General characteristics of the system	Obliged entities
On-farm ETS	OPTION 1* Emissions of all GHG	Under this system, an overall limit would be set for emissions resulting from farm activities. The AgETS would set an upper limit on total allowable emissions and would require farms regulated under the system to surrender enough allowances to cover their GHG emissions, thereby ensuring emissions reductions. It would enable farmers to buy and sell emission allowances (and thus transfer responsibility for achieving emission reductions), leading to an efficient price for carbon. This option would also impose a regulatory obligation on farmers to track their GHG emissions to ensure they have enough allowances.	The point of obligation would be the farm. The simplest approach to determining who should be considered responsible for each farm would be to assume that the same person receiving CAP payments (i.e. the "active farmer") is responsible. The aim would be to ensure that the responsibility falls on the person most able to make changes to farming practices to mitigate climate change. If a farm does not receive CAP payments, the owner of the land on which the installation is located should be responsible.
	OPTION 2* Emissions of GHG from livestock farming	This AgETS would set an overall cap on GHG emissions from farm animals, allowing covered entities to buy and sell emission allowances (and thus transfer responsibility for achieving emissions reductions), leading to an effective carbon price. However, as with Option 1, Option 2 would allow for the distribution of free allowances to reduce carbon leakage and the risk of livestock farmers losing their income due to competition from their non-EU counterparts who may not be subject to an effective carbon pricing. Alternatively, the introduction of a carbon border adjustment mechanism (CBAM) should be considered.	The EU principle of managing GHG emissions at their source would require this regulation to cover all livestock farms. Of the total 10.5 million farms in the EU, there are around 6.2 million farms engaged in animal breeding. The average size of a livestock farm in Europe is 34 ha and the herd size is 47 breeding units (LSU). Many of these farms are semi-subsistence farms with very few livestock, and MRV will be particularly difficult for these very small emitters. However, even if small farms were excluded from AgETS in Option 2, there would still be a large number of entities subject to regulation.
	OPTION 3 Emissions of GHG from peatland	This option applies the PPP principle to GHG emissions from drained peatlands used as agricultural land. This would involve setting an upper limit on net GHG emissions from such soils. Entities managing farms using this type of soil, if they reported net GHG emissions, would have to surrender a sufficient number of allowances to cover these emissions. They could also buy and sell emission allowances. Other GHG emissions from such farms (e.g. from livestock or fertilizer use) would not be taken into account. They would therefore have to be included in other policy options at EU or national level.	The point of obligation for this policy option would be at the farm level and would cover all farms in the EU using drained organic soils for agricultural production. Farms covered by the obligation to participate in the ETS in Option 3 would be unevenly distributed across EU Member States, given the strong imbalance in the distribution of peatlands across Europe. GHG emissions from drained peatlands used for agricultural activities are highly concentrated - 57% occur in just 3 Member States: Germany, Poland and Romania. The 17 EU Member States account for 99% of agricultural emissions from peatlands. In each of the remaining 10 countries, GHG emissions and the area of agricultural land on organic soils are negligible.
Off-farm ETS	OPTION 4* Upstream ETS	The AgETS in this option would cover products whose consumption causes GHG emissions on farms. The obligation would fall on entities supplying products purchased by farmers (feed for farm animals, fertilizers). These entities would be obliged to surrender an appropriate number of emission allowances in exchange for GHG emissions caused by their products on farms, while GHG emitted during the production of products would not be covered by this policy option. The PPP principle would not apply to agricultural GHG emitters (farms) directly, but would rely on upstream entities to pass on the costs of GHG emissions to issuers.	Different actors at different stages of the livestock feed and fertilizer supply chain would be involved. In terms of choosing the point where the obligation arises, the entities considered are: • producers and importers, i.e. entities that are the first to introduce feed for farm animals or fertilizers to the EU market; • distributors and/or retailers, e.g. wholesalers. The emissions trading system would need to be set up in such a way that the price incentive for farmers is sufficiently strong, i.e. that low-carbon products are generally cheaper than high-carbon products.
	OPTION 5* Downstream ETS	This option concerns the application of the PPP principle to agricultural products. The AgETS system in Option 5 would cover products whose production causes emissions on farms. The obligation would fall on entities receiving products sold by farmers, i.e. meat and dairy processors. These entities would be obliged to surrender an appropriate amount of emission allowances in exchange for the GHG emissions that these products would cause on farms, while GHG emitted during product processing would not be covered in this policy option. The settlement would be made on the basis of substitute data related to the production of relevant products (milk, meat). The PPP principle would not apply directly to agricultural GHG emitters (farms), but would rely on downstream entities to pass on the costs of GHG emissions to issuers.	This AgETS system would impose an obligation on meat and dairy processors. Therefore, these would be processors that would have to report GHG emissions. Milk processors are understood to mean any enterprise purchasing any type of milk from farms, and meat processors are understood to mean any enterprise purchasing and processing live animals, including into meat, leather or other products of animal origin that require slaughter. GHG emissions could be estimated based on the amount of livestock or raw material processed. AgETS in Option 5 focuses on upstream processors to reduce the number of actors in the system (with the carbon price of GHG being passed on to downstream processors and ultimately to final consumers).

*in the analyzed variant, the de minimis threshold (DMT) is taken into account

Source: Own study based on Trinomics et al., Study: "Pricing agricultural emissions and rewarding climate action in the agri-food value chain"

TABLE 5. ETS OPTIONS FOR AGRICULTURE (AgETS) AND THEIR POSSIBLE SCOPE

Source of GHG emissions	Type of GHG			Net emissions per annum ($MtCO_{2e}$)	On-farm ETS			Off-farm ETS	
	CH_4	N_2O	CO_2		OPTION 1 Emissions of all GHG	OPTION 2 Emissions of GHG from livestock farming	OPTION 3 Emissions of GHG from peatlands	OPTION 4 Upstream ETS	OPTION 5 Downstream ETS
Enteric fermentation	+			182,5	+	+		+	+
N_2O emissions from managed agricultural soils		+		118,0	+		+	+*	
Manure management	+	+		62,9	+	+			+
Grasslands			+	25,0	+				
Croplands			+	22,6	+				
Liming			+	5,6	+				
Urea application			+	3,5	+			+	
Rice farming	+		+	2,7	+				
Other agricultural emissions**	+	+		1,7	+				
Burning crop residues	+	+		0,7	+				
On-farm energy use			+	0,7	+				
Energy consumption on farms	+	+	+	?					

*Partially

**The only EU Member State reporting emissions under CRF 3.J "Other agricultural emissions" category in 2021 was Germany

Source: Own study based on Trinomics et al., Study: "Pricing agricultural emissions and rewarding climate action in the agri-food value chain"

analyzed whether CAP measures actually have contributed to reducing GHG emissions from agriculture during the period in question. It also examined whether the CAP did a better job of encouraging farmers to adopt effective climate change mitigation practices in the 2014-2020 period than in the 2007-2013 period. The Court's findings related to the main sources of emissions from the livestock farming, soil fertilization and land use sectors. In its report, the Court found that climate action had only a minor impact on agricultural emissions, which had not been changed significantly since 2010, and the CAP budget rarely financed actions with a high potential to mitigate climate change – it lacked, among other things, efforts to limit or reduce the number of farm animals (50% of emissions from agriculture come from breeding), support was provided to farmers cultivating drained organic soils (responsible for 20% of the sector's emissions). ECA therefore recommended that the Commission takes steps to reduce agricultural emissions through the CAP as well as reduce emissions from farmed drained organic soils, and report regularly on the CAP's contribution to mitigating climate change.

Moreover, in Special Report No. 16/2021, the Court emphasized that the EU does not apply the polluter-pays principle (PPP) to emissions from the agricultural sector, according to which those responsible for pollution should cover the costs they

cause. Moreover, in its Special Report No. 12/2021[15], ECA issued a recommendation that the Commission should assess regulatory and administrative changes and the overall cost-benefit ratio of better application of the PPP. In the case of climate, it considered that the PPP could be implemented through bans or limits on GHG emissions or through pricing of emissions (e.g. in the form of a CO_2 tax or a cap-and-trade system).

In this context, the Commission is exploring the possibilities of pricing agricultural GHG emissions across the value chain through the emissions trading system (AgETS), as well as rewarding farmers and other landowners for climate action through carbon farming.

Proposals to create a new ETS for agriculture (AgETS)

The European Commission, supported in this task by Trinomics and its partners – IEEP, Ecologic Institute, Umweltbundesamt and Carbon Counts – is currently examining 5 policy options for applying the PPP to emissions from agriculture:

ETS at the level of farms (On-farm ETS), in which the potential obligated entities are the "operators" of these farms, i.e. farmers. 3 options are considered:

- emissions of all GHG;
- emissions of GHG from livestock farming;
- emissions of GHG from peatlands;

Off-farm ETS, in which potential obligated entities are entities located at the beginning or end of the supply chain of the agricultural sector. 2 options are considered:

- Upstream ETS, in which potential obligated entities are fertilizer producers and feed importers;
- Downstream ETS, in which potential obligated entities are meat and dairy processors.

The individual options analyzed, presented above (see Table 4), are examples of an emission allowance trading system that differ in scope and level of ambition (see Table 5). It would require the creation of different methods of management and administration, including the appropriate definition of the entities involved, the establishment of individual emission measurement requirements, the appropriate setting of the emission limit (the so-called "cap and trade"), conducting a potential pilot phase for MRV before implementing the system, establishing the necessary institutions and supporting structures, as well as introducing an effective system of incentives to undertake good practices on farms.

Leaving aside the issue of the final choice of any of the ETS options for agriculture considered above, the emission allowance trading system is a solution whose main attribute is to leave the entities covered by this system the freedom to decide whether and when, as well as in what way and pace, they will reduce their GHG emissions. For this reason, the above solution would, in principle, ensure no sudden changes in the level of supply of the sectors covered by AgETS, which seems to be particularly important in the case of agriculture, whose main task is to produce food and ensure food security. Of course, the introduction of such a solution would have to be combined with mechanisms to prevent carbon leakage, aimed at discouraging entities from moving agricultural production to countries with less restrictive regulations on reducing GHG emissions.

However, it should be borne in mind that the implementation of such a system in agriculture may prove to be very time-consuming and expensive.

[15] European Court of Auditors, Special Report 12/2021: The Polluter Pays Principle: Inconsistent application across EU environmental policies and actions, July 2021, (OJEU 2021/C 272/04).

TABLE 6. CO_2 REMOVAL POLICY MODELS

Integrated AgETS system	Offsets	Deductions	Interconnected: through government	Disconnected markets
• Direct, unrestricted link between compliance entities (polluter) and removers, who are also compliance entities in the ETS; • Allowances are fully fungible and can be traded to meet compliance obligations, with no limits.	• Removers participate voluntarily and are external to the ETS (not compliance entities); • LULUCF removals not generally covered by an ETS – only mobilised in the form of offsets.	• Remover is a polluter (i.e. compliance entity within the ETS); • LULUCF removals are not generally covered by an ETS – removals only mobilised in the form of deductions; • Polluter reduces emissions liability through removals onsite (farmer) or by insetting within supply chain (processor).	• Government procures removals using revenue from polluter pays ETS (e.g. by auctioning removals credits or using allocation); • Government sells removal credits to polluters (to meet their compliance obligations).	• Government procures LULUCF removals from removers using polluter pays revenue; • Removals do not affect ETS: while the government uses revenue generate by ETS, removals provision does not affect ETS supply.

Source: Own study based on Schield A., McDonald H., Technical Workshop, presentation "Pricing agricultural emissions and rewarding climate action in the land sector", Brussels, 14 June 2023.

Moreover, the implementation of a separate Ag-ETS system would require its participants to have knowledge about how to trade emission allowances, as well as their possible involvement in the purchase or sale of these allowances, which in turn could prove to be an extremely ambitious task in the case of a sector with a very large number of entities characterized by with very different emission levels. Although, according to Eurostat data, in the years 2005-2020 the number of farms in the EU decreased by 5.3 million (37%) to 9.1 million, it was still over a thousand times more than the number of current EU ETS participants (approx. 15 thousand). A separate and completely open question is how much grassroots legitimacy and political determination will be enough for the Commission in its current or future institutional term, in the perspective of the next elections to the European Parliament, which will take place between the 6th and 9th of June, 2024, as well as the current and future economic reality[16].

[16] According to the European Economic Forecast published by the European Commission in February 2023, real GDP growth in the EU-27 will amount to 0.8% in 2023 and 1.6% in 2024.

"The implementation of a separate AgETS system would require its participants to have knowledge about how to trade emission allowances, as well as their possible involvement in the purchase or sale of these allowances, which in turn could prove to be an extremely ambitious task in the case of a sector with a very large number of entities characterized by with very different emission levels.

Combining the AgETS system with CO_2 removals in the LULUCF sector – opportunities and challenges

The introduction of AgETS could contribute, through the implementation of appropriate incentives and business models, to achieving long-term reductions in GHG emissions and improving their removal by natural sinks, contributing to unlocking the potential of the agricultural and forestry sector to mitigate climate change and develop the local and regional bioeconomy, as well as to meet the recommendations contained in the Court's reports.

TABLE 7. REMOVALS POLICY MODELS: THEORETICAL COMPARISON OF RELATIVE STRENGTHS AND WEAKNESSES

		No link	Indirect link	Direct link		
		No link: Disconnected market	Interconnected: through government	Deductions	Offsets	Integrated AgETS
Effectiveness	Increased land-based removals					
	High quality removals					
Efficiency	Static efficiency					
	Dynamic efficiency					
	Economy-wide efficiency					
	Administrative costs					
	Participant transaction costs					
Coherence	AgETS match					
Political/legal feasibility	Absence of legal / political barriers					

Wherein the potential impact of individual options in relation to a given assessment criterion is marked with colours:

(+)	(-)	(+/-)
The option will have mainly **positive effects**	The option will have mainly **negative effects**	The option will have both **positive and negative effects**

Source: Own study based on Trinomics et al., Study: "Pricing agricultural emissions and rewarding climate action in the agri-food value chain"

> The introduction of AgETS could contribute, through the implementation of appropriate incentives and business models, to achieving long-term reductions in GHG emissions and improving their removal by natural sinks.

The issue of including removals in the EU climate policy would, however, require a comprehensive assessment of the maturity of possible solutions, as well as the potential for additional benefits. Some key challenges would need to be addressed, such as the reliability and cost of MRV, durability, additionality, and carbon leakage. Various possible options for linking the AgETS system designed for the agricultural sector with CO_2 removals in the LULUCF sector are presented in Table 6.

It is also worth bearing in mind that the combination of non-CO_2 emissions from land use and agriculture could potentially undermine necessary progress in the agricultural sector, as other sectors, such as the forestry sector, could compensate for its difficulties in reducing emissions. Furthermore, the potential to increase net carbon sequestration and reduce GHG emissions in the LULUCF sector varies significantly between EU Member States.

Since the choice between different removal policy models often involves the choice of different objectives (e.g. effectiveness/environmental

integrity versus efficiency/low removal costs), Table 7 presents an assessment of the relative strengths and weaknesses of each removal policy model compared to other models, assuming that all other elements remain the same.

Wherein the potential impact of individual options in relation to a given assessment criterion is marked with colours:

Summary

The use of CDR (carbon dioxide) and GGR (total greenhouse gases removal) technologies, in parallel with other efforts to reduce GHG emissions, will probably be another direction to strengthen the achievement of EU climate goals, consistent with the goals of the Paris Agreement. These methods are very diverse and focus on increased biological uptake, natural inorganic reactions and technologies that remove carbon dioxide from the air. The technological differences between them result in their different biophysical limitations, economic costs and potential side effects of implementation, in addition to differences in the durability of the proposed solutions, as well as differences in the level of social acceptance and risk. Carbon dioxide absorption in the LULUCF sector, i.e. its biological capture using natural methods, plays a key role in achieving the EU's climate goals.

To increase carbon removals in the LULUCF sector, individual farmers or forest managers need a direct incentive to store more CO_2 on their land, in their forests and in carbon-accumulating products. Revenues or demand for allowances from the AgETS system for agriculture considered by the Commission could possibly be used to reward additional and certified carbon dioxide removals in the LULUCF sector. However, the introduction of such a system would require the Commission to define its scope and select measures very carefully, taking into account the weaknesses of policy models in the field of absorption (e.g. quantitative or qualitative limitations of the LULUCF sector), as well as the natural state of inequality between the reduction of GHG emissions and CO_2 removals.

The study currently published by the European Commission on the possibilities of mitigating climate change in agriculture by setting the price for emissions and rewarding carbon farming, together with other input data taking into account a number of activities, may be used for the political debate that will take place after the publication of the Commission Communication in the 1st quarter of 2024 on the EU's climate target for 2040. This Communication will prepare the ground for a legislative proposal on the EU's 2040 climate target by amending European Climate Law. Any subsequent sector-specific legislation will be introduced at a later date.

In order to scale up sustainable CDR and create incentives for the use of innovative CO_2 capture, recycling and storage solutions in the agricultural, forestry and industrial sectors, it is necessary to establish rules on the certification of carbon dioxide removals at the EU level, setting out the necessary monitoring, reporting and verifying rules, confirming the authenticity of removal of a specific amount of carbon dioxide. This is a necessary and significant step towards integrating carbon dioxide removal into EU climate policy and unlocking the potential of the CDR market.

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Table 2. Summary of carbon dioxide removal (CDR) methods

Method	Route of CDR*	TRL	Cost at scale ($/t CO_2)	Mitiga tion potential (Gt CO_2/yr)	MRV	Example hazards	Example co-benefits
DACCS (Direct Air Carbon Capture and Storage)	(Chemical capture via solid sorbent or liquid solvent) => (Concentrated CO_2 stream) => (Storage in lithosphere)	6	100-300	5-40	Capture: very high, no; Storage: high, yes.	Increased energy use can lead to GHG emissions or competition for renewable energy; Increased water use with some options.	Water produced (solid sorbent Direct Air Capture designs only).
Enhanced rock weathering	(Geochemical capture via spreading crushed silicate rocks on land or ocean) => (Storage in minerals or as bicarbonate)	3-4	50-200	2-4	Capture: low, no; Storage:low, no.	Mining impacts.; Air quality impacts of rock dust when spreading on land; Heavy metal contamination, especially nickel and chromium, from some rock types.	Reduced soil acidity and increased nutrient supply, which can enhance plant growth and soil carbon sequestration.
Ocean alkalinisation	(Geochemical capture via adding alkaline materials to the ocean such as silicate or carbonate rocks) => (Storage in minerals or as bicarbonate)	1-2	40-260	1-100	Capture: low, no; Storage: low, no.	Increased seawater pH and saturation states may have local adverse impacts on marine biota; Possible release of nutritive or toxic elements and compounds may perturb marine ecosystems; Mining impacts.	Reduced ocean acidification can benefit biodiversity, especially corals and crustaceans.
Ocean fertilisation	(Biological capture via fertilisation or enhanced upwelling)[a] => (Storage in marine sediment)	1-2	50-500	1-3	Capture: low, no; Storage:low, no.	Nutrient redistribution, enhanced oxygen consumption and acidification in deeper waters could perturb marine ecosystems; Could encourage toxic algae; The fraction of removed CO_2 reaching durable storage is uncertain, due to re-metabolisation.	Enhanced biological productivity, which could increase fish catch.
Coastal wetland (blue carbon) management	(Biological capture via aquatic biomass) => (Storage in aquatic biomass)	2-3	Insufficient data	<1	Capture: low, no; Storage: medium, no.	Vulnerable to reversal through sea level rise; Difficult to quantify CDR accurately.	Can contribute to ecosystem-based adaptation, coastal protection, increased biodiversity. Can reduce methane emissions. Could benefit human nutrition or be used to produce fertiliser for agriculture, to produce a methane-reducing feed additive, or as an industrial feedstock.

Table 2. Summary of carbon dioxide removal (CDR) methods

Method	Route of CDR*	TRL	Cost at scale ($/t CO_2)	Mitiga tion potential (Gt CO_2/yr)	MRV	Example hazards	Example co-benefits
BECCS (Bioenergy with Carbon Capture and Storage)	(Biological capture via plant growth => cropping and forestry residues, organic wastes, or purpose-grown crops) => (Concentrated CO_2) => (Storage in lithosphere)	5-6	15-400	0,5-11	Capture: high, yes; Storage: high, yes.	Competition for land and water resources, if based on purpose-grown biomass feedstock; Loss of biodiversity, carbon stock and soil fertility if from unsustainable biomass harvest; Use of potentially contaminated biomass residues (such as post-consumer wood waste) can pose air pollution risks..	Bioenergy (bio-electricity, biofuel, biogas) displaces fossil fuels and enhances fuel security; Reduction in air pollution when engineered BECCS facilities displace in-field biomass burning; Utilisation of residues provides additional income and can improve crop growth and health; Purpose-grown biomass crops can enhance biodiversity, soil health, water quality and land carbon.
Afforestation/ Reforestation	(Biological capture via trees) => (Storage in trees)	8-9	0-240	0,5-10	Capture: high, yes; Storage: high, yes.	Reversal of CDR through wildfire, disease, pests; Reduced catchment water yield and lower groundwater level if species and biome[b] are inappropriate; Finite carbon carrying capacity of land; capacity may be reduced under climate change.	Enhanced employment and local livelihoods, improved biodiversity, improved renewable wood products provision, soil carbon and nutrient cycling; Possibly less pressure on primary forest.
Biochar	(Biological capture via cropping and forestry residues, organic wastes, or purpose-grown crops) => (Storage in biochar)	6-7	10-345	0,3-6,6	Capture: high, yes**; Storage: medium, yes**.	Particulate and GHG emissions from biochar production; Biodiversity and carbon stock loss if from unsustainable biomass harvest.	Increased crop yields; Reduced non-CO_2 emissions from soil; Resilience to drought.
Soil carbon sequestration	(Biological capture via various agricultural practices and pasture management) => (Storage in soils)	8-9	-45-100	0,6-9,3	Capture: medium, yes; Storage: low, yes.	Increased nitrous oxide emissions due to higher levels of organic nitrogen in soil; Finite capacity of soil to protect organic matter; capacity may be reduced under climate change.	Improved soil quality, resilience and agricultural productivity.
Peatland and wetland restoration	(Biological capture via rewetting and revegetation) => (Storage in soils)	8-9	Insufficient data	0,5-2,1	Capture: low, yes; Storage: low, yes.	Increased methane emissions.	Increased productivity of fisheries; Improved biodiversity; Soil carbon and nutrient cycling.

Table 2. Summary of carbon dioxide removal (CDR) methods

Method	Route of CDR*	TRL	Cost at scale ($/t CO_2)	Mitiga tion potential (Gt CO_2/yr)	MRV	Example hazards	Example co-benefits
Agroforestry	(Biological capture via trees) => (Storage in trees)	8-9	Insufficient data	0,3-9,4	Capture: medium, yes; Storage: medium, yes.	Trade-offs with agricultural crop production.	Enhanced employment and local livelihoods; Variety of products; Improved soil quality; More resilient systems.
Durable Harvested Wood Products***	Biological capture via trees) => (Storage in wood in construction)	8-9	b.d.	0,2-1,3	Capture: high, yes; Storage: medium, yes	Increased fertiliser use and introduced species could reduce biodiversity and increase eutrophication; Fire risk.	Reduced ecological toxicity; Improved human health and wellbeing; Reduced duration of construction compared with alternative building materials.
Improved forest management	(Biological capture via trees) => (Storage in trees)	8-9	b.d.	0,1-2,1	Capture: medium, yes; Storage: medium, yes	Increased fertiliser use and introduced species could reduce biodiversity and increase eutrophication.	Improved productivity; Enhanced employment and local livelihoods; Can enhance biodiversity.

*For each method's route, the ultimate form of carbon storage is colour coded to match the carbon pools in Fig. 2.

**The Intergovernmental Panel on Climate Change (IPCC) provides a biochar MRV methodology as an option for national inventories.

***Data for wood in construction taken from Himes & Busby. Wood buildings as a climate solution. Developments in the Built Environment 4, 100030 (2020). doi.org/10.1016/j.dibe.2020.100030, and Mishra et al. Land use change and carbon emissions of a transformation to timber cities. Nat Commun 13, 4889 (2022). https://doi.org/10.1038/s41467-022-32244-w

[a]Upwelling – the phenomenon of deep ocean water rising to the surface, usually from a depth below the thermocline. We distinguish between coastal upwelling and equatorial upwelling. A process in the opposite direction is downdwelling.

[b]Biome – a high-ranking biological entity, including similar climax components, a fragment of the biosphere with typical, distinctive environmental conditions.

Source: Smith, S. M. et al. (2023). The State of Carbon Dioxide Removal – 1st Edition, p. 18-19

Problem-ridden removals. Tropical forests, voluntary carbon markets and REDD+

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Problem-ridden removals. Tropical forests, voluntary carbon markets and REDD+

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Conclusion

The absorption of carbon dioxide from anthropogenic emissions is considered by the IPCC to be crucial for achieving the goals of the Paris Agreement. Work is underway to disseminate new technologies that will enable the capture and permanent storage of CO_2, while natural removals from forests and other reservoirs in the land use sector currently play a major role. Forests absorb about 30% of global emissions from the energy sector. However, they are threatened by economic expansion, especially agriculture, as well as the extraction of natural resources and large-scale logging of timber. Developing countries have lost large areas of forest since the 1970s, but they are taking steps to slow down these adverse trends. Most NDCs include plans to reduce deforestation. The UN, the G7 and other international bodies are taking action and adopting declarations on this issue. To support the protection of forests outside Europe, the EU has adopted the EU Deforestation Regulation (EUDR). One of the instruments proposed by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) to protect forests is the REDD+ programme, which aims to reduce deforestation, forest degradation, afforestation and reforestation of former forest areas. REDD+ proposes payments based on the results of the actions taken. REDD+ is also a large segment of voluntary carbon markets, and carbon credits from projects that halt deforestation are among the most popular among investors in this segment of the carbon market.

The significance of carbon removals for achieving the long-term goals of the Paris Agreement. Introduction

Striving to achieve climate neutrality, EU member states will have to resort to carbon removal technologies (carbon dioxide removal, CDR).[1] Although there are great expectations towards emerging technologies that are expected to allow for the permanent removal of CO_2 from the atmosphere, natural removals provided by the land use, land use change and forestry (LULUCF) sector, and especially forests, will continue to play an important role. Europe has the largest share of forest area in the total area (46%), North and South Americas (41%) represent a similar level of afforestation, and the rest of the world is forested at

[1] Of course, we are not talking about physically eliminating CO_2 from the world's atmosphere, but about offsetting the EU's current and future historical emissions by absorbing them from the atmosphere.

about 20%.[2] The opposite applies to the area of arable land. Asia ranks first with 54% of the total agricultural land, followed by Oceania with 45% of the total land, Africa with 37% of the total arable land, the Americas with 29% of the total land, while Europe is last with 21% of the total area.[3] Although only about 5% of Europe's forests are considered primary, the condition of European forests is quite satisfactory compared to other regions of the world. Between 1990 and 2020, Europe's forest area increased by 9% and the amount of carbon stored in biomass increased by 50%, while the supply of wood increased by 40%.[4] The EU's Biodiversity Strategy for 2030 includes plans to plant at least three billion new trees in the EU by 2030, as part of a wider effort to increase the EU's forest area and increase the global role of forests in absorbing carbon from the atmosphere[5]. In addition, the EU has a range of policies and initiatives to support sustainable forest management, biodiversity conservation and forest protection. These include the EU's New Forest Strategy for 2030[6], the EU Timber Regulation in force between 2010-2023[7], the new EU regulation on deforestation-free products, also known as the Deforestation Regulation (EUDR)[8] and EU support for initiatives that promote sustainable forest management and the use of wood-based products as a renewable resource.

In light of the above data, it is therefore important to look at the issue of natural removals outside Europe, especially in developing countries, which in the near future will not have the latest technologies for removing and storing CO_2, due to the associated costs of creating and maintaining appropriate infrastructure which are a formidable barrier to dissemination of such carbon capture and storage measures. Therefore, the potential contribution of these countries to international efforts to achieve the goals of the Paris Agreement will be practically limited to protecting existing forest resources and reducing emissions from agriculture. While the former goal is unquestionably supported, reducing emissions from agriculture is a difficult negotiating issue, as it involves ensuring food security and achieving the Sustainable Development Goals (SDGs), especially SDG 2, which seeks to achieve a world free of hunger.[9] An analysis of current Nationally Determined Contributions (NDCs) conducted by WRI at the end of 2022 indicates that more than 140 NDCs include actions to protect existing ecosystems, improve land management to reduce emissions or restore degraded ecosystems.

> **More than 140 NDCs include actions to protect existing ecosystems, improve land management to reduce emissions or restore degraded ecosystems.**

Seventy-eight NDCs include activities in all three categories. At the same time, however, only slightly more than half of the NDCs concretize these plans by adopting measurable targets related to

[2] FAO, Statistical Yearbook 2021, (https://www.fao.org/3/cb4477en/online/cb4477en.html#chapter-4_1, access: 18.10.2023).
[3] Ibidem.
[4] Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010, (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1115, access: 19.10.2023).
[5] Strategia na rzecz bioróżnorodności 2030 - Wspólna Polityka Rolna po 2020 roku, (https://www.gov.pl/web/wprpo2020/strategia-na-rzecz-bioroznorodnosci-2030, access: 18.10.2023).
[6] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, New EU Forest Strategy for 2030, (https://eur-lex.europa.eu/legal-content/PL/TXT/?uri=CELEX:52021DC0572, access: 18.10.2023).
[7] Regulation (EU) No 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market Text with EEA relevance.
[8] The EUDR is discussed in more detail later in this article.
[9] The 17 th Sustainable Development Goals, (https://sdgs.un.org/goals, access: 16.10.2023).

land use and forestry.[10] The issue of maintaining or, under favourable conditions, increasing natural removals by the LULUCF sector is therefore crucial to achieving the goals of the Paris Agreement.

On a global scale, both the parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) attribute to forests an important role in balancing and absorbing global emissions. The IPCC Special Report on Climate Change and Land (SRCCL)[11] notes that more than 70 % of the global land area is not covered by ice and that economic activities in land use, land use change and forestry are affected by human activities. Agriculture, Forestry and Other Land Use (AFOLU)[12]account for 23 % of total net anthropogenic greenhouse gas emissions[13]. As much as 11% of greenhouse gas emissions globally are caused by deforestation and forest degradation, which is the second most important source of global emissions after the energy sector.[14] However, the FOLU (forestry and other land use) sector is also a CO_2 sink, and some of the agricultural practices that are currently being promoted are also at work, albeit on a smaller scale at the moment.[15] They lead to CO_2 sequestration, although other agricultural practices are sources of CO_2, CH_4 or N_2O emissions.[16]

As every elementary school student knows, photosynthesis, a process crucial to maintaining

life on Earth, involves the conversion of sunlight, carbon dioxide and water into glucose and oxygen by plants, algae and some bacteria. Glucose becomes the building block of plant tissue in the process of carbon fixation. By absorbing CO_2, plants emit, in different proportions and depending on the species and environmental conditions, oxygen. According to UNEP, forests and wooded areas absorb about 30% of anthropogenic emissions from industry and energy.[17] However, one of the problems of natural CO_2 uptake in the context of using this process to remove anthropogenic CO_2 emissions from the atmosphere is the reversibility and impermanence of this process. One of the reasons for the reversal of the absorption process, which leads to an increase in anthropogenic greenhouse gas emissions and has been attracting the attention of not just experts but also public opinion for years, especially in developed countries, is the rapid pace of deforestation and degradation of tropical forests. According to UNEP[18] about 11% of CO_2 emissions, and according to other sources, as much as 15% of global CO_2

[10] World Resources Institute, „9 things to know about National Climate Plans (NDCs)", (https://www.wri.org/insights/assessing-progress-ndcs, access: 21.10.2023).
[11] IPCC Special Report on Climate and Land, (https://www.ipcc.ch/srccl/, access: 15.09.2023).
[12] The AFOLU sector covers the same land use categories as LULUCF and agriculture.
[13] IPCC SRCCL. Summary for Policymakers., (https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/, s.1., access: 15.09.2023).
[14] UN-REDD Programme Fact Factsheet about REDD+ , (https://www.un-redd.org/sites/default/files/2021-10/Fact%20Sheet%201-%20About%20REDD3.pdf, access: 9.10.2023).
[15] Agroforestry, cover crops, crop rotation and no-till farming, among others.
[16] Such practices as, among others, cattle rearing, rice cultivation, use of artificial fertilizers, deep plowing.
[17] Deforestation | UNEP - UN Environment Programme, (https://www.unep.org/resources/factsheet/deforestation, access: 15.09.2023).
[18] Ibidem.

emissions come from deforestation and degradation.[19]

> **Deforestation not only alters the carbon balance of ecosystems, but also leads to soil depletion and the release of CO_2 stored in organic matter.[20]**

By deforestation we mean the removal of forests, including both deforestation and other forms of forest destruction, such as deliberate burning, or caused by the spread of fire beyond the area initially intended for burning which became uncontrolled. Not only do felled or burned trees no longer absorb CO_2 from the air, but at the same time, the carbon stored in their matter is released into the atmosphere in the combustion process [21]. Contrary to appearances, more emissions from burning forests this century come from the temperate zone than from the tropics, and this is attributed to the occurrence of drought and high temperatures, and thus linked to climate change. Deforestation not only alters the carbon balance of ecosystems, but also leads to soil depletion and the release of CO_2 stored in organic matter.

Deforestation is most often caused by the predatory felling of valuable tree species and the rapid development of large-scale agricultural production. The expansion of agriculture, industrial plantations and the ruthless exploitation of forest resources are the main, but not the only, reasons for the disappearance of tropical forests. Because deforestation is often carried out in a primitive way, combined with the burning of forest clearances, fires frequently get out of control. The problem is often exacerbated by the lack of regulation of land ownership in many developing countries and, until recently, the almost universal granting of long-term concessions for the development of large-scale plantations or concessions for the extraction of natural resources to large foreign corporations, for which environmental protection was and often still is, despite their declared social responsibility, one of their last priorities.

Problems of the Global South with containing deforestation

During the period of decolonization, governments of developing countries recognized, and in some cases still recognize, deforestation as a cost of development as well as a means of supplementing state revenues. The problem of systemic deforestation based on legally granted concessions is exacerbated by illegal activities related to the criminal harvesting of valuable species of wood, but also by the illegal clearing of forests by local communities in order to establish small farmlands to sustain their families in the absence of other alternatives.

> **The problem of systemic deforestation based on legally granted concessions is exacerbated by illegal activities related to the criminal harvesting of valuable species of wood.**

The most well-known example is the loss of forests in the Amazon basin, known as the lungs of the world, which accelerated in the 1970s as a result of the conversion of virgin forests into pastures,

[19] Ibidem.

[20] Deforestation: Effects, Causes, Statistics, And Solutions, (https://eos.com/industries/forestry/deforestation/#:~:text=Fire%20causes%20more%20deforestation%20annually%20than%20logging%20and,to%20their%20advantage%2C%20other%20areas%20are%20less%20adapte, access: 16.10.2023).

[21] Wood that has been treated and turned into construction lumber, furniture or paper is classified as one of the Harvested Wood Products (HWPs) that store the carbon element it contains until the end of the product's life cycle (by burning or decomposing). The carbon content changes during the life cycle of a product and is eventually re-emitted into the air through decomposition or incineration. Properly maintained, wooden objects and structures can last for several hundred years. The oldest wooden building in the world is the Horyuji Temple, erected in 607 AD in Nara, Japan. The issue of stopping the possibility of reversing natural uptake by plant matter (biomass) by intercepting emissions from biomass combustion is at the heart of BECCS technology (Bioenergy with carbon capture and storage).

industrial soybean plantations or rubber tree plantations. Until the beginning of this century, Brazil, which covers 60 percent of the original Amazon rainforest, was at the forefront of this practice.[22] Unfortunately, Brazil is not the only country that has failed to remedy this governance failure. Between 2000 and 2013, uncontrolled deforestation of the Amazon took on alarming proportions in Bolivia and Venezuela. In Colombia, the peak period of deforestation of the Amazon rainforest was between 2005 and 2020. Despite this growth in the pace of deforestation, the degradation of the Amazon slowed after 2000 compared to the period between 1970 and 2000, although its level remained a problem that the governments of the region failed to resolve, despite the support (and pressure to act) of the international community. Between 2003 and 2015, a 76% decline in deforestation rates in Brazil's largest swathe of the Amazon was partially offset by an increase in the frequency of wildfires. For example, during the 2015 drought, the frequency of fires increased by 36% compared to the previous 12 years. The 2015 drought had the highest ratio of active fires to deforestation on record, with active fires occurring over an area of 799,293 km2.[23] Droughts primarily affect areas of the Amazon that have already been deforested and are overgrown with secondary vegetation, shrubs and scrub. When, during a period of drought, human activity related to the preparation of agricultural land by burning grubbing or pastures starts a fire, the fire often spreads uncontrollably to the neighbouring forests.

The mining industry is also contributing to the deforestation of the Amazon. Beneath the Amazon rainforest, there are deposits of copper, iron, manganese and gold, as well as oil and gas. In addition to the environmental damage in the areas directly affected by the exploration and extraction of these resources, the construction of infrastructure and roads that attract new settlers and people who aspire to make a living from agriculture on land they consider to be no-man's, cutting down and burning more and more forests in order to establish farmland, contribute to accelerating deforestation in regions where the extractive industry is established. Brazil is struggling with the problem of concentration of land ownership in the hands of the owners of large landed estates. In 2006, 50% of the smallest farms occupied only 2.3% of the total arable land. In contrast, the top 5% of large farms occupied 69.3% of Brazil's agricultural area.[24] The lack of regulation of land ownership through partial deconcentration (e.g. using compensation payments) is one of the main reasons for deforestation caused by landless people, but at the same time, uncontrolled deforestation is convenient for landowners because it allows them to expand the areas of their large farms.[25]

> A little-known factor exacerbating the problems of destruction in the Amazon is illegal gold prospecting.

A little-known factor exacerbating the problems of destruction in the Amazon is illegal gold prospecting. As much as 20% of the world's gold mining comes from Artisanal and Small-scale Gold Mining (ASGM), which employs between 10 and 20 million people and accounts for about 90% of the gold mining workforce. About 4 to 5 million people who work voluntarily or under duress

[22] Council on Foreign Relations, Deforestation in the Amazon, (https://www.cfr.org/amazon-deforestation/#/en, access: 15.09.2023).
[23] Aragão, L.E.O.C., Anderson, L.O., Fonseca, M.G. et al. 21st Century drought-related fires counteract the decline of Amazon deforestation carbon emissions. Nat Commun 9, 536 (2018). (https://doi.org/10.1038/s41467-017-02771-y, access: 20.10.2023).
[24] Reydon, B.P., Fernandes V.B., Telles T.S., „Land tenure in Brazil: The question of regulation and governance", Land Use Policy, vol. 42, January 2015, p. 509.
[25] Ibidem.

in this sector are women and children. In Latin America, about 1.5 million people are involved in gold mining.[26] Most gold prospectors in the Amazon operate illegally, including in areas that are formally designated as protected nature reserves. Illegal gold mining is controlled by criminal gangs. Gold mining involves the cutting down of tree stands, combined with the subsequent removal of the top layers of soil before the gold is washed away, and the destruction of watercourses, combined with poisoning with mercury compounds used for gold extraction. Gold prospectors and criminal gangs controlling mining violate the rights of indigenous peoples. In the 1990s, conflicts between Indian tribes and gold prospectors in the state of Roraima (Brazil) forced the government to carry out a military operation against gold prospectors.[27] Although gold mining destroys incomparably smaller areas of primary forests than the expansion of agriculture, cattle ranching and commercial logging, the damage caused by gold mining is more concentrated and leads not only to deforestation and soil depletion but also to severe water pollution in the rivers of the Amazon.[28]

The forests of the Amazon belong to 9 countries of South America[29] The cumulative loss of forest cover in the original tropical Amazon rainforest between 1970 and 2013 amounted to 13.3% of the forest area. In the last decade, the rate of deforestation has slowed significantly in most of these countries, with the exception of Venezuela, which is on the brink of economic catastrophe and social collapse. Temporary upward trends have also been observed in Brazil during President Bolsonaro's term in office and, unfortunately, the new government of President Lula has not been able to stop this process either. In 2021, illegal logging in the Amazon rainforest in Brazil reached a level not seen in 15 years.[30] It should be noted that it is not only about cutting down tree stands, but also burning large areas of forest, with the purpose of using the land obtained in this way for cultivation and illegal housing development on the outskirts of large cities.[31]

[26] Amazon Aid Foundation, Gold mining in the Amazon, (https://amazonaid.org/threats-to-the-amazon/gold-mining/, access: 20.10.2023).
[27] WWF, Amazon mining, (https://wwf.panda.org/discover/knowledge_hub/where_we_work/amazon/amazon_threats/other_threats/amazon_mining/, access: 20.10.2023).
[28] Ibidem.
[29] Brazil, Bolivia, Equador, Columbia, Peru, Suriname, French Guyan i Gujayna and Venezuela.
[30] Deforestation in the Amazon..., (https://www.cfr.org/amazon-deforestation/#/en, access:15.09.2023).
[31] Currently (October 2023) forest fires surround Manaus city in Brazil, „Wildfires in dry Amazon rainforest choke Manaus city", Reuters, October 2023, (https://www.reuters.com/world/americas/wildfires-dry-amazon-rainforest-choke-manaus-city-2023-10-12/?utm_source=cbnewsletter&utm_medium=email&utm_term=2023-10-13&utm_campaign=Daily+Briefing+13+10+2023, access: 13.10.2023).

„The fluctuation in the rate of deforestation in the Amazon in recent decades indicates how easily forest conservation trends are reversed and how quickly forests can become sources of emissions instead of absorbing them and storing them in biomass and soil."

At the same time, the instability of these trends confirms the difficulties that developing countries will face in achieving the targets they have set for themselves in their national contributions to the Paris Agreement (NDCs) for the reduction or limitation of anthropogenic greenhouse gas emissions. In addition to what is happening in the Amazon, similar processes, caused by the same factors and conditions, are also taking place in Africa and Asia. The Asia-Pacific region covers 740 million hectares of forests, representing 26% of the region's land area and 18% of the world's forests.[32] The main causes of deforestation in Southeast Asia are the harvesting of valuable timber species, the expansion of agricultural areas and plantations of oil palms and rubber trees. Southeast Asia accounts for about 80% of global palm oil production.[33] The main producers of palm oil are Malaysia and Papua New Guinea, as well as Indonesia. In the last decades of the previous century, public opinion was moved and mobilized by consumer boycotts by the uncontrolled logging of tropical forests in Indonesia, symbolized by the fate of orangutans. This island country is characterized by rich mangrove forests along its coastline, lowland tropical rainforests, mountain forests in inland Sumatra, Sulawesi, and Borneo, and subalpine and alpine vegetation in Papua.[34] The process of deforestation and degradation of Indonesian forests began as early as the mid-twentieth century. In 1950, as much as 87% of Indonesia's land area was covered by forests, which covered 159 million hectares of the total area of 191.9 million hectares.

In 1950, as much as 87% of Indonesia's land area was covered by forests.

Notably, 9.2 million hectares of Indonesia were inland waterways. As recently as in the middle of the last century, Indonesia was almost entirely forested. The process of deforestation accelerated rapidly after 1970, mainly due to the overexploitation of timber that was exported abroad. One of the reasons for the massive deforestation was the deregulation of foreign investment in the 1980s.[35] By 1997, Indonesia had already lost 59 million hectares of forest.[36] However, the industrial felling of valuable exotic tree species without taking into account the imperative to protect the ecosystems is not the main cause of the loss of primary forests in developing countries. According to estimates by the Food and Agriculture Organization of the United Nations (FAO), based on the results of remote sensing studies, the expansion of agriculture is currently the most important reason for deforestation in the global South.[37] As the population in developing countries grows, so does the demand for food, and the increase in affluence leads to an increase in the demand

[32] Asia-Pacific Forestry Commission (APFC) dev | FAO Regional Office for Asia and the Pacific | Food and Agriculture Organization of the United Nations, (https://www.fao.org/asiapacific/apfc/en/, access: 25.09.2023).

[33] Jong, H.N., "Deforestation for palm oil falls in Southeast Asia, but is it a trend or a blip?", Mongabay, 23 March,2022, (https://news.mongabay.com/2022/03/deforestation-for-palm-oil-falls-in-southeast-asia-but-is-it-a-trend-or-a-blip/, access: 7.09.2023).

[34] Indonesia, National Communication (NC). NC3. (https://unfccc.int/documents/39829, access: 7.09.2023).

[35] R. Tsujino, T. Yumoto, S. Kitamura, I. Djamaluddin, D. Darnaedi, „History of forest loss and degradation in Indonesia", Land Use Policy, vol. 57, 30 November 2016, p. 335.

[36] Ibidem, p. 335.

[37] FAO attributed 90% of forest cover loss to agriculture, in data presented at COP.26. (https://www.fao.org/newsroom/detail/cop26-agricultural-expansion-drives-almost-90-percent-of-global-deforestation/en#, access: 27.09.2023)

for meat, and so drives the expansion of the areas consigned to both crops and pastures.

> The expansion of agriculture is currently the most important reason for deforestation in the global South.

An example of such an evolution of the causes of deforestation can be found in Cambodia. In the 60s of the last century, as much as 73.3% of the country's area was covered by forests. Deforestation in the years 1970-1993 was caused by the ongoing civil war at the time, and during the reconstruction period of the country after its end – by the plundering of timber for export. Since 2009, the rate of deforestation has increased due to the expansion of arable land linked to the expansion of small farms.[38] In 2010, Cambodia had only 7.2 million hectares of primary forest, covering 42% of the country's area. Between 2002 and 2022, the total area of primary tropical forests in Cambodia decreased by 33%, resulting in the loss of another 1.39 million hectares of primary forest area.[39] During this period, 147,000 hectares of land were afforested in Cambodia, increasing the area of forested areas by about 0.11%.[40]

As pointed out by the FAO, on the scale of the entire Asia-Pacific region, the trend of deforestation has been halted since the early 2000s and even the number of new forests has begun to increase at a rate of 2.3 million hectares per year in the years 2000-2005 and 0.7 million hectares in the years 2005-2010.[41] Reforestation, while a positive development, does not compensate for the loss of biodiversity caused by the deforestation of primary forests and does not counterbalance the CO_2 emissions associated with deforestation. Since 2020, deforestation associated with the establishment of oil palm plantations in Southeast Asia has slowed down. It is not entirely clear whether this trend will continue.[42]

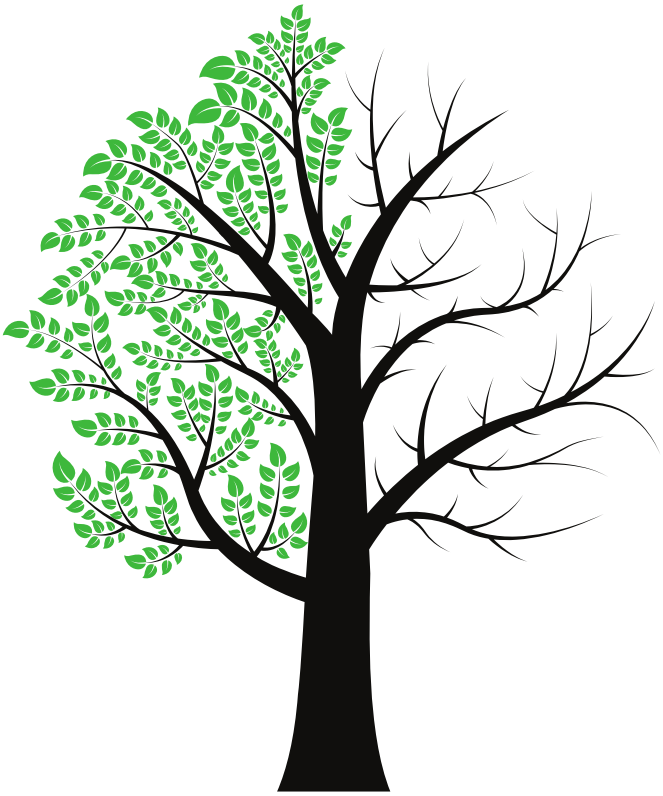
> Reforestation, while a positive development, does not compensate for the loss of biodiversity caused by the deforestation of primary forests and does not counterbalance the CO_2 emissions associated with deforestation.

In Africa, where about 26% of the continent's land area is still covered by forests,[43] most countries are struggling with deforestation. The rate of deforestation on the continent is, according to the FAO, twice as fast as the world average. Every year, 4 million hectares of forests disappear in Africa.[44] The most serious losses are recorded in the rainforest of the Congolese Basin, the largest area of tropical forest in the world after the Amazon. A significant part of the forests of the Congolese basin is located in the Democratic Republic of the Congo (DRC)[45]. Between 2000 and 2014, the DRC lost about 13 million hectares of primary forest or almost 1 million hectares per year.[46] The defor-

[38] R. Tsujino, T.Kajisa, T. Yumoto, „Causes and history of forest loss in Cambodia", International Forestry Review 21(3), September 2019, p. 372 (https://www.researchgate.net/publication/335888339_Causes_and_history_of_forest_loss_in_Cambodia, access: 18.09.2023).
[39] Cambodia Deforestation Rates & Statistics, GFW, globalforestwatch.org, (https://www.globalforestwatch.org/dashboards/country/KHM/ , access: 18.09.2023).
[40] Ibidem.
[41] Asia-Pacific Forestry Commission (APFC) dev. FAO Regional Office for Asia and the Pacific. Food and Agriculture Organization of the United Nations, (https://www.fao.org/asiapacific/apfc/fr/, access: 16.10.2023).
[42] To address the continued deforestation and forest degradation, the EU adopted on 31 May 2023 a regulation concerning trade in goods coming from deforestation and forest degradation which will be more extensively discussed on next pages of this article .
[43] Deforestation in Africa: Causes, Effects, and Solutions, Earth.Org, (https://earth.org/deforestation-in-africa/, access: 16.10.2023).
[44] Africa Open D.E.A.L: Open Data for Environment, Agriculture and Land & Africa's Great Green Wall, fao.org, (https://www.fao.org/3/cb5896en/cb5896en.pdf, access: 16.10.2023).
[45] According to FAO, DRC forests cover 155 mln ha, Ibidem.
[46] Moon H., Solomon T., „Forest Decline in Africa: Trends and Impacts of Foreign Direct Investment: A Review", International Journal of Current Advanced Research, vol. 7, issue 11 ©, November 2018, pp

estation of the DRC is caused by the expansion of farmland and the expansion of the mining industry, which, paradoxically, is largely related to the development of "green" energy. RDC mines not only gold and diamonds but also copper, tin, tantalum and cobalt. Copper is the metal without which most of the technologies currently used in the production of solar and wind energy, energy storage, batteries, motors and power transmission systems used in electric cars, not to mention traditional applications in electrical cables and wires, would not exist. Both tantalum and tin are among the important raw materials used in the manufacture of components for green energy production equipment, solar panels, and wind turbines. Tantalum is used in the manufacture of capacitors used in photovoltaic equipment, as well as in some parts of wind turbines. Tin, on the other hand, is used in the form of tin layers on copper wires used in photovoltaic panels, as well as in the manufacture of some wind turbine components. It is an important component of the renewable energy industry as it helps to store electricity efficiently.

Cobalt, on the other hand, thanks to its ability to hold large amounts of energy in a relatively low mass, is essential in the production of modern lithium-ion batteries, which are widely used in portable electronic devices, such as electric cars, but also in the production of batteries powering smartphones or laptops. At the same time, as much as 70% of the cobalt produced globally comes from Congo, of which about 30% is mined in small, primitive mines, often in violation of labour or even human rights.[47]



As much as 70% of the cobalt produced globally comes from Congo, of which about 30% is mined in small, primitive mines, often in violation of labour or even human rights.

Due to the increasing demand for renewable energy around the world, the demand for these raw materials is likely to continue or increase, and therefore their importance to the renewable energy industry will continue to be important. For example, a 2020 WEF report states that by 2030, the demand for cobalt will quadruple.[48] However, the development of technology may lead to the search for alternative solutions that could minimize dependence on these raw materials and,

16358; DOI: (http://dx.doi.org/10.24327//ijcar.2018. 16361.3021, access: 13.10.2023).

[47] Many publicly available sources provide information on minors working in cobalt mines. NGOs promoting cobalt certification initiatives and corporations with ESG programmes undertake efforts to eradicate this practice, with mixed results.

[48] World Economic Forum, „Making mining safe and fair: artisanal cobalt extraction in the Democratic Republic of the Congo", September 2020, (https://www.weforum.org/whitepapers/making-mining-safe-and-fair-artisanal-cobalt-extraction-in-the-democratic-republic-of-the-congo, access: 13.10.2023).

therefore, their extraction and the associated negative impact on the environment.

In many other African countries, deforestation is progressing primarily as a result of the extraction of raw wood for the timber industry and the expansion of agricultural areas. The increase in demand for arable land is due to the rapid growth of Africa's population. According to the FAO, 350 million hectares of agricultural land in Africa, and between 2000 and 2021, 17 million hectares of new farmland were added, increasing the acreage of agricultural land by 5%.[49]Agriculture is also a source of income from exports, mainly coffee, cocoa, peanuts and other agricultural products that cannot be produced in other climatic zones. These are often monoculture crops. For example, in countries such as Ghana and Côte d'Ivoire, increasing deforestation is associated with industrial-scale logging and the expansion of cocoa plantations.[50]

Deforestation also occurs as a result of fires, some of which may have natural causes, although they are often deliberately caused to take up land for farming.

Deforestation also occurs as a result of fires, some of which may have natural causes, although they are often deliberately caused to take up land for farming. Increasingly, fires are also attributed to climate change, although in the case of tropical forests, spontaneous combustion due to natural causes is practically not possible and in practice, there is a deliberate action behind every rainforest fire. Data on forest loss due to fires show that, globally, fires have consumed more than a quarter of forest area over the past 20 years compared to 2001. The year 2021 was a record year in this respect when a total area of 9.3 million hectares of forests were burned.

However, about 70% of the forest area lost each year due to fires is not in tropical forests, but in boreal forests. In 2021, a record year in terms of forest area lost, as much as 5.4 million hectares of forest burned in Russia, which experienced the largest wave of forest fires in 20 years, recording a 31% year-on-year increase in forest area lost to fires.[51] The increase in the frequency of fires and the loss of larger areas of forest due to fires in the temperate zone have been linked to climate change, which is occurring faster in this part of the globe. According to WRI, the area of forests lost to fires in the temperate zone has increased annually by about 110,000 hectares over the past 20 years or about 3% per year.[52] For comparison, over the last 20 years, the rate of loss of tropical forest area due to fires has increased by about 36,000 hectares per year (which corresponds to an increase in deforestation area in the tropics by about 5% per year).[53] Although the loss of tropical forest area between 2001 and 2022 was significant, rainforests still store between 228 and 247 GT of carbon.[54]

Deforestation in the tropics continues despite real efforts by many countries to combat it. Governments in developing countries face several challenges that hinder the effectiveness of such measures.

[49] FAO, 2021, World Food and Agriculture – Statistical Yearbook 2021, Rome, (https://doi.org/10.4060/cb4477en, access: 12.10.2023).
[50] FAO, „State of the World's forests", 2020, (https://www.fao.org/state-of-forests/en/, access: 13.10.2023).
[51] New Data Confirms: Forest Fires Are Getting Worse, World Resources Institute, wri.org, (https://www.wri.org/insights/global-trends-forest-fires, access: 18.10.2023).
[52] Ibidem.
[53] Ibidem.
[54] EOS Data Analytics, Forestry, Deforestation monitoring and management. See also: https://research.wri.org/gfr/latest-analysis-deforestation-trends (access:16.10.2023)

Deforestation in the tropics continues despite real efforts by many countries to combat it. Governments in developing countries face several challenges that hinder the effectiveness of such measures. These challenges include, among others, the dependence of many countries' economies on agriculture and timber exports. Reducing deforestation would have to involve changing such economic dependencies, which is a complex and difficult task to achieve. Nor do all countries have natural resources that could finance economic development. In addition, in many developing countries, limited financial resources and poorly developed infrastructure hinder the implementation of effective sustainable forest management strategies. A lack of budgetary resources results in insufficient funding for nature conservation efforts, and the lack of money is exacerbated by the lack of adequate monitoring and enforcement mechanisms.

Many developing countries face political and institutional challenges that make it difficult to reduce deforestation and effectively address deforestation drivers. Lack of political will to tackle deforestation and insufficient institutional enforcement capacity, poor governance, corruption and conflicting interests within government or between different stakeholders undermine efforts undertaken to protect natural resources, protect biodiversity and take action to curb adverse trends in greenhouse gas emissions. In addition, increasing demographic pressures, combined with the poverty of the population, increase the number of people trying to make a living, most often illegally, from the exploitation of forest resources through deforestation and the illegal conversion of forest land into agricultural land using the 'slash and burn' method. Initiatives to combat poverty and support sustainable development are key to addressing the root causes of deforestation in such regions. In some countries, local communities may not fully understand the long-term negative impact of deforestation on their environment and livelihoods.

Initiatives to combat poverty and support sustainable development are key to addressing the root causes of deforestation.

A lack of education, lack of knowledge about sustainable land use and the importance of forest conservation among local communities can hinder the adoption and use of practices that promote sustainable forest management.

It should not be forgotten that international demand for certain products associated with deforestation, such as timber, palm oil and soy, is exacerbating the negative trend of deforestation in developing countries. The high demand for these products creates strong economic incentives for local actors to engage in activities that negatively impact local environmental efforts. The EU has therefore decided to adopt a regulation that will provide access to the EU market for certain products combined with deforestation processes only if their production does not lead to deforestation and forest degradation. This is Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the Union market and exports from the Union of certain commodities and products related to deforestation and forest degradation and repealing Regulation (EU) No 995/2010[55], which is known as the Regulation on deforestation-free products.

[55] Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010, (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1115&qid=1705688021350, access: 19.10.2023).

EU Deforestation-Free Products Regulation

As part of the European Green Deal, the EU Deforestation Regulation (EUDR) is an example of the EU's efforts to shape environmental policies outside Europe along the lines of the rules and standards adopted by the EU Member States. Its stated objective is to minimise the impact of demand for certain products in Member States on deforestation, forest degradation and biodiversity loss both in the EU and in other regions of the world. Equal treatment between Member State and third-country operators is intended to ensure that this regulation is compatible with WTO rules. This regulation entered into force on 29 June 2023 and the subjects of the regulation are European companies and their supply chains, which will fulfil the related obligations from 30 December 2024. The exception is micro-enterprises and SMEs, which will be subject to the obligations set out in the regulation from 30 June 2025.

The Regulation is part of a broader action plan to tackle deforestation and forest degradation, first presented in the Commission's 2019 Communication on stepping up EU action to protect and restore the world's forests. This commitment was later reaffirmed in the European Green Deal, the EU Biodiversity Strategy for 2030 and the Farm to Fork Strategy.[56] The impact assessment shows that the unregulated consumption and processing of seven commodities covered by the regulation: cattle, coffee, cocoa, oil palm, rubber, timber and soybeans would result in the deforestation of approximately 248,000 hectares per year by 2030.[57] With the full implementation of this regulation, CO_2 emissions related to the production and consumption of these goods and products in the Member States will be reduced by at least 32 million tCO_2 per year.[58] As a result of the implementation of the Regulation, producers with more sustainable production practices should gain a larger share of the EU market and increase their competitiveness compared to producers using supplies from 'high-risk' countries under the Regulation.

As regards timber and timber products, the EUDR replaced the Timber Regulation (EU) No 995/2010 of 2010. The cut-off date for the application of the obligation to monitor regulated products and goods placed on the EU or exported from the EU is 31 December 2020. The area from which these commodities and products will originate must not be subject to deforestation or, according to the accepted definition, to the degradation of forest areas after this date. In addition to commodities such as palm oil, soybeans, cocoa, coffee, wood, rubber, cattle, the regulation covers

[56] EU Communication (2019) on stepping up EU action to protect and restore the world's forests, (https://commission.europa.eu/publications/eu-communication-2019-stepping-eu-action-protect-and-restore-worlds-forests_en, access: 20.10.2023).

[57] Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the Union market and the export from the Union of certain commodities... - (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1115&qid=1705688021350, access: 19.10.2023).

[58] Regulation on deforestation-free products, European Commission, (https://environment.ec.europa.eu/topics/forests/deforestation/regulation-deforestation-free-products_en#:~:text=Deforestation-free%20products%201%20Overview%20By%20promoting%20the%20consumption,force.%20...%203%20Objectives%20...%204%20Publications%20, access: 20.10.2023).

derived products (beef, cowhide, soybean products, chocolate, tyres, several palm oil-based products, paper, printed paper products, charcoal and wood products, including furniture) whose production or origin may harm forests.

The definition of degraded forests has been broadened by the EU to include in the regulation the conversion of primary forests or naturally regenerating forests into plantation forests or other wooded land and the conversion of primary forests into planted forests. On the other hand, the definition of deforestation adopted in the regulation is in line with the FAO definition.

Following the entry into force of this Regulation, goods or products may be released on the Union market or exported from Member States to third countries only if they do not cause deforestation or forest degradation and do not violate human rights, are manufactured in accordance with the laws of the country of origin and have been subjected to an audit, the results of which are confirmed by a due diligence statement. These conditions must be met cumulatively, i.e. failure to meet any of the above conditions eliminates the goods or products from the Union market.

The due diligence procedure includes an obligation for companies to collect information regarding the geographical origin of goods/products and to preserve the human rights and rights of indigenous peoples during the production process. This data must be detailed. They include, for example, the geolocation data of the plots of land from which the goods covered by the Regulation or the components of the product originate and the date of manufacture/production.[59] At the same time, the application of the Regulation does not preclude the application of other EU legal acts that refer to due diligence requirements in the value chain. Companies are also required to establish risk management and mitigation processes for large corporations, appoint a compliance officer and submit an annual report on the implementation of the regulation, which is to be publicly available. Interested parties may also raise substantiated objections to the application of the Regulation by companies, which should be examined. The due diligence system, combined with indicators, aims to enable small and micro enterprises to benefit from lower costs of simplified due diligence by placing products from low-risk supply chains on the market. The regulation is expected to increase the demand for deforestation-free products in the regulated categories.

According to the adopted system of indicators, third countries and Member States will be grouped according to the level of risk of deforestation and forest degradation. As a temporary measure, the regulation assumes that as of the date of its entry into force, i.e. 29 June 2023, all third countries have been identified as standard risk countries. By 30 December 2024 at the latest, the European Commission will carry out a procedure to classify the countries of origin of goods or parts of their territories, if justified, into one of three risk categories (low, standard or high).[60] Classification into one of the three risk categories determines the type of obligations of entities and administrations in the Member States in the field of reporting and confirming compliance with the regulations through inspections and controls in individual Member States, which will affect at least 9% of traders dealing in goods originating from high-risk areas and 9% of trade in goods with these countries, 3% of traders in goods originating in countries with standard risk and 1% of traders in

[59] A detailed list of the required data and information is given in Art. 9 of the Regulation.

[60] Classification details are listed in Art.29 of the Regulation.

goods and products originating in countries with a low level of risk. The purpose of the inspection is to confirm compliance with the requirement of due diligence when purchasing and placing on the market the goods and products listed in the regulation. Penalties for failing to adequately comply with the obligations set out in the Regulation should be equivalent to at least 4% of a company's annual turnover in the EU, combined with a temporary exclusion from public procurement and access to public finance. The European Commission should work with high-risk countries and the identified stakeholders in these countries to take joint action to reduce the level of risk.

> As part of a coordinated approach, the Regulation provides for the involvement of both the Commission and the Member States in a dialogue with third countries that are producers of the goods covered by the Regulation.

As part of a coordinated approach, the Regulation provides for the involvement of both the Commission and the Member States in a dialogue with third countries that are producers of the goods covered by the Regulation. By 30 June 2024 at the latest, the European Commission is expected to present an impact assessment and an appropriate legislative proposal extending the application of the Regulation to "other afforested land". The definition of the category 'other afforested land' refers to 'land not classified as forest, with an area of more than 0,5 hectares, covered by trees more than 5 m high and a tree stand of 5 to 10 % between trees that can reach these limit values in situ, or covered by shrubs and trees in total by more than 10 %, excluding areas where agricultural or urban land use predominates'.[61]

Two years after the entry into force of the Regulation, the European Commission will present an assessment of the extension of its scope to natural ecosystems other than forests, assess the appropriateness of extending the regulation to other commodities including maize and biofuels, and assess the need to impose specific obligations related to the prevention of deforesta-

[61] Art. 2.12 of Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010, (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1115&qid=1705688021350, access: 17.10.2023).

tion on financial institutions whose activities have an impact on investments that may contribute to deforestation and forest degradation.

A detailed list of commodities and derived products covered by the Regulation can be found in Annex I to the Regulation. Annex II contains a template of a due diligence statement. To ensure that the Regulation is in line with developments in trade, science and technology and that it is updated, the Commission has been empowered to adopt acts in respect of the list of CN codes for products set out in Annex I to the Regulation, in accordance with Article 290 TFEU.

Approaches to deforestation and forest degradation described by the IPCC.

In its special report on climate change and land use, the IPCC highlights that many land-based climate change mitigation options do not increase pressure for land-use conversions such as deforestation to increase arable land, and that many of these options bring economic and social co-benefits in the context of climate change adaptation. These include measures to increase food productivity, which will reduce the pressure to expand agricultural areas, measures reducing crop losses caused by poor conditions of food storage, measures to reduce deforestation and forest degradation, measures to increase soil organic carbon, policies and measures improving the protection of forests against fires. The report also highlights the importance of two other options with high potential for reducing emissions, dietary changes to reduce meat consumption and reduction of food waste.

In its other reports, the IPCC also raises the issue of the impact of reducing greenhouse gas emissions from the LULUCF sector and promoting sustainable land management practices, including forest protection and restoration, on the feasibility of the global climate change mitigation strategy. Among the options available to preserve forests and halt forest degradation, the most important are improving governance mechanisms, establishing laws and enforcing them to protect forests from illegal logging, land grabbing and other forms of deforestation, and sustainable forest management, through the responsible use of forest resources to protect forests, promoting agroforestry and sustainable agriculture, and protecting the rights of indigenous peoples and local communities who depend on forests for their livelihoods.

> Agroforestry is considered a sustainable land-use practice that combines trees and shrubs with crops or livestock on the same piece of land.

Agroforestry is one of the most interesting approaches to land management described by the IPCC as being crucial to solving the problem of forest degradation and at the same time ensuring food security in developing countries. Agroforestry is considered a sustainable land-use practice that combines trees and shrubs with crops or livestock on the same piece of land. According to experts, agroforestry offers various environmental benefits to climate change mitigation, such as carbon sequestration, soil improvement, reduction of greenhouse gas emissions and increased resilience to climate change impacts. The 2019 IPCC special report highlights the role of agroforestry in enhancing food security, protecting biodiversity, and mitigating climate change by sequestering carbon in both above-ground and underground biomass. It also discusses the importance of agroforestry in sustainable land management and its potential to contribute to climate and land-related sustainable development goals. Similar recommendations are echoed by the FAO, recom-

mending agroforestry as a sustainable land use practice in various regions around the world. FAO recognises the potential benefits of agroforestry in solving many agricultural and environmental challenges. Agroforestry is expected to contribute to the preservation of biodiversity, soil protection, the reduction of greenhouse gas emissions through natural CO_2 capture, the sustainable management of water resources and, at least in theory, to increasing the income of smallholder farmers by diversifying crop yields and expanding revenue streams through the sale of fruit, nuts and the possibility of controlled timber harvesting. Agroforestry recommendations and the suitability of such practices may vary depending on specific local conditions, including climate, soil type and available resources. However, we should not expect the large-scale use of agroforestry on a global scale. An example is the failed attempt to introduce agroforestry at the community level in Myanmar). Myanmar's Ministry of Forestry has established agroforestry-based community forests (ACFs) to increase the density of trees in areas that have previously been cleared for agriculture. However, this experiment proved to be unsuccessful, partly due to farmers' negative perception of the ideas to plant trees on their recently cleared fields.[62]

Solving the problem of deforestation in developing countries requires a comprehensive and individual approach that takes into account the social, economic and environmental costs of the loss of primary forests, but also presents attractive alternatives to deforestation that reward the protection of forest resources on the one hand, and provide other alternative paths for economic development and poverty recovery on the other. This includes implementing policies that combine economic development with sustainable land-use practices, promoting alternative livelihoods, strengthening environmental education, and providing effective governance and enforcement mechanisms to implement green legislation and promote sustainable forest management.

Global initiatives to save tropical forests

As long as deforestation is more beneficial than keeping forests untouched, developing countries will not be able to cope with the spontaneity of the phenomenon. To this end, the international community is seeking to implement global solutions to promote forest conservation and restoration where possible. The EUDR, which is currently being implemented by the EU, is an example of a regulation that seeks to support international efforts to save forests in every climate zone, but by identifying the crops that have the greatest impact on accelerating deforestation in the tropics, it can have a positive impact on supporting the efforts of developing countries to protect their own forest resources. At COP.26 in Glasgow, more than 100 countries joined an initiative to reverse the global trend of deforestation and halt it by 2030.[63] A total of $20 billion has been pledged for this purpose. It remains to be seen to what extent this initiative will prove to be effective, even to a small extent, and to what extent it will remain just another declaration on paper.

In 2014, the New York Declaration on Forests (NYDF) was adopted at the UN climate summit in New York, pledging to halve the loss of primary forests by 2020 and halt it by 2030. The NYDF proposed a common, multi-vector framework for forestry action to the signatories, consolidating a number

[62] S. Mon San, N. Kumar, L BiberFreudenberger, Ch. B. Schmitt, „Agroforestry-based community forestry as a large-scale strategy to reforest agricultural encroachment areas in Myanmar: ambition vs. Local reality", Annals of Forest Science, 27 (2023), (https://annforsci.biomedcentral.com/articles/10.1186/s13595-023-01191-x, access: 3.10.2023).

[63] COP26 brings countries together to protect world's forests - GOV.UK, (https://www.gov.uk/government/news/cop26-brings-countries-together-to-protect-worlds-forests, access: 18.10.2023).

of different initiatives and setting common goals for the protection, restoration and sustainable use of forests. Initially, more than 150 stakeholders signed the declaration: governments, large corporations, representatives of indigenous peoples and civil society organizations, and in the following years the number of signatories increased to more than 200. In addition to halting deforestation, the declaration calls for improved forest management, the restoration of 350 million hectares of degraded landscapes and woodlands, an increase in forest funding, and a reduction in emissions from deforestation and forest land degradation.[64]

However, the annual reports assessing the implementation of this declaration do not inspire optimism. The last available report, published in 2022,[65] showed that the area occupied by tropical forests continues to be under constant pressure from drivers of deforestation. In order to achieve the declared goal of halting deforestation completely by 2030, it would be necessary to reduce the rate of deforestation by 10% per year. However, in the year 2021, deforestation rates worldwide declined by only 6.3% compared to the 2018-20 baseline. In the humid tropics, the rate of loss of irreplaceable primary forest decreased by only 3.1%. Despite the persistence of these negative trends, the aforementioned report assessing the implementation of the 2022 New York Forest Declaration states, quite optimistically, that it is still possible to achieve the goals of the declaration. The greatest progress in this direction has been made in Southeast Asia, a region where the 2030 Pledge targets appear achievable if the implementation of forest policies is maintained, while Central American and African countries, although they have reduced deforestation compared to 2018-20 levels, will not meet the Pledge's targets without additional decisive action. If the NYDF fails to meet its targets, not only will it be problematic to limit the global temperature increase to 1.5°C, given the large role of forests in the implementation of many of the Nationally Determined Contributions (NDCs) of developing countries, but also the goal of halting biodiversity loss, stated in the Convention on Biological Diversity, will not be met.[66]

Among the actions pledged in the NYDF are indigenous peoples' commitments to protect tropical forests, government commitments to reduce deforestation and restore forests in degraded areas, and bilateral and multilateral programs that provide countries with large forest areas with financial resources to secure and maintain them. Giving money to developing countries to stop deforestation on their territory is a controversial idea, but it has many supporters, especially among the potential beneficiaries of such transactions. At the core of this concept is the idea of the global impact of forest removals on climate change, i.e. the recognition that forest conservation is a common good of all humanity, for which all should pay in accordance with the principle of common but differentiated responsibilities (CBDR).

At COP26 in Glasgow and the parallel summit of leaders, heads of state and governments of 140 countries, which cover more than 90% of forests, adopted a voluntary declaration known as the Glasgow Leaders' Declaration on Forests. In this declaration, the countries represented by these leaders pledged to work together to halt and reverse deforestation and forest degradation by 2030. The declaration was also joined by a number of heads of large corporations, financial

[64] New York Declaration on Forests - Forest Declaration, (https://forestdeclaration.org/about/new-york-declaration-on-forests/, access: 3.10.2023).

[65] Forest Declaration Asssessment: Are we on track for 2030?, October 2022 (https://forestdeclaration.org/resources/forest-declaration-assessment-2022/, access: 3.10.2023).

[66] Forest Declaration Assesment 2022, Executive Summary.

actors and representatives of non-governmental organizations. After the end of the COP, five more countries joined the team. In addition to the declarations to stop financing trade in deforestation-causing commodities and other actions with similar impacts, as reported by the heads of more than 30 financial institutions managing assets worth more than USD 8.7 trillion, the heads of government of the 28 countries representing a 75% share of trade in goods that can negatively affect the state of forests have signed a new "Statement on Forestry, Agriculture and Trade in Goods" (FACT).[67] The statement is part of an action plan to ensure sustainable trade and reduce pressure on forests, including support for smallholder farmers and improving the transparency of supply chains. The EU's Deforestation-Free Products Regulation, which entered into force in June 2023, is in line with the spirit of this statement, reaffirming the EU's commitment to promoting a multilateral approach to raising the ambition of the Parties to the Paris Agreement and the Regulation's compatibility with WTO rules.

> **In addition to strong political will, money is needed for actions aimed at protecting primary forests.**

In addition to strong political will, money is needed for actions aimed at protecting primary forests. This need has been met by the EU27, represented by the European Commission, the US, Japan, Canada, the UK and several Member States, which have pledged to provide USD 12 billion in public funding between 2021 and 2025 as part of the new Global Forest Finance Pledge. In addition, the nine multilateral development banks issued a joint statement outlining the actions they will take to mainstream nature in policy, analysis, evaluation, advice, investment and operations, in line with their respective mandates and operating models.

Steps have also been taken to create and develop a market for voluntary carbon credits generated by high-quality jurisdictional REDD+ projects.[68] LEAF (Lowering Emissions by Accelerating Forest Finance) Coalition[69], established in April 2021 during the White House Leaders Summit on Climate organized by the White House in Glasgow, it pledged to mobilise more than USD 1 billion for activities and investments in tropical and subtropical countries that are successful in reducing emissions from deforestation and forest degradation. The LEAF partnership involves private

[67] World leaders summit on 'Action on forests and land use', (https://www.gov.uk/government/publications/cop26-world-leaders-summit-on-action-on-forests-and-land-use-2-november-2021/world-leaders-summit-on-action-on-forests-and-land-use, access: 16.10.2023).

[68] Jurisdictional REDD+ refers to a holistic, government-led approach to land use and forestry on the territory of one or more legally defined territories (jurisdictions) over which the country claims sovereignty.

[69] The LEAF Coalition, (https://resources.leafcoalition.org/, access: 19.10.2023).

corporations (more than 20 companies have joined the coalition so far) and the governments of the US, Norway and the UK. These funds will be used to purchase reduction credits from voluntary jurisdictional REDD+ projects generated based on the ART-TREES high integrity standard.

> LEAF provides a formal framework for accelerating climate action through voluntary carbon market transactions.

LEAF provides a formal framework for accelerating climate action through voluntary carbon market transactions serving as a financing mechanism for countries that commit to protecting their tropical forests. Participating companies commit to adhering to the stringent integrity criteria generated by the REDD+ projects of the credits on the demand side by ensuring that the REDD+ units acquired complement the results of the ambitious emission reduction efforts of the acquiring companies. To date, 23 eligible ART/TREES-compliant applications have been submitted for carbon credits generated over the next five years from REDD+ projects at the national or subnational level (in specific areas called 'jurisdictions'). Further applications are expected in the next editions of the competitions.

REDD+ and halting deforestation in developing countries through financial support

REDD+ (Reducing Emissions from Deforestation and forest Degradation, REDD) is a global programme aimed at mitigating climate change by reducing emissions from deforestation and forest degradation, adopted and implemented by the Parties to the UNFCCC. The aim of REDD+ is to encourage developing countries to take action to mitigate climate change by reducing greenhouse gas emissions associated with slowing, halting and reversing deforestation and forest degradation and increasing the absorption of greenhouse gases from the atmosphere through conservation, responsible management and expansion of forests. REDD+ offers financial support to developing countries in exchange for implementing measures to reduce forest-related emissions and promote sustainable forest management. These may include projects to monitor and report on deforestation, develop sustainable land use practices, and support local communities that depend on forests for their livelihoods.

> REDD+ offers financial support to developing countries in exchange for implementing measures to reduce forest-related emissions and promote sustainable forest management.

REDD+ has been identified as an important component of a comprehensive global CO_2 removal strategy due to the carbon sequestration capacity of forest areas, while contributing to biodiversity conservation, climate change mitigation, fostering sustainable development and fostering international cooperation in achieving the goals of the UN Climate Convention and the Paris Agreement. Payments under this programme are made after the countries implementing REDD+ have demonstrated the results of their actions, which is why this approach is referred to as results-based payments.

> The idea of REDD+ and results-based payments is controversial.

The idea of REDD+ and results-based payments is controversial for some stakeholders and climate activists. One of the main objections to this mechanism is that the implementation of REDD+ could lead to mass land grabbing and displacement of indigenous peoples in the name of forest conservation. Opponents and critics of the implementation of REDD+ are climate activists working for climate justice. They believe that REDD+ could lead to the displacement of indigenous peoples and the illegal expropriation of their forests. In such cases, the slogan of protecting forests would be a cover for the takeover of land claimed by indigenous peoples and local communities by both governments and large corporations. Many critics of REDD+ believe that this mechanism can be used as a tool to demonstrate achievements in the field of corporate social responsibility in a way that deviates from the truth, exaggerates decarbonisation achievements or creates a positive image of companies that is inconsistent with reality (greenwashing).

Despite criticism, REDD+ has the potential to become an effective tool for reducing emissions from deforestation and forest degradation. It can also bring economic benefits to developing countries, while protecting forests as a source of absorption and biodiversity, with the support of local communities and indigenous peoples in REDD+ activities, while respecting their rights and traditional knowledge. By the end of 2022, REDD+ activities undertaken by developing countries were implemented in forest areas covering at least 1.35 billion hectares, which accounted for about 62% of the forested area in developing countries and about 75% of the area affected by various forms of deforestation.[70]

> **According to the UNFCCC Secretariat, around 60 developing countries are currently implementing REDD+ activities in accordance with the framework established by the Parties to the Climate Convention.**

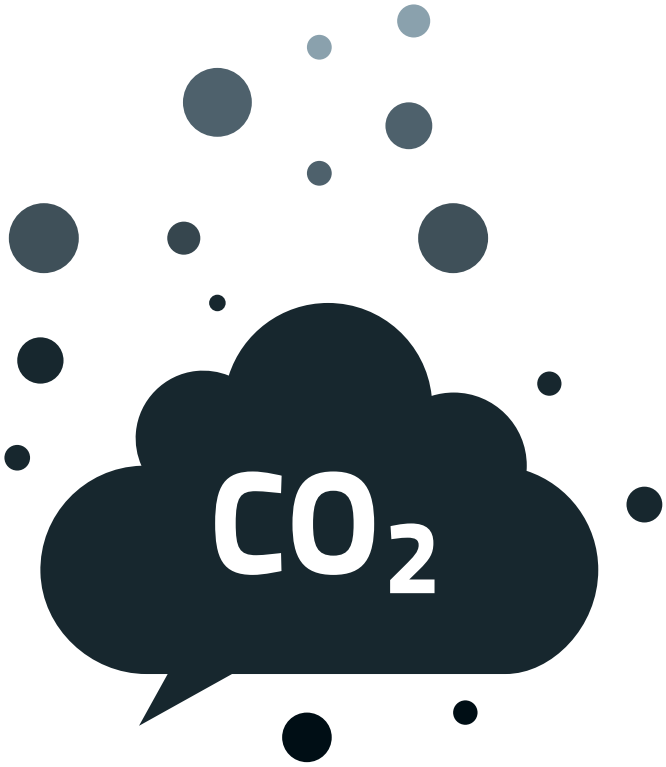
According to the UNFCCC Secretariat, around 60 developing countries are currently implementing REDD+ activities in accordance with the framework established by the Parties to the Climate Convention.[71] REDD+ actions not only combat deforestation, but also affect social, environmental and economic aspects. They include five types of activities:

1. Reduction of emissions from deforestation;
2. Reducing emissions from forest degradation;
3. Conservation of forest carbon resources;
4. Sustainable forest management;
5. Increasing and maintaining CO_2 uptake by forests.

The implementation of REDD+ is progressing in stages. In the preparatory phase, REDD+ countries prepare the National REDD+ Strategies and the National REDD+ Strategy Action Plans, develop the policies and corresponding implementation measures, and prepare capacity-building plans. The national REDD+ strategy includes, among other things, plans to initially reduce and then eliminate the drivers of deforestation and forest degradation. The government of the country adopts the Forest Reference Level (FRL) developed by the relevant government agency with the participation of experts, which

[70] What is REDD+?, UNFCCC, (https://unfccc.int/topics/land-use/workstreams/redd/what-is-redd, access: 3.10.2023)

[71] REDD +, UNFCCC, (https://unfccc.int/topics/land-use/workstreams/reddplus, access: 6.10.2023).



is validated by independent external experts in preparation for the technical assessment of the REDD+ Baseline, which becomes the baseline for the REDD+ Actions.

It is also necessary to prepare a national forest monitoring system. Parties to the UNFCCC can build on existing systems and use them as a basis for the development of a full infrastructure over time. MRV at the local level is possible but requires reporting on the approach to emissions outside the project's boundaries. REDD+ also introduces safeguards and reports on measures equivalent to the 7 REDD+ safeguards.[72]

The implementation phase includes capacity building, technology deployment and transfer, and results-based demonstration activities. The third stage involves moving to performance-based activities that are measured, reported and verified, enabling applications for results-based payments.

The history of REDD in the UNFCCC negotiations

The concept of reducing global greenhouse gas emissions from deforestation and forest degradation (REDD) was presented at the 2005 COP.11 negotiations in Montreal by delegations from Papua New Guinea and Costa Rica, and supported by the countries that formed the Coalition for Rainforest Nations in May 2005. CfRN). Negotiations on the Montreal agenda item "Reducing Deforestation Emissions in Developing Countries and Approaches to Stimulating Action" agreed on the need to include this issue in mitigation efforts, which is particularly important in light of the high share of emissions from deforestation in developing countries in global greenhouse gas emissions. The Conference of the Parties set up a Contact Group on Deforestation, which prepared conclusions for the launch of a process to address the reduction of emissions from deforestation at the next negotiating session in May 2006. The parties were also invited to submit their submissions on REDD+ to the UNFCCC Secretariat. From May 2006 to June 2015, successive sessions of the UNFCCC's Subsidiary Body on Scientific and Technological Advice (SBSTA) negotiated the agenda item "Methodological Guidelines for Action to Reduce Emissions from Deforestation and Forest Degradation and the Role of Conservation, Sustainable Forest Management and Forest Carbon Enhancement in Developing Countries". Workshops were also organised during the inter-sessional period, allowing the parties to exchange experiences and discuss important aspects related to the reduction of emissions from deforestation in developing countries. The workshops discussed social, socio-economic, technical and methodological issues, including

[72] Deforestation is a critical problem affecting people, the environment and the climate, (221024_BLS22123 UCC REDD+_infographic-5 (unfccc.int), access: 19.10.2023).

the role of forests, in particular tropical forests, in the global carbon cycle; definition issues, including agreeing on a reference to the links between deforestation and degradation; availability and quality of data; scale; indicators and drivers of deforestation; estimating changes in carbon stocks and forest cover; and the associated uncertainties. In addition, the Parties to the UNFCCC discussed policy approaches and implementation of the positive incentive systems to reduce emissions from deforestation in developing countries, including the causes of deforestation; the short- and long-term effectiveness of deforestation reductions in terms of emission reductions; shipments of emissions; bilateral and multilateral cooperation in the protection of tropical forests; linking deforestation prevention efforts with those of other relevant international bodies; issues related to the improvement of sustainable forest management; capacity-building, financial mechanisms and other alternatives, based on the experience of the parties and the lessons learned. From the very beginning, the parties have taken care of the transparency of the negotiation process at this point of the agenda and have asked the secretariat to invite representatives of relevant NGOs and experts. The workshop, which allowed negotiators to better understand the parties' positions and deepen their knowledge, was the source of the parties' conclusions and contributions to the draft decision adopted by COP.13.

Coalition for Rainforest Nations

The Coalition of Rainforest Nations is an 18-year-old voluntary intergovernmental organization of more than 50 countries in Africa, South America, Central America, the Caribbean, Asia and Oceania that aims to promote the reduction of CO_2 emissions by slowing the loss of rainforests. The CfRN supports Member States in the development and implementation of forest protection policies, capacity building and training, and through direct funding of certain initiatives and actions, mainly from the sale of REDD+ results units (RRUs).

In addition to other transaction paths, such as unit sales agreements with large corporations or countries, CfRN operates the REDD trading platform.

At COP.13 in Bali in 2007, reducing emissions from deforestation and protecting forests was high on the negotiating agenda. The location of the COP and the support of the Indonesian Presidency of the COP to achieve the outcome of the negotiations in this area were not without significance. The Bali Action Plan (BAP), which set out the directions for further negotiations under the Convention and the Kyoto Protocol, also recognised the importance of reducing emissions from deforestation and forest degradation in developing countries, encouraging the Parties to the Convention to develop national strategies and action plans to achieve this goal. In 2008, the parties communicated their views on methodological issues, including proposals to assess changes in forest cover and associated carbon stocks, emission reference levels, impacts of national and regional approaches, options for assessing the effectiveness of ongoing efforts, capacity building, technical assistance and technology transfer. In December 2008, the SBSTA conclusions preceding COP.13 proposed methodological guidelines for the assessment of emissions from the forest sector based on the 1996 IPCC Guidelines and Decision 2/CP.13, and recommended the establishment of MRV systems for monitoring anthropogenic emissions and removals in the forestry sector.

In 2009, negotiators agreed on a draft decision on methodological guidelines for action to reduce emissions from deforestation and forest degradation and the role of conservation, sustainable forest management and increasing carbon

stocks in forests in developing countries. The Conference of the Parties adopted this decision (4/CP.15) at its fifteenth session. In the following years, the parties discussed capacity-building issues, engaged in methodological discussions and participated in expert meetings organised by the Secretariat.

Another important event for the negotiations on forests was COP.19 in Warsaw, which adopted five decisions on methodological issues that are part of the Warsaw Framework on REDD+. (Warsaw Framework). The adoption of these decisions was an important step in strengthening efforts to protect tropical forests and reduce greenhouse gas emissions associated with deforestation. The purpose of the Parties was to increase trust and support for REDD+ programmes by ensuring transparency, accountability and efficiency in the management of forest protection projects and the reduction of greenhouse gas emissions. The Warsaw Framework for REDD+ allowed for a more coherent approach to the implementation of REDD+ projects at the international level, while providing greater clarity on arrangements for monitoring, reporting and verifying progress in reducing emissions from deforestation.

The REDD+ negotiations were linked to the negotiations on non-market-based approaches in 2014 and continued under the SBSTA in 2015. Among other things, methodological issues related to the non-carbon benefits of REDD+ were discussed.

Warsaw Framework for REDD+

The architecture of the REDD+ mechanism is based on the seven COP19 decisions adopted by the Parties to the UNFCCC in November 2013 in Warsaw and known collectively as the Warsaw Framework for REDD+ or the Warsaw REDD+ mechanism. REDD+ aims to provide financial support to developing countries to protect forests and reduce greenhouse gas emissions.

The Warsaw REDD+ mechanism builds on previous decisions adopted by the COP and provides clarity on a number of important issues related to the implementation of REDD+ by establishing requirements for the recognition of the results of actions resulting in emission reductions in the FOLU sector and the rules for receiving results-based payments related to these actions. The decisions adopted in Warsaw cover issues such as the technical assessment of the proposals of the Parties to the UNFCCC on the proposed forest reference levels, the coordination of support for the implementation of mitigation measures in the forest sector by developing countries, and the work programme on performance-based financing to support progress towards the full implementation of the actions referred to in Decision 1/CP.16, paragraph 70, that is, the protection of natural forests and biodiversity, support for the protection of primary forests and the services provided by forest ecosystems, and enhance other social and environmental benefits, taking into account the need to preserve the sustainable livelihoods of indigenous peoples and their harmonious existence in the forests of Parties, in accordance with the United Nations Declaration on the Rights of Indigenous Peoples. REDD+ activities are implemented in more than 60 developing countries. This confirms the popularity of the idea underlying this mechanism according to which the countries in the Global North provide financial support to the countries of the Global South in exchange for the protection and conservation of tropical forests.[73]

[73] REDD+ | UNFCCC (https://unfccc.int/topics/land-use/workstreams/reddplus, access: 22.10.2023).

> REDD+ activities are implemented in more than 60 developing countries. This confirms the popularity of the idea underlying this mechanism according to which the countries in the Global North provide financial support to the countries of the Global South in exchange for the protection and conservation of tropical forests.

In order to ensure a high level of integrity of carbon markets, units generated from projects in the forestry sector must meet not only the requirements of the Warsaw REDD+ Mechanism, but also specific rules and regulations for individual carbon markets, including third-party verification and independent validation, which determines and confirms the environmental and social integrity[74] of these units. Therefore, although the Warsaw REDD+ mechanism was not explicitly included in Article 6 of the agreement, the results of REDD+ as such were not completely excluded.

Continuation of REDD+ under the Paris Agreement

REDD+ reporting is reflected in Article 5 of the Paris Agreement with the following findings: the technical assessment of the Parties' proposals for the proposed forest reference levels or forest reference levels will continue to be organised once a year as a centralised action. The technical analysis of the results presented in the technical Annex to the biennial Transparency Reports (BTRs) will take place in parallel with the technical expert review for the BTRs. This will allow the parties to report on the results achieved as part of the implemented REDD+ activities also in the reports on the implementation of NDCs, increasing the level of transparency in the reporting of the NDCs activities.

It is important to include REDD in the scope of actions that can be carried out by the parties under Article 6 of the Paris Agreement. The scope of Article 6 of the Agreement covers both emission reductions and removals. This allowed the parties to the Agreement to adopt an interpretation according to which REDD+ activities meeting all other applicable requirements for the implementation of Article 6 are or will implicitly qualify as categories of activities recognised under Article 6.2 or Article 6.4. One of the main achievements of COP26 was the completion of work by the parties to the Agreement on the so-called Paris Rulebook, adopted in general outline by COP24 in Katowice. The mood in Glasgow was jubilant after the parties reached an agreement on several issues previously stalled during two previous conferences of the parties. In particular, the agreement

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In addition to other transaction paths, such as unit sales agreements with large corporations or countries, CfRN operates the REDD trading platform

[74] In the context of human rights or indigenous peoples' rights, for example.

on the operationalisation of Article 6 of the Paris Agreement was a big step forward.

In Glasgow, the Parties to the Paris Agreement adopted guidelines on in collaborative approaches (Article 6.2), including Internationally Transferred Mitigation Outcomes (ITMOs), and agreed on rules, modalities and procedures that will govern the mechanism established under Article 6.4, and have made progress in negotiations on non-market approaches by establishing the Committee on Non-Market Approaches (NMAs). The modalities for the transition from the Clean Development Mechanism to Article 6.4 and details on the application of corresponding adjustments (CAs) to avoid double counting of the results of Article 6 actions were also agreed.

> The market mechanisms provided for in Article 6 provide for two different types of carbon credits.

The market mechanisms provided for in Article 6 provide for two different types of carbon credits. Credits issued under the cooperative approaches set out in Article 6(2) are called Internationally Transferred Mitigation Outcomes (ITMOs) and credits issued under the Sustainable Development Mechanism (SDM) or Article 6.4 Mechanism (this term is more popular) are universally known as Article 6.4 Emission Reductions, Article 6.4 ERs. A6.4ERs are emission reduction units, just like the Certified Emission Reductions (CERs) under the Kyoto Protocol's Clean Development Mechanism (CDM). However, ITMOs are not limited to emission reductions and may include other types of credits (e.g. renewable energy units or energy efficiency credits), in accordance with the subject matter of the Article 6.2 transaction between the parties.

The Sharm El-Sheikh Implementation Plan adopted by the parties to the agreement at the end of COP.27 reaffirmed the efforts of developing countries to slow, halt and reverse deforestation through the REDD+ mechanism. The efforts of the Coalition of Rainforest Nations have led to the parties reaffirming the REDD+ mechanism as the primary global initiative to halt deforestation under the Paris Agreement.

> The efforts of the Coalition of Rainforest Nations have led to the parties reaffirming the REDD+ mechanism as the primary global initiative to halt deforestation under the Paris Agreement.

The Parties reiterated the role of the private sector in financially supporting developing countries' efforts to slow down deforestation and reduce emissions at the national level, through the implementation of NDCs. The African Group, Brazil and Indonesia also supported the initiative. One of the objectives of the cooperation between these countries was to ensure the primacy of the REDD+ mechanism over other voluntary market standards, including ART/TREES, in the regulation of actions to stop deforestation and tropical forest degradation. In the decision adopted in Sharm El-Sheikh, there was a reference to the possibility of using private sector financing to implement actions under the REDD+ mechanism in exchange for carbon credits generated in this way. According to the CfRN, sovereign carbon credits created by countries under sovereign REDD+ carbon credits represent the highest level of environmental integrity. Gabon became one of the first countries to issue sovereign carbon credits based on the UNFCCC-approved REDD+ Results. The results approved by the UNFCCC are equivalent to 90 Mt-CO_2e, created by slowing deforestation between

2010 and 2018. The sale of this pool of carbon credits is expected to provide Gabon with the means to finance further environmental protection, sustainable forest management, debt repayment and the transition to a sustainable economy.[75] More CfRN member states have issued or plan to issue their sovereign carbon credits in 2023 based on UNFCCC-approved REDD+ results.

The coalition's promotion of sovereign carbon credits at the expense of standards-certified voluntary credits has led to tensions with proponents of the latter. Since it is left to the parties to decide on the scope and manner of implementation of cooperation between the parties in the scope of Article 6.2, sovereign REDD+ credits may be treated by the contracting parties as ITMOs. Therefore, credits generated by REDD+ according to UNFCCC-approved and verified methodologies can be purchased by companies as an alternative to VCS, GS or ART/TREES certified bodies.[76]

Problems with the environmental integrity of some forestry projects

It is estimated that the LULUCF sector is capable of delivering up to a third of the emission reductions that are necessary to avoid the most severe impacts of climate change. The protection of forest complexes and the sustainable development of forest management can lead to significant emission reductions, and tropical forests alone can provide low-cost emission reductions of 3.3 Gt CO_2 per year.[77]

> There are problems with the assessment of the results of activities carried out within the LULUCF sector.

However, there are problems with the assessment of the results of activities carried out within the LULUCF sector, mainly those related to the measurement, estimation and accounting of the reductions achieved, the sustainability of the results achieved, additionality, the prevention of carbon leakage, the risk of project reversibility, the avoidance of double counting and the minimisation of risk for investors.

Verification of declared carbon reduction units/credits is the confirmation of actual carbon sequestration, which requires a robust MRV system. Difficulties in measuring and estimating reductions are a major problem for MRV mitigation activities in the LULUCF sector. Measuring carbon sequestration in forests is difficult. Estimating the amount of carbon stored in trees and soil is a complex process, and determining the specific carbon reduction impact of a particular forestry project is based on specific methodological assumptions that are debatable and can be challenged in the context of both the environmental integrity and risk management of the projects. Changes in carbon stocks due to forest management practices, natural disturbances [78] or other factors must be carefully considered by the methodology used in the project. It can be complicated

[75] Coalition for Rainforest Nations, Press Release, PR Newswire, "COP27: Sharm El-Sheikh Implementation Plan Re-Affirms Developing Country Action to Slow, Stop, and Reverse Deforestation through the REDD+ Mechanism", Markets Insider , (https://markets.businessinsider.com/news/stocks/cop27-sharm-el-sheikh-implementation-plan-re-affirms-developing-country-action-to-slow-stop-and-reverse-deforestation-through-the-redd-mechanism-1031945070, access: 23.10.2023).

[76] Verra VCS – Verra Voluntary Carbon Standards, GS – Gold Standard, ART Architecture for REDD + Transactions., TREES – The RED Environmental Excelence Standard.

[77] UN REDD programme, (https://www.un-redd.org/ , access: 23.10.2023).

[78] Term: natural disturbancies is used in the LULUCF towards natural phenomena such as storms, selfignited fires, pests and other environmental factors, eg. natural regrowth after fires. These pehonomena impact forests and ecosystems, changing their structure, composition or functioning. Natural disturbancies may have both, positive and negative impacts on the carbon balance of the ecosystems. Understanding and accounting of the results of these factors is key for policies and measures in the LULUCF sector.

to determine the exact impact of these changes on a project's overall carbon accounting.

Another problem is the uncertainty about the permanence of carbon sequestration in the long term. The absorption of CO_2 by plants is a reversible process and the sustainability of the results depends on various factors such as natural disasters, disease epidemics and deforestation, and even the gradual loss of absorption capacity by ecosystems. Accurately predicting these hazards and the sustainability of the natural removals is the more difficult the the longer the period it covers. Ensuring the sustainability of carbon sequestration and preventing the reversal of these efforts is crucial in this context but poses a significant challenge.

Taking into account carbon leakage is another problem of projects implemented in the LULUCF sector, in addition to the durability of removals. The potential for deforestation or carbon dioxide emissions to be diverted to other areas due to forestry projects is a real pain point for reduction projects in this sector.

Meeting these challenges in accounting for reductions requires the development of robust accounting standards and guidelines for forestry reduction or mitigation projects, as well as the implementation of effective, widely recognised and reliable monitoring, reporting and verification mechanisms to ensure transparency and accuracy of carbon accounting. Effectively, MRV standards, transparency of registers and the ability to track the carbon credits' unique numbers from their generation to cancellation by companies and individuals are to provide effective protection against double counting, i.e. offsetting emissions more than once using the same units.

Due to these problems, forestry projects, despite the possibility of implementing them under the Kyoto Protocol's Clean Development Mechanism (CDM), have not been allowed to be used for compliance with the EU emissions trading system, although operators of installations were able to partially account for their emissions within the agreed limits between 2008 and 2020 using CERs generated by other CDM projects.[79]

In response to the challenges that the Clean Development Mechanism has not fully addressed, the UNFCCC's REDD+ mechanism was created, and the voluntary market, which has developed in parallel to the flexible mechanisms of the Kyoto Protocol, has provided methodologies for the implementation of REDD+ projects responding to the challenges related to sustainability, additionality, carbon leakage and meticulous accounting of reductions in REDD+ projects.

[79] Certified Emission Reductions from CDM projects.

The standards for the certification of voluntary projects also include methodologies and guidelines formulated for forestry projects.

The standards for the certification of voluntary projects also include methodologies and guidelines formulated for forestry projects. The most widely used VCS (Verified Carbon Standard) includes guidelines for project developers in this sector as well and provides a certification process for offset units from these projects. VCS also offers a separate module for REDD projects, specifying the requirements for MRV. The second and most well-known certification system is the Gold Standard. The GS includes criteria for different types of projects, including afforestation and reforestation, with co-benefits such as the achievement of Sustainable Development Goals (SDGs). In addition to these two basic standards, there is a jurisdictional REDD in which governments play a major role. The Jurisdictional Approach (JA) refers to a government-led, comprehensive attempt to treat forest and land use in one or more legally defined territories similarly.

One of the standards used for MRV reductions or removals in the forest sector for REDD+ projects in a jurisdictional approach is the TREES standard (The REDD+ Environmental Excellence Standard) adopted by a voluntary global independent program known as ART (Architecture for REDD+ Transactions), which has been in place since 2018.

ART aspires to generate credits (verified abatement and sink credits) that could both be traded on voluntary markets and used under Article 6 of the Paris Agreement and the pay-for-performance mechanism.

Developing countries' readiness to comply with the requirements of the ART/TREES standard means that their NDCs cover the forestry sector, the national forest monitoring system is correlated with the CO_2 accounting requirements for the TREES standard, the existing REDD+ strategy or action plan at the national level can be used to prepare the TREES Implementation Plan, countries have a Safeguards Information System (SIS) or an analogous system for providing information on the inclusion and adherence to safeguards and a Summary of Information (SoI) at the central level (if national governments declare their participation in the project) or a report on safeguards in line with national reporting to the UNFCCC at the level of national governments) or a report on safeguards in line with national reporting to the UNFCCC at the subnational level. If all of these criteria are not met, applying jurisdictions should identify all existing gaps and provide a plan to address them with a timeline.[80]

The competition between sovereign REDD+ credits and credits issued in accordance with standards adopted by private organizations has been triggering, since the end of 2022, i.e. since the confirmation, at the initiative of the CfRN, of the validity of credits issued by state governments based on the UNFCCC-approved REDD+ results, tensions between the proponents of the use of REDD+ credits issued in line with the REDD+ results under the UNFCCC and the promoters of voluntary credits issued in accordance with the VCS, GS or TREES standards. The idea is for voluntary credits, purchased by corporations to demonstrate zero emissions as part of their corporate responsibility, to take over as much of the market as possible. Several articles appeared in the European and American press, depreciating especially the VCS of the VERRA company, entailing not only VERRA's replicas but also corrective actions against the alleged issuance of too many carbon

[80] The LEAF Coalition, (https://resources.leafcoalition.org/resources/, access: 19.10.2023).

credits and their alleged questionable quality. In response, after a few months, articles appeared about the too-easy crediting of activities carried out by developing countries using the methodology adopted under the REDD+ mechanism established by the UN Climate Convention.[81]

However, all these methodologies are not completely watertight when it comes to maintaining the integrity of the credits generated, and the problem lies not so much in the methodologies as in the constraints associated with the lack of sustainability of removals, the difficulty of avoiding carbon leakage and other problems associated with rewarding avoided deforestation and the actions, or rather omissions, that result in slowing down forest degradation. This problem will not be appeased easily, and the conflict resulting from the competition to convince buyers will not be quickly resolved.

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[81] Bedford, C.„How did carbon accounting make the headines?", Carbon Pulse, 26 September 2023 (access: 26.09.2023).

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