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Foreword

The European Union's climate policy is currently at a turning point, though this primarily concerns its implementation, while its main objectives and directions remain in place. Increasingly apparent, however, are social, economic and political tensions linked to the costs of the transition, the pace of change, and their impact on industrial competitiveness and citizens' standard of living. While there are many voices in this age of disinformation questioning global warming, unsupported by scientific evidence, the serious debate concerns not 'whether', but 'how' and 'at what cost' to achieve climate goals in the face of an economic slowdown, volatile geopolitics and growing social pressure.

To achieve the ambitious goals set out in the Paris Agreement, the European Union is continually expanding and refining its range of measures aimed at reducing greenhouse gas emissions. The result is a complex ecosystem of regulations, market mechanisms and financial instruments that will continue to grow considerably over the next few decades. Reform of the EU ETS, the implementation of the CBAM mechanism, setting a new EU reduction target for 2040 and preparations for the launch of ETS2 are not just regulatory measures, but are also having a tangible impact on markets, businesses and households. Therefore, it is no surprise that the European Commission is increasingly signalling the need for adjustments and simplifications, as reflected in the Omnibus packages and the growing emphasis on a 'just transition'. This all means that climate policy remains one of the key areas that will determine Europe's future development model. For the sake of formality, it is worth reiterating that this applies in particular to Poland: a country with a high share of fossil fuels in its energy mix, relatively low household incomes compared to the EU average and a highly energy- and regulation-sensitive industry.

In this issue of GO2'50, the authors continue their efforts to explain, explore and update key elements of EU climate policy from Poland's perspective, providing an overview of the current situation and demonstrating how the various EU climate policy components are beginning to interlock. The articles herein demonstrate that decisions made at the European level significantly impact national policies, including energy prices, transport costs, corporate strategies, local government investment plans, and public debates. Understanding these mechanisms is essential for an informed, evidence-based discussion on the direction of the Polish and EU transitions.

The Emissions Trading Scheme (EU ETS) remains the cornerstone of the EU's climate policy. For two decades, it has provided a price signal for emissions reductions in energy-intensive sectors. This publication shows that a new phase in the EU ETS's operation is beginning. Given the decreasing supply of allowances, the system's expansion to additional sectors, and the growing involvement of financial investors, the ETS market is becoming more sensitive to regulatory and political decisions. An analysis of fundamental, regulatory and technical factors reveals why the price of CO_2 emissions

no longer merely reflects current economic conditions, but also long-term expectations regarding the energy transition. This publication shows that significant changes to the market balance of EUAs may be expected in the coming years, resulting from supply constraints, the extension of the system to new sectors and regulatory changes. For Poland, this means growing cost pressures, but it also provides an increasingly strong incentive to accelerate investment in low-carbon energy sources, energy efficiency, and industrial modernisation.

At the same time, the European Union is developing measures designed to safeguard industrial competitiveness and prevent carbon leakage beyond its borders. Although still in the process of implementation and legislative refinement, the Carbon Border Adjustment Mechanism (CBAM) is becoming one of the most hotly debated elements of the climate package. Our publication outlines its general principles and technical operation, including the role of emissions verifiers and the impact of recent regulatory simplifications. From a Polish perspective, CBAM has dual significance. On the one hand, it could mitigate the risk of domestic steel, cement and fertiliser producers losing their competitive edge. On the other hand, it will impose new administrative obligations on importers and national institutions. Articles on CBAM demonstrate that its effectiveness will largely depend on the administrative capacity of the European Commission and Member States, including Poland, to implement and oversee it efficiently.

We also address the fundamental debate on the EU's long-term climate targets in this issue, including the interim emissions reduction target for 2040. The process of setting this target has highlighted tensions between climate ambition and concerns about the social and economic costs of the transition. Poland has repeatedly raised these issues and the need for greater flexibility in the choice of reduction pathways in this discussion. Our analyses show that how efforts are divided between the ETS and non-ETS sectors, and how offset credits are used, may be crucial to achieving ambitious targets nationally. The framework is currently taking shape and, in the coming years, it will determine investment decisions and the pace of decarbonisation.

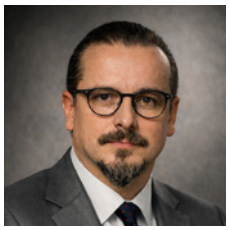
Likewise, the growing importance of carbon capture and removal technologies in this context is worth highlighting. The EU's Carbon Removal Certification Framework (CRCF) creates new opportunities for Poland, particularly with regard to the development of regenerative agriculture and the implementation of innovative CDR technologies in industry and the energy sector. An article on this matter shows that the CRCF is not just a technical certification standard, but also has the potential to stimulate development, including in Poland, by enabling the mobilisation of capital, innovation and new markets. However, we must also acknowledge the barriers, such as high costs, the lack of a national strategy and low public awareness. Nevertheless, the appropriate use of EU financial instruments could make the CRCF an important element of Poland's climate and innovation policy.

The social dimension of the transition remains a sensitive matter, in particular the impact of introducing the ETS2 system to cover the buildings and road transport sectors. Clearly, this will

affect the cost of living in Poland, a topic that we have been writing about and debating for some time. The analyses presented in this issue show that, while the cost increases may be moderate in scale, they are unevenly dispersed. Without appropriate protective measures, there is a real risk ofexacerbatingenergyandtransportpoverty.Inthiscontext,theSocialClimateFundemergesasavitaltool for reconciling climate goals with social justice. Appropriately designed protective policies are also essential for the acceptance of the transition.

The discourse in this edition is enriched by a more expansive global viewpoint, encompassing the international emissions crediting mechanisms that have emerged from the Paris Agreement and the preparations of EU candidate countries to implement EU climate policy. Unsurprisingly, European regulations are having an increasingly strong impact beyond the Union's borders, setting standards and the pace of change for its partners. For Poland, a key participant in the debate on the future of climate policy and an EU border state, these issues are significant in geopolitical, economic and regulatory terms.

This issue intends to provide an overview of the most significant challenges and dilemmas in climate policy from a Polish perspective. While we recognise that it is difficult, if not impossible, to provide simple answers to all questions related to the climate transition, we hope that this issue will provide our readers with the tools to better understand the mechanisms that are already shaping the future of the European economy. We hope that the collected texts will encourage readers to view climate policy as more than just a set of regulations, but as an ongoing process that requires a balance between ambition, efficiency, and social justice, and which is already influencing the conditions for the development of the Polish economy in the coming decades.



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Analysis of the CO_2 market in the EU ETS: outlook and forecasts for 2026

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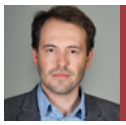
Analysis of the CO_2 market in the EU ETS: outlook and forecasts for 2026



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Keywords: EUA price, EU ETS, ETS2, auctions, MSR, demand, supply, emission, CO_2 market

Abstract

This article aims to identify the key fundamental and technical factors that could influence the EUA price by 2026. Particular emphasis is placed on analysing supply and demand conditions, as well as regulatory factors, which could lead to significant changes in market balance in the coming year.

The first part of the article presents a fundamental analysis of the EU ETS (CO_2) market, focusing on supply factors, like the impact of the systematically decreasing emission cap, the role of the MSR reserve, and the obligation to surrender allowances in the maritime sector. Additionally, it analyses the frontloaded auctioned allowances to finance the RRF fund, as well as potential adjustments to 2026 auction volumes, which could further reduce the actual supply of allowances on the primary market.

The second part of the article identifies key demand factors that may significantly affect the market balance of EUA's in 2026. These include the projected volume of emissions in sectors covered by the EU ETS, the growing importance of industrial hedging strategies in the context of phasing out of free allowances, increased demand from the maritime sector, obligations under the CBAM mechanism, and growing financial funds activity. Combined with limited supply, these factors pose a risk of a structural deficit of allowances in 2026.

The third part of the article presents the political and regulatory factors that could influence how investors perceive the CO_2 market in 2026. Particular attention is paid to the planned revision of the EU ETS Directive and the MSR mechanism, the experience of revising ETS2, and the increasing pressure from Member States to reduce CO2 price volatility. It is suggested that potential changes to the MSR rules, such as the invalidation mechanism and the speed of the reserve's response, could significantly impact the CO_2 market.

The final section of the article presents a technical analysis of EUAs, identifying the current market trend. Key support and resistance levels, the structure of the growth channel, and signals from the main technical analysis indicators (RSI and MACD) are identified. Based on this analysis, a EUA price scenario for 2026 is presented assuming a continuation of price increases within the EUR 85-100 range, while outlining the technical conditions whose violation could indicate a change in the current trend.

1. EUA allowances to be auctioned in 2026

The year 2026 is set to see significant changes in the market supply of allowances, compared to previous years. These changes will be most evident in the auctioned volumes. According to the auction calendar for 2026, which was published in December 2025, approximately 531 million allowances will be offered for sale on the primary market. However, this figure does not account for adjustments resulting from transfers of allowances to the MSR in the last four months of 2026. Based on our own estimates, taking these transfers into account, the actual volume to be auctioned in 2026 may be around 440 million, which is over 25% less than in 2025.

Table 1. Market supply of allowances expressed as the number of allowances sold at auctions and the average price of allowances in a given year in 2021-2026.

Year	EUA's sold or to be auctioned (in mln)	Annual change	Average EUA (in EUR)	Price range (w EUR)
2021	586,738	x	53,56	31-89
2022	486,087	-17,2%	80,82	56-89
2023	523,307	7,7%	83,47	66-97
2024	599,490	14,6%	65,23	50-74
2025	588,735	-1,8%	71,97	60-83
2026	440*	-25,3%	?	?

** CAKE/KOBIZE projection based on the updated auction calendar for 2026 dated 11 December 2025 and estimates of transfers of allowances to the MSR.*

Source: Own study based on the EC report

> *„The EUA volumes to be auctioned in 2026 is expected to be around 440 million, which is over 25% less than in 2025."*

Why are auction volumes expected to be around a quarter lower in 2026 than in 2025? Firstly, the supply of allowances is still being affected by the decreasing emission cap in the EU ETS and the annual linear reduction factor (LRF). Secondly, a one-off reduction of the cap by 27 million allowances, known as "rebasing", is planned for 2026 only. Thirdly, a significant proportion of allowances will continue to be transferred to the MSR reserve, which limits the supply available at auctions[1].

Another important factor for auction volumes is the full obligation for entities in the aviation sector to purchase allowances from 2026 onwards. However, the maritime sector is of key importance and will be gradually included in the EU ETS between 2024 and 2026. Emissions from this sector are included on a cumulative basis: 40% in 2024, 70% in 2025, and 100% from 2026 onwards. This will significantly impact the supply of allowances in 2026 and 2027.

1 According to KOBiZE estimates, approximately 270 million allowances will be transferred to the MSR in 2026.

Auction volumes for 2026-2027 also take into account the adjustment for the cancellation of allowances allocated to the maritime sector in accordance with Articles 3gb and 12(3e) of the EU ETS Directive. As the cancellation is based on the difference between verified emissions and surrendered allowances, the scale of the cancellation is determined after settlement. Consequently, the volumes to be cancelled are deducted from the auction supply and included in the auction calendar. The European Commission has already applied this type of adjustment for 2026, deducting approximately 54.24 million EUAs from the auction calendar this year, as reflected in the updated calendar published on 11 December 2025.

Notably, the EUA volumes to be auctioned in 2026 are very similar to those volumes sold in 2022, much as the volumes sold in 2021 and 2025 were almost identical. The scale of the decline in supply between 2021/22 and 2025/26 is also comparable, at around 17% and 25% respectively. Therefore, it can be concluded that the current market situation shows significant similarities to that of five years ago.

During that period, allowance prices rose significantly, from an average of €53.56 in 2021 to €80.82 in 2022 - an increase of around 51%. If the same dynamics were applied to the current situation, prices could rise from an average of around €72 in 2025 to around €108 in 2026. Of course, these are purely comparative estimates and do not constitute a forecast, but a similar scenario cannot be ruled out, especially as futures contract prices are already around €85.

2. Planned sale of frontloaded allowances to RRF fund – will there be an adjustment?

According to the current auction calendar, approximately 93.28 million EUAs will be sold in 2026 to finance the RRF fund. The EC has indicated that this amount was determined on the basis of Article 10(6) of the Auctioning Regulation. This took into account revenues generated to date, the average auction clearing price over the previous six calendar months, and the time remaining until 31 August 2026. RRF auctions will end when the target revenue of EUR 20 billion is reached, but no later than 31 August 2026.

It should be emphasised that the indicated volume for the RRF, i.e. 93.28 million allowances, is not final and will likely be adjusted depending on the development of EUAs prices. As shown in Table 2, for the RRF auctions to end as planned with the assumed volume, the average sale price would need to be around €56 per EUA. In practice, this means that the Commission has adopted cautious assumptions and has included a higher volume in the 2026 auction calendar than is likely to be sold.

Based on current and anticipated levels of the EUA price, it is unlikely that the remaining volume of allowances for the RRF fund will be sold at such a low price. A price scenario of around €90, as shown in Table 3, seems much more realistic. In this case, the auction calendar for 2026 would need to be reduced by around 35 million allowances.

2 https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/autumn-2025-economic-forecast-shows-continued-growth-despite-challenging-environment_en

Table 2. The volume of allowances sold and due to be auctioned on the RRF fund.

Year	Frontloaded RRF volumes* (in mln)	Auction clearing price (in €)	Value (in mln €)
2023	35,325	79,26	2 800
2024	86,685	64,60	5 600
2025	86,685	73,30	6 354**
2026	93,280	56,24	5 246***
Sum	301,975	x	20 000

** The volume is consistent with historical volumes and the 2026 auction calendar (as of 11 December 2025).*
*** The value is calculated based on the average auction clearing price (CAP3) on the EU platform in 2025.*
**** The amount estimated after deducting all the necessary years from the €20 billion required to be raised under the RRF fund.*

Source: Own study based on the EC data

Table 3. The 'realised' volume of allowances to be auctioned on the RRF fund.

Year	Frontloaded RRF volumes* (in mln)	Auction clearing price (in €)	Value (in mln €)
2023	35,325	79,26	2 800
2024	86,685	64,60	5 600
2025	86,685	73,30	6 354
2026	58,289	90,00*	5 246
Sum	266,9839	x	20 000
Correction	34,991	x	x

** The average auction clearing price is assumed to be €90. This means that, to obtain a total value of €20 billion, approximately 58.29 million allowances would need to be sold under the RRF instead of 93.28 million. This would mean that the sale of allowances under the RRF would end earlier than expected by the EC (approximately 35 million allowances would need to be removed from the auction calendar for 2026).*

Source: Own study based on the EC data

3. Potential demand for EUA allowances in 2026

With data on verified emissions for 2024, published in the European Commission's report „Report from the Commission to the European Parliament and the Council on the functioning of the European carbon market in 2024", it is possible to estimate the potential volume of emissions – and thus the demand for allowances – in 2026. Based on observed emission trends from previous years (see Table 4), it can be estimated that the demand for allowances in the EU ETS in 2026 will fluctuate around the level of approximately 1.1 billion allowances. In this scenario, total emissions in the EU ETS in 2026, covering energy, industry, aviation and the maritime sector, would fall by approximately 6.6% compared to 2024.

> *It can be estimated that the demand for allowances in the EU ETS in 2026 will fluctuate around the level of approximately 1.1 billion allowances, i.e. it would decrease by approximately 6.6% compared to 2024.*

However, it should be emphasised that these are estimates based on historical data. Taking into account the macroeconomic forecasts for the EU, including the projected solid GDP growth of around 1.4% in 2026[2], the current PMI for Eurozone at 49.6 points[3] (close to the 50-point threshold signalling an improvement in the outlook for European industry), and the scale of planned defencespendingundertheReArmEuropeplan/Readiness 2030, totalling approximately €800 billion by 2030 , a scenario cannot be ruled out in which the actual volume of emissions, and thus the demand for allowances, will turn out to be higher than the estimated 1.1 billion EUAs.

Table 4. Estimated level of emissions in 2026 r. (in mln ton of CO_2).

Emission level**	2024*	2026 (forecast)	Projected change in 2024-2026
Electricity and heat generation	493	434	-12%
Industrial production	540	513	-5,00%
Aviation	63	71	13%
Maritime	90	90	0%
Sum	1 185	1 107	-6,6%

** actual data based on the EC report*
*** The emissions for the energy and industry sectors in 2026 were determined based on the average percentage change over the last five years. Aviation emissions were calculated using the average percentage change over the last two years (due to the drastic drop in emissions caused by the pandemic, a shorter period was used for the calculation). Emissions for the maritime sector remained at the same level as in 2024.*

Source: Own study based on the EC data

4. Negative balance of EUA allowances in 2026

Comparing the volumes of allowances to be auctioned with estimates of free allocation and projected emissions for 2026 indicates a potential shortage of supply on the market. Depending on the extent to which volumes are allocated to the RRF fund, the supply gap could reach around 150-185 million allowances (see Table 5). However, the negative allowance balance in 2026 could worsen further as a result of additional demand.

Table 5. Estimated balance of allowances for 2026 (in millions).

Category	Supply (auctiones and free allowances*)	Demand (emissions)	Balance of demand
Without RRF correction	957	1 107	-150
With RRF correction	922	1 107	-185

**The amount of free allowances was estimated based on the average allocation for the period 2021–2025, in accordance with the EC report on the functioning of the allowance market in 2024. This figure was also adjusted to account for the reduction in allowances resulting from the CBAM factor.*[5]

Source: Own study based on the EC data

3 https://tradingeconomics.com/euro-area/manufacturing-pmi

4 https://commission.europa.eu/topics/defence/future-european-defence_en

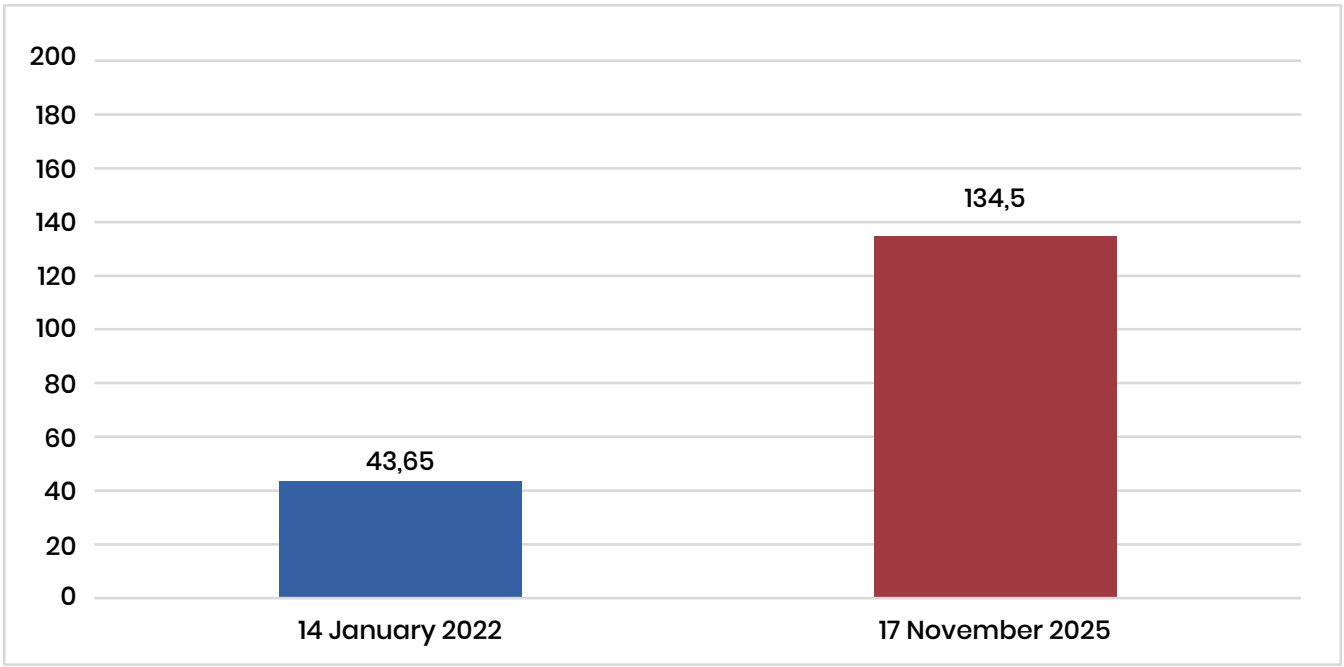
5 Free allowances in sectors covered by the CBAM are set to decrease gradually between 2026 and 2034. By 2030, they are expected to have fallen by 48.5% (compared to only 2.5% in 2026). According to EC data, CBAM sectors currently account for around 53% of the free allowance volume.

Firstly, the growing importance of hedging strategies in the industrial sector must be recognised. Faced with the prospect of a gradual reduction in free allowances, industrial companies may increase their purchases of allowances in advance, as the energy sector has done so far, to secure their emission needs for the coming years. Secondly, new participants from the maritime sector will generate additional demand in the EU ETS, as their compliance obligation will increase significantly when emissions are fully covered from 2026 onwards. Thirdly, demand for allowances may also increase from entities outside the EU ETS that are subject to the obligation to purchase CBAM certificates, particularly importers[6].

Another important factor is the activity of hedge funds and other financial institutions, whose role in shaping EUA prices could be pivotal given the structurally declining supply of allowances. According to Commitment of Traders data from November 2025, long positions held by hedge funds on the futures market reached a record level of approximately 135 million allowances[7], reflecting strong bullish expectations. In a scenario of further supply constraints from 2026 onwards, these funds may increase their exposure further, thereby strengthening demand pressure.

In addition, Spark Change indicated (during the 23 April 2024 webinar) that the demand resulting from industry hedging alone may reach approximately 80 million allowances. Taking this figure into account, along with the volume of allowances currently 'locked' in long positions held by hedge funds, the total updated allowance deficit in 2026 could increase to approximately 400 million allowances (185 million + 80 million + 135 million).

Chart 1. A comparison of the long positions (i.e. futures contracts for an increase in the EUA's price) held by hedge funds in 2022 and 2025, expressed in millions.



Sources: Commitment of Traders data

6 They can easily hedge by purchasing ETF units directly via stock exchanges.

7 https://www.ice.com/report/234

> *The deficit of allowances in 2026 could be as high as approximately 400 million.*

5. Political factors that could halt the rise in EUA prices

Political factors remain a key element that could limit rise of EUA prices. In this respect, 2026 is set to be a pivotal year for the EU ETS, primarily due to the mid-year revision of the EU ETS Directive and the Market Stability Reserve mechanism. The most notable potential change is the modification of the EU ETS allowances reduction pathway after 2030, which aims to prevent the "end game" scenario, whereby the supply of allowances on the primary market[8] is exhausted by the end of the next decade. Other potential changes include the inclusion of carbon dioxide removal units (CDR) in the EU ETS, or the extension of the system to new sectors such as waste. From a market perspective, however, the MSR review will be of key importance.

Recent months have seen the relaxation of the ETS2 implementation framework, including the postponement of its launch until 2028 and the softening of the MSR and pricing mechanisms. This shows that pressure to protect industrial competitiveness and public concerns can result in originally very ambitious regulations being weakened. The delay and revision of ETS2 in response to concerns about high costs and public acceptance issues increases the likelihood of similar pressures arising during the revision of ETS1, particularly if there are sharp increases in the EUA prices. This increases the risk of mitigation measures being implemented in the ETS1, ranging from delays to further regulation tightening (e.g. phasing out free allowances in CBAM sectors) to MSR parameter modifications and cap trajectory revision after 2030.

An additional political factor is the growing pressure from some Member States to limit EUA price volatility and introduce stabilising mechanisms, such as the so-called price corridor. The discussion itself may affect market expectations, temporarily reducing investors' willingness to purchase EUAs or causing their prices to become more volatile.

6. MSR review – a game changer for the CO_2 market in 2026?

The MSR review could be one of the key factors that will shape the situation on the EU ETS market in 2026. The current structure of the MSR is becoming less and less responsive to market realities due to several structural limitations. Firstly, the method used to calculate the total number of allowances in circulation (TNAC) does not fully consider historical aviation sector data and is based on verified emissions published in April of a given year. This means that, at any given time, approximately 10% of surrendered allowances are excluded from the calculations. Secondly, the MSR mechanism is clearly asymmetrical, transferring significantly more allowances from the market to the reserve (approximately 250-300 million per year) than it will be able to release in the future (100 million). Thirdly, the mechanism has a delay of around 1.5 years, meaning it is too slow to respond effectively to sudden changes in market conditions.

While all these elements are important, the invalidation mechanism remains the most problematic from the perspective of market stability.

8 The primary market provides emission allowances (EUAs) that are initially traded in the EU ETS by public institutions and EU Member States.

According to the current rules, allowances accumulated in the MSR above the 400 million threshold are permanently invalidated. In a system moving towards a structural shortage of allowances, this is a risky solution in practice, as it automatically tightens the emission cap regardless of the economic situation. Consequently, there is a real risk that by around 2040, the MSR will not have sufficient volume of allowances to effectively counteract potential supply (price) shocks.

In response to these challenges, some proposals have been put forward that would mitigate the impact of the MSR rather than tightening it further. For instance, Veyt's white paper suggests raising the threshold for invalidated allowances from 400 million to 600 million to counterbalance the introduction of a frontloading for allowances to the RRF fund. Another proposal is to introduce an additional intermediate threshold between the current levels of 833 million and 400 million allowances. This would enable a more gradual and earlier release of allowances from the reserve (before the TNAC falls below 400 million). The ETS2 provides a similar solution with an additional threshold of 260 million allowances, however, different thresholds apply here than in the ETS1 (210-440 million). This suggests that any MSR review in 2026 will focus more on increasing flexibility and stabilising high EUA prices rather than on further tightening the mechanism.

> *„MSR review in 2026 will likely focus on increasing flexibility and stabilising EUA prices rather than further tightening the mechanism".*

7. EUA price forecast for 2026

Since April 2023, there has been a clear downward trend in the EUA prices, after they formed a double peak at around €100 on the weekly chart. This trend was characterised by a sequence of lower highs and lower lows. The first signs that this trend might be coming to an end only appeared at the end of 2024, when the so-called "bear line" was broken. Earlier, in February 2024, EUA prices had reached a local low of around €51. From that point onwards, prices began forming higher highs and higher lows, which could indicate a gradual shift from a downward to an upward trend. Key confirmation of this change came in April 2025 when the local low of around €62 was defended, marking the lower limit of the upward channel within which prices have moved to date. Currently, having broken through significant local resistance at around €82, EUAs are heading towards the upper limit of the upward channel (marked in yellow on Chart 2), i.e. around €95. Breaking this line would pave the way for a retest of the historical highs from mid-August 2022, which are located around €100. Conversely, a fall in prices below €62 would suggest a renewed downward trend.

Chart 2. EUA price quotations on the futures market on a weekly basis, with upward and downward trend lines, as well as support and resistance lines plotted.

Source: Own study based on investing.com (access 15 December 2025)

The RSI[9] oscillator, which measures price strength, broke through the falling resistance line in November 2025. This is a strong signal confirming the dominance of the upward trend. However, it is approaching the overbought zone at 70 points, which could lead to a short-term downward correction. The second most important technical analysis indicator is the MACD[10] oscillator, which analyses the convergence/divergence of moving averages. It broke through the downward trend line a month earlier than the RSI and has remained above the zero line for some time. This is a very strong buy signal, increasing the likelihood of EUA prices continuing to rise as they have in recent months.

Assuming EUA prices continue to rise within the upward channel (marked in yellow on chart 2) in 2026, they are expected to range between €85 and €100. The average of this range is approximately €92. This level is very close to that forecast by various analytical institutions[11]: €90.

> *Assuming that EUA prices continue to rise within the upward channel in 2026, they are expected to range between €85 and €100. The average of this range is approximately €92.*

8. Summary

The year 2026 is set to be a pivotal moment for the EU ETS market, primarily due to a substantial decrease in the supply of allowances and increasing demand. Auction volumes are expected to be much lower than in previous years due to

9 The Relative Strength Index (RSI) is measured on a scale from 0 to 100. The most popular time periods for calculating this indicator are 9, 14 and 21 days. The RSI measures the strength of upward movements in relation to downward movements. A signal occurs when the indicator enters or leaves the oversold or overbought levels of the market. It is generally accepted that an RSI value below 30 indicates an oversold market and an RSI value above 70 indicates an overbought market.

10 The MACD (Moving Average Convergence Divergence) indicator is one of the most commonly used. It is calculated by subtracting the 26-day exponential moving average from the 12-day exponential moving average. A buy signal is generated when the MACD crosses above the non-rising signal line, and a sell signal when it crosses below.

11 The average forecast from the six largest analytical institutions (BNEF, Vertis, Energy Aspects, LSEG, Pact Capital and Morgan Stanley) as of 7 October 2025.

the falling cap, one-off rebasing, the strong absorption of allowances by the MSR, the obligation to purchase allowances being applied to the entire aviation sector, and the final stage of incorporating the maritime sector into the system. Furthermore, actual supply could be reduced further as a result of adjustments to the front-loaded volumes allocated to the RRF fund. Comparing supply with projected emissions indicates a structural deficit of allowances in 2026, which could worsen when additional demand from industry hedging, the growing activity of the maritime sector, CBAM obligations, and hedge fund activity are considered.

A similar situation occurred in the CO_2 market in 2021-22, when a decline in auction volumes led to a sharp rise in EUA prices. While such analogies do not constitute a forecast, current futures prices and market expectations suggest that upward pressure in 2026 could be substantial. At the same time, political and regulatory factors that could stabilise or dampen prices are becoming increasingly important. The planned revision of the EU ETS Directive and the MSR mechanism, experience gained from ETS2 revising and pressure from Member States to reduce price volatility all increase the likelihood of modifications to the system's parameters. In particular, the MSR review - especially the rules for invalidation mechanism and the speed of the reserve's response - could be a game changer, shifting the emphasis from further system tightening towards greater flexibility and market stability amid structurally declining supply.

From a technical perspective, the EUAs entered an upward trend at the end of 2024 after breaking through the long-term bearish line and defending the key low in the €62 area. This marked the lower limit of the upward channel. Breaking through significant resistance at around €82 created space for further gains towards the upper limit of the upward channel, i.e. around €95-€100. Market strength indicators, such as RSI and MACD, signal the dominance of the demand side. However, the RSI approaching the overbought zone increases the risk of short-term corrections. Assuming the upward trend continues, the average price of EUAs in 2026 may be around €92, which is in line with the consensus forecast of analytical centres (€90).

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The 2040 intermediate greenhouse gas emissions reduction target in the amended European Climate Law

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The 2040 intermediate greenhouse gas emissions reduction target in the amended European Climate Law

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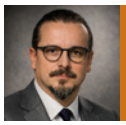

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Keywords: 2040 reduction target, EU energy and climate policy, climate neutrality, economic impact of climate policy

Abstract

This article examines the process of setting the European Union's intermediate greenhouse gas emissions reduction target for 2040. The authors recall that the European Commission's initial 2024 proposal envisaged a 90% net reduction in emissions relative to 1990 levels, with only very limited scope to use international offset units (up to 3%). The proposal sparked significant controversy among Member States, including Poland, which pointed to insufficient flexibility and potential risks to the EU's competitiveness. Key concerns related to the restrictive approach to offsets and to a decarbonisation pathway that would rely on technologies still at a pre-commercial stage, such as hydrogen and direct air carbon capture and storage (DACCS).

The authors also discuss the political agreement reached in the trilogue in December 2025, which modified the Commission's original assumptions. While the overall 90% target was retained, an element of flexibility was introduced: 85% of the emissions reduction is to be achieved through domestic effort within the EU, while up to 5% of the target may be met through high-quality international offset units. A major concession is the possibility of pilot use of offset units already from 2031, as well as leaving open the option of integrating such units into the EU Emissions Trading System (EU ETS), although this issue has not yet been decided. The authors then analyse two options for reallocating the burden across ETS1, ETS2 and non-ETS sectors: (i) a proportional allocation of offset limits across ETS1, ETS2 and non-ETS policy instruments, and (ii) an approach in which offset are used exclusively in the non-ETS sector.

In conclusion, the paper emphasises that achieving such an ambitious target requires careful balancing of social and economic costs. The authors argue that success will depend on the final legislative design, which must provide industry with investment predictability and ensure a fair distribution of the required mitigation effort across Member States.

1. Introduction

Until the latest decision to adopt a climate policy target for 2040, the European Union had two legally binding greenhouse gas reduction targets: a 55% reduction by 2030 and net climate neutrality by 2050[1]. These targets are set out in the European Climate Law (ECL), firstly adopted in 2021[2]. The Act states that an intermediate target for 2040 is to be adopted as well, in order to provide predictability and legal certainty for economic actors, investors and consumers, and to safeguard the irreversibility of achieving climate neutrality. This is reflected in Article 4(3) of the ECL, which required the European Commission to submit a legislative proposal to amend the ECL within six months of the first global stocktake under the Paris Agreements (Article 14 therein)[3].

Acting pursuant to that provision, the European Commission submitted, on 2 July 2025, a legislative proposal to amend the ECL, including the establishment of a 2040 net emissions reduction target of 90%[4]. Assessing this proposal requires consideration of the ECL's stipulation that the Commission must provide a "robust and objective assessment based on the most up-to-date scientific, technical, and socio-economic findings, and representative of a broad range of independent expertise" when presenting its proposal. This assessment must be based on relevant information, including analyses by the advisory bodies operating within the Commission's Joint Research Centre, as well as the most up-to-date and relevant scientific knowledge in the field. In the impact assessment published alongside the legislative proposal, the Commission analysed several scenarios defining a linear trajectory for emissions reductions, linking the 2030 and 2050 targets[5]. Ultimately, the Commission selected the most ambitious variant, which is consistent with the 2023 recommendations of the European Scientific Advisory Board on Climate Change, indicating that the European Union is capable of achieving a net emissions reduction of 90–95%.

In March 2026, the EU finally adopted an amendment to the European Climate Law. This set a legally binding reduction target of 90% by 2040, relative to 1990. The domestic target was set at 85%, with up to 5% coming from high-quality international carbon credits, an option applicable from 2036 onwards.

2. Conditions and constraints for achieving the reduction target

In its July 2025 proposal, the European Commission assumed that the 90% reduction target would be primarily achieved through domestic measures undertaken by Member States. However, it would allow for the limited and strictly regulated use of 'high-quality international emission reduction units' (offsets) originating from Article 6 mechanisms of the Paris Agreement, up to 3% of the EU's 1990 emissions (ultimately increased to 5%). This equates to around 140 million tonnes,

1 The reduction targets expressed as percentages are referenced to the European Union's greenhouse gas emissions level in 1990.

2 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).

3 Proposal for a regulation of the European Parliament and of the Council amending Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality. 2025/0524 (COD).

4 See Section 2: Commission Staff Working Document. Impact Assessment Report. SWD(2024) 63 final.

5 European Environment Agency and European Scientific Advisory Board on Climate Change, Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050, Publications Office of the European Union, 2023.

or roughly 30% of emissions in 2040, assuming the proposed reduction target is met (in other words, EU emissions in 2040 could be higher by that amount, provided they are offset). Under the proposal, the use of offsets would only be permitted from 2036 onwards (as was finally adopted).

According to the explanations included at the beginning of the Commission's legislative proposal (the Explanatory Memorandum), these units would not be used for compliance under the EU Emissions Trading System (EU ETS). In the Commission's published Q&A, their role is described as strictly supplementary, limited to partially supporting the achievement of the overall net emissions reduction target, without affecting the climate policy instruments applied to individual sectors in the EU[6]. The Commission's scepticism towards the use of international offset units within the EU ETS was also reflected in the position presented by Mette Quinn (European Commission in the document "Carbon Removals in the EU ETS", delivered on 7 July 2025 at a meeting of the Environment Working Party. The document indicated that the role of international credits in future policy had not yet been defined, and suggested that they were not intended to be integrated into the EU ETS. It also mentioned the possibility of using such units to reduce domestic efforts marginally, thereby easing pressure on the emissions trading system.

International reduction and/or removal units must originate from credible, transformational projects in partner countries whose climate objectives align with the goals of the Paris Agreement. According to the published impact assessment, key technologies for achieving the target include hydrogen, synthetic fuels, and direct air carbon capture and storage (DACCS). However, these solutions are still in the pre-commercial stage, and there is a great deal of uncertainty surrounding their costs and scalability. At the same time, the Commission is assuming the very rapid rollout of renewable energy, the acceleration of transport electrification and the expansion of hydrogen infrastructure, as well as the development of infrastructure for transporting and injecting captured CO_2. However, there are strong indications that the CO_2 removal capacities envisaged for 2030 in the 6 December 2024 strategy will not be delivered, which may also constrain the development of these technologies over the next decade. The proposed amendments to the European Climate Law in 2025 do not include permanent CO_2 removal technologies (DACCS, BioCCS and biochar) in the delivery of the 2040 climate target. The aforementioned Explanatory Memorandum specifies that international units must originate from projects embedded in the long-term emissions reduction strategies of third countries, supporting the development of global net-zero value chains. They could only be used subject to prior agreement with the countries of origin on benefit-sharing arrangements related to emissions reductions (Explanatory Memorandum; Q&A, Question 4). Nevertheless, the Commission signals that it will return to this issue in the 2026 review of the EU ETS, including an assessment of the potential role of international units, possible support instruments, and the conditions for any eventual integration with market-based climate policy mechanisms.

6 See Questions and answers on the 2040 EU climate target proposal.

3. Concerns and objections regarding the European Commission's proposal

The European Commission's proposal to set a legally binding target to reduce net emissions by 90% by 2040, compared to 1990 levels, is an ambitious step in the EU's ongoing climate transition. Although the target was adopted in March 2026, the final policy architecture requires sufficient flexibility mechanisms, cost predictability and a fair distribution of effort. This poses a significant risk to the competitiveness of the economies of Member States, including Poland.

Several Member States (e.g. Poland and Italy) drew particular attention to the insufficient limit on the use of offsets, questioned to late date from which their use would be permitted and criticised the lack of an option to use them within the EU ETS. In responses to the Commission proposal, these countries emphasised the need to increase the limit (adopted) and to allow international units already from 2031 (finally did not succeed). The rationale behind such demands is primarily to enhance flexibility in allocating mitigation effort across targets and to enable earlier development of the mechanisms and market for units that have been absent from EU climate policy for more than a decade (the Commission has explained its reluctance by referring to negative experiences with offsets from the flexible mechanisms of the Kyoto Protocol).

From the perspective of higher-emitting Member States such as Poland, the earlier deployment of an offset mechanism is of particular importance. Due to their economic structure and higher share of emissions-intensive industries, these countries face more challenging transition processes Earlier access to offsets would enable the mitigation effort to be spread more evenly over time, facilitate the initiation of necessary investments in zero-emission technologies, and reduce transition costs — particularly in sectors where the proposed pace of decarbonisation poses a significant challenge.

In addition, some Member States (e.g. France, Poland, the Czech Republic and Hungary) questioned the trajectory between the 2030 and 2050 targets. They stressed that the intermediate target should be more realistic while still being ambitious on the pathway to climate neutrality. A 90% reduction would require the deployment of solutions that are still in the early stages of development, which would significantly increase costs. However, analyses by KOBiZE suggest that reducing emissions by around 83% by 2040 using currently foreseeable technologies and cost assumptions appears achievable, which is broadly consistent with Scenario S1 presented by the Commission in its impact assessment.

4. Political agreement - outcomes of EU interinstitutional negotiations

On 5 November 2025, the environment ministers of the EU Member States adopted by qualified majority the Council position on the reform of the European Climate Law, namely the general approach constituting the mandate for negotiations with the European Parliament within the framework of the trilogue. The Council conclusions of 6 November 2025 confirmed the retention of the European Commission proposal for an intermediate net reduction target

for 2040 set at 90%compared to 1990, with at least 85% to be achieved through domestic efforts and up to 5% to be compensated through the use of high quality international offset units, increasing the original Commission limit of 3%. The possibility of using offsets already in the period 2031 to 2035 was also introduced under a pilot phase, with full application from 2036. At the same time, the provision previously proposed by the Commission that explicitly excluded the use of such units in the EU ETS was removed, leaving the door open to further regulatory decisions.

The Council also adopted an expanded review mechanism, including in particular an assessment of the impact of climate policy on economic competitiveness, energy price levels, social conditions, technological progress, and infrastructure development. This mechanism provides for the possibility of reassessing the 2040 target, as well as a potential increase in the limit of domestic emission units by an additional 5%. Monitoring of progress towards the intermediate targets would take place on a cyclical basis every two years.

The Council conclusions also underlined the need to ensure geographically balanced access to financing for investments in new technologies. Member States additionally declared their readiness for further analysis regarding the potential inclusion of permanent CO_2 removals in the EU ETS, which may be of significant importance for the future architecture of climate policy after 2030. In parallel, the European Parliament adopted amendments aligned with the Council mandate, including the split of the target into 85% domestic reductions and 5% international reductions.

An agreement was reached on 9 December 2025 on the future shape of the European Climate Law regulation, which was finally adopted in March 2026.

The use of international units to cover up to 5% of emission reductions will be possible from 2036, as proposed by the Commission, while pilot solutions in this area were allowed already from 2031. It was emphasised that these must be high quality international units compliant with Article 6 of the Paris Agreement, and that supporting projects in partner countries that are contrary to the strategic interests of the EU is not permissible, in order to avoid negative impacts associated with CDM projects under the Kyoto Protocol.

Furthermore, it was agreed that the Commission would examine various options for incorporating international units into future EU regulations concerning the 2040 target. In other words, there is no guarantee that the amended ECL will be interpreted in the same way by all parties; the details will be crucial here, for example with regard to the use of offset units in the EU ETS. While the agreement did not explicitly prohibit international carbon credits in the EU ETS, it did contain wording that refers to the need to ensure the stability of the EU ETS.

The agreement allows for the use of permanent carbon dioxide removals achieved through domestic efforts to compensate for hard to abate emissions within the EU ETS and introduces greater flexibility both within individual sectors and between sectors. While the inclusion of removal units in the EU ETS is promising, limiting their use exclusively to hard-to-abate emissions creates a hierarchy that is inconsistent with

a technologically neutral and economically efficient approach. There was also no explicit agreement on whether the use of international removal units will be permitted, which leaves uncertainty over the rules for inclusion in the EU ETS.

5. A plausible scenario proposed by CAKE/KOBiZE experts

This section presents how the greenhouse gas reduction target proposed for 2040 could be allocated between sectors covered by the EU ETS and sectors operating in the non-ETS area. The objective of the analysis is to reconstruct a potential mechanism for distributing reduction efforts between these two main areas based on available projections and regulatory assumptions.

The estimates assume that the future distribution of reductions between EU ETS and non-ETS sectors will remain proportional to the projected emission reductions included in the Impact Assessment[7] prepared by the European Commission. In this approach, it is possible to estimate how future GHG reduction targets for both regulatory areas might look. According to the estimates, after setting the EU emission reduction target for 2040 at 90% (approximately 464 Mt $CO_{2\ eq.}$) compared to the 1990 baseline, and assuming that 5% of reductions (approximately 233 Mt $CO_{2\ eq.}$) will be achieved through the use of international units (offsets), the actual reduction target that would need to be achieved with in the European Union would amount to 85% (approximately 697 Mt $CO_{2\ eq.}$).

It should be emphasised that at this stage there is no certainty regarding the mechanisms for integrating international units into the EU climate policy framework. It is unclear whether these units will be used directly by individual sectors and Member States, for example in the non-ETS area, or whether their purchase and distribution will be managed by a designated intermediary institution, such as the European Carbon Bank[8]. There is still uncertainty regarding how many international units will be allowed in the EU ETS and in what manner. Alternatively, although less likely, a situation could arise during the negotiation process in which there is no agreement on the use of offset units in the EU ETS, and ultimately they would only be used by Member States to meet non-ETS targets.

Consequently, this analysis considers two variants of redistributing reduction targets:

- Variant A – international units are included in all EU climate policy mechanisms, namely EU ETS and non-ETS. The share of these units is proportional to the emission limit that must be achieved in 2040 in EU ETS and non-ETS.

- Variant B – international units amounting to 233 Mt $CO_{2\ eq.}$, corresponding to 5% of net EU emissions in 1990, would relieve the reduction obligations of Member States in the non-ETS sectors only

The starting point for determining the allocation of the reduction target between sectors is the set of emission projections presented in the European

7 Commission Staff Working Document. Impact Assessment Report. SWD(2024) 63 final.

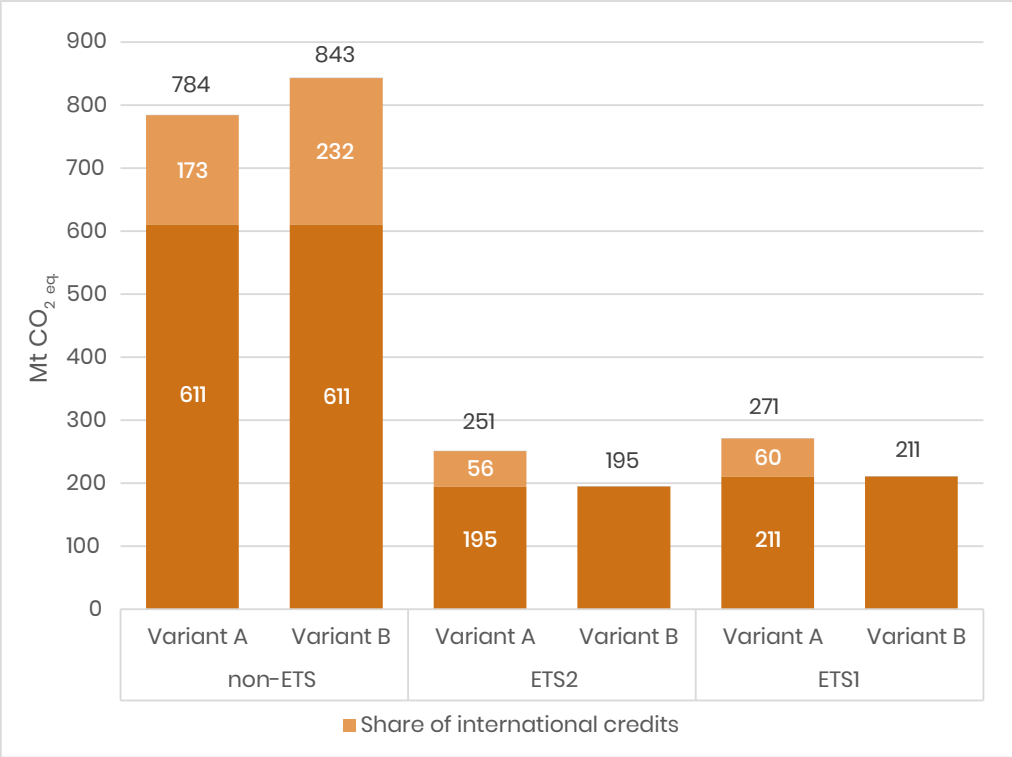
8 More information on the proposal for a European Carbon Central Bank can be found in the document: European Carbon Central Bank – Policy Brief, KOBiZE / Centre for Climate and Energy Analyses, June 2025.

9 Commission Staff Working Document. Impact Assessment Report. SWD(2024) 63 final.

Commission Impact Assessment for 2040 under scenario S3[9]. Based on the data in the document, emissions were aggregated into three categories: ETS1, covering traditional energy-intensive sectors and the power sector, ETS2, the newly adopted system covering buildings, road transport and small industry not included in ETS1, and non-ETS.The share of each of these groups in the total projected GHG emissions in 2040 was then calculated by dividing the emissions of each category by total emissions.

In the next step, for variants A and B, emission limits corresponding to a 90% reduction in the EU compared to the baseline, taking offsets into account, were determined. These limits represent the target emission ceilings in the EU that would need to be achieved in 2040. The total emission limit for each variant was then distributed among the ETS1, ETS2, and non-ETS sectors proportionally to their shares in the emissions estimated in the projections contained in the Impact Assessment for scenario S3. In the case of variant B, the 90% reduction target was adjusted only in the non-ETS area by taking into account 233 Mt $CO_{2\ eq.}$ of offsets that could potentially be used by the EU. As a result, projected emission limits were obtained for each regulatory area, namely ETS1, ETS2, and non-ETS, which could serve as a basis for future legislative proposals. It should be emphasised that the current architecture of EU climate policy has been maintained. Consequently, emissions from sectors covered by ETS2 remain included in the non-ETS area.

Figure 1. GHG emission limits in the EU ETS and non-ETS in 2040, Mt $CO_{2\ eq.}$



Source: CAKE/KOBiZE

The challenges associated with emission reductions in non-ETS sectors should be considered more difficult to address than in sectors covered by the ETS1 system. Consequently, it can be expected that a less stringent reduction target will be set for non-ETS sectors (Table 1). This is primarily due to the specific characteristics of these sectors, in which

the implementation of regulatory instruments is more challenging.

An important role in achieving reduction targets in the non-ETS area is also expected to be played by the newly established ETS2 emissions trading system, which currently covers around half of EU emissions that are simultaneously classified as non-ETS. ETS2 was fundamentally designed as an instrument to support Member States in achieving reduction targets in non-ETS sectors.

Table 1. GHG emission reduction targets in the EU in 2040 relative to 2005 emissions for ETS1, ETS2, and non-ETS, %

Target achieved within and outside the EU (with the use of 5% offsets)			
	non-ETS	**ETS2**	**ETS1**
90% emissions reduction	76%	86%	90%

Domestic target within the EU			
	non-ETS	**ETS2**	**ETS1**
Variant A	69%	81%	88%
share achieved through offsets	7%	5%	2%
Variant B	66%	86%	90%
share achieved through offsets	10%	0%	0%

Source: CAKE/KOBiZE

The highest level of emission reductions relative to 2005 is envisaged for ETS1 at 90%, followed by ETS2 at 86%, while the lowest reduction is foreseen for non-ETS sectors at 76%. These values reflect the overall emission reduction target, including the use of offsets, and illustrate the differentiated mitigation potential across sectors.

Variant A assumes a reduction of domestic mitigation ambition relative to 2005 emission levels to 69% in non-ETS sectors, including 7% achieved outside the EU through the use of offsets, to 81% in ETS2, with 5% achieved outside the EU, and to 88% in ETS1, with 2% achieved outside the EU.

Variant B assumes the achievement of targets in ETS1 and ETS2 of 90% and 86% respectively relative to 2005 levels, without the use of offsets. At the same time, Variant B assumes a reduction of the domestic target in non-ETS sectors to 66%, with this target compensated by a 10% reduction achieved outside the EU.

Concluding remarks

The European Commission's proposal to reduce greenhouse gas emissions by 90% by 2040, relative to 1990 levels, was finally adopted and constitutes an ambitious step towards EU climate neutrality. However, expert analyses suggest that, given the current state of technology and the economy, this target is challenging to attain. Analyses conducted by CAKE, based on general equilibrium and sectoral models, consider the technical and economic constraints of the transition. Assuming continuation of the current net reduction pathway, a realistic level that is acceptable in light

of economic efficiency criteria is estimated at 80 to 83% in 2040. Importantly, under this scenario, allowance prices would remain high, but at a level that would enable continued economic growth: around 300 euros per tonne of CO_2 in the EU ETS in 2040[10].

Scenarios assuming a 90% reduction by 2024, as originally proposed by the Commission, and not taking offsets into account, would require significantly higher carbon prices and the rapid commercialisation of technologies that currently do not exist on an industrial scale. Clearly, such a reduction scenario did not gain broad acceptance, and the possibility of achieving part of the emission reduction target outside the EU through offsets has been permitted. At the same time, the domestic target to be achieved within the EU has been lowered to at least 85%. Nevertheless, efforts must be made to ensure that the forthcoming architecture of the EU climate policy is carefully designed. Particular attention should be paid to the following issues:

- The maintenance of an ambitious yet realistic intermediate reduction target requires appropriate flexibility mechanisms that allow the use of offsets both in the EU ETS and in the non-ETS area, enabling a smoother distribution of reduction efforts over time and limiting transition costs.
- The strengthening of support mechanisms for permanent CO_2 removal technologies through the inclusion of carbon removal units within the EU ETS, increasing the likelihood of achieving the target in the next decade.
- Systematic monitoring of progress towards the targets is essential, alongside consideration of the impact of climate policy on economic competitiveness and social costs. Where necessary, appropriate intervention mechanisms to reduce carbon prices should be ensured, for example through the application of a price corridor in the EU ETS.
- Continued dialogue among Member States is required to ensure a fair distribution of reduction efforts and an equitable allocation of financial resources for the transition.

It should be consistently emphasised to policymakers that EU climate targets require a careful balance between ambition and realistic technological, economic, and social capacities, while maintaining predictability for industry.

10 Pyrka M., Jeszke R., Boratyński J., Witajewski-Baltvilks J., Antosiewicz M., Tatarewicz I., Rabiega W., Wąs A., Lewarski M., Skwierz S., Rosłaniec M., Lizak S., Zborowska I., Chodor M., Kobus P., Cygler M., Gorzałczyński A., Tylka A., Lewarska I., Mzyk P., Sekuła M. (2024). VIIEW on EU ETS 2050: Exploring synergies between the EU ETS and other EU climate policy measures - carbon removal, hydrogen, and sectoral transport policy, IOŚ-PIB / KOBiZE, Warsaw, April 2024.

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The impact of the ETS2 system on road transport in the initial years of implementation: a scenario analysis for Poland

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The impact of the ETS2 system on road transport in the initial years of implementation: a scenario analysis for Poland

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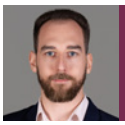

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Keywords: ETS2, passenger cars, electromobility, uNECP, household budgets

Streszczenie

This article examines the potential impact of introducing the ETS2 system on the cost of passenger car use in Poland during the initial years of its operation (2028–2032)[1]. ETS2 is an important component of the EU's transport decarbonisation strategy, based on a market-based price signal intended to progressively reduce emissions by strengthening investment incentives and influencing behaviour – while recognising the importance of accompanying compensatory measures to maintain social acceptability. The purpose of this study is not to challenge ETS2 as a market mechanism, but rather to estimate as precisely as possible the magnitude and distribution of costs in the first years of the system's operation in Poland, and to indicate what these imply for the design of public policies (protective measures, investment priorities, and communication). The analysis focuses on the main transmission channels: the EUA2 allowance price -> higher fuel costs -> effects on vehicle total cost of ownership (TCO) -> potential consumer decisions and the short-term evolution of the fleet structure. The assessment is conducted using the TR3E transport sector model, incorporating assumptions from the updated National Energy and Climate Plan (uNECP)[2].

Simulation results indicate that in 2028–2029 the increase in fuel prices should be moderate and – under the uNECP/TR3E assumptions adopted – should not exceed 10% of the retail fuel price for petrol and diesel, and 15% for LPG. As a consequence, the total cost of ownership and use (TCO) of internal combustion engine (ICE) passenger cars will rise on average by around 1.4–3.2% in 2028–2029 and by 2.8–6.7% in 2030–2032, depending on the fuel type. The smallest increase applies to petrol-fuelled vehicles, while the largest is observed for LPG vehicles. This reflects the higher baseline TCO of petrol cars and lower petrol consumption per kilometre than LPG in ICE vehicles. Over the entire 2028–2032 period, the cumulative ETS2 costs borne by passenger car users amount to 11.9% of total expenditure on petroleum-derived fuels.

An economic consequence of ETS2 implementation will be a gradual shift in the vehicle fleet composition towards a higher share of zero-emission powertrains (battery-electric and hydrogen). By 2032, the number of additional electric cars could increase by around 120 thousand units compared with the assumed baseline pathway for electromobility. The higher stock of zero-emission vehicles will contribute to a reduction **in transport CO_2 emissions of more than 2 Mt CO_2** over the period analysed, while also lowering local air pollution and reducing dependence on imported fossil fuels.

In 2028–2032, technological change on the fleet side is expected to be limited (due to the inertia of the existing vehicle stock); therefore, in the short run the dominant channel through which ETS2 affects road transport remains the fuel price effect. At the same time, even moderate cost increases may have social and political salience in specific segments (e.g., poorly connected areas and lower-income households), which supports a scenario-based approach to impact assessment and places emphasis on compensatory and investment instruments.

The results suggest that, without appropriately designed protective measures, there is a risk of increased transport exclusion, particularly among low-income households and those living in areas with limited access to public transport. It is therefore crucial to make effective use of the revenues generated from the sale of ETS2 CO_2 emission allowances and of resources from the Social Climate Fund – especially by targeting measures that durably reduce mobility costs, such as improving the availability and quality of public transport and providing targeted support for economically vulnerable transport users.

Introduction

From 2028, the European Union is expected to launch ETS2 – a new carbon emissions trading system covering the road transport and buildings sectors. The rationale for introducing this system is that emissions from transport account for one quarter of total greenhouse gas (GHG) emissions in the EU. Moreover, transport is the only major EU economic sector in which GHG emissions still exceed their 1990 level (by 18%)[3].

Road transport accounts for around 95% of emissions from the transport sector as a whole (73% when aviation and maritime transport are included). Over 2005–2023, emissions from road transport fell by less than 5%, indicating that gains in vehicle efficiency and the growing number of newly registered zero-emission cars were almost entirely offset by the parallel increase in transport activity. This implies that the decarbonisation of the transport sector must accelerate if the EU's climate targets

1 The applied price scenario reflects the European Commission's planned postponement of the ETS2 start to 2028. At the same time, it does not incorporate the European Commission's proposed revision of the mechanisms intended to stabilise allowance prices and limit costs for households, because at the time the manuscript was submitted for publication, no official information on the scope of the revision was available.

2 Ministry of Climate and Environment (Poland). (2025). Draft update of the National Energy and Climate Plan (uNECP), Annex 3: Forecast assumptions and forecasting methodology. (https://www.gov.pl/attachment/fe392b99-f36b-46e5-a984-6d25bbaa83c8), accessed 19 December 2025.

3 European Commission. (2025). Climate Action Progress Report 2025 (Chapter 3). (https://climate.ec.europa.eu/eu-action/climate-strategies-targets/progress-climate-action/eu-climate-action-progress-report-2025/chapter-3-effort-sharing-emissions_en#road-transport, accessed 17 December 2025.)

are to be met[4]. In response, the EU has sought additional mechanisms to reduce transport emissions, leading to the establishment of ETS2 as a complementary market-based instrument.

As an emissions trading system, ETS2 introduces a uniform carbon price signal for CO^2 emissions in the buildings and transport sectors, leading to a more levelised cost burden across carbon-intensive energy carriers and fuels. [AT1.1] Market-based carbon pricing encourages abatement where it can be achieved at the lowest cost, thereby improving the cost-effectiveness of climate policy. The system also generates public revenues, which should be used to finance modernisation investments and instruments that mitigate cost impacts on households.

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It should also be emphasised that the price effect will not be evenly distributed across households[5]. This follows from the fact that the shares of transport-related GHG emissions attributable to households in different income deciles are not equal (see, e.g., Brand and Boardman, 2008). While high-income households emit substantially more, the relative financial burden of ETS2 will be more pronounced for lower-income groups, because fuel expenditure represents a larger share of their disposable income. Low-income households also more often rely on older, less efficient vehicles and are more frequently located in areas with limited access to public transport.

Therefore, the discussion of ETS2 cannot be confined to average effects; it must take account of their distribution and support the design of instruments that reduce the risk of energy poverty and transport exclusion while, at the same time, reinforcing incentives for investment.

Companies operating in transport-intensive sectors (e.g., logistics, delivery services, and retail) will face changes in their cost structures related

4 Ibidem.

5 European Commission. (2021). Impact assessment accompanying the proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading (SWD(2021) 601 final). (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021SC0601, accessed 17 October 2025).

to fuel use as a result of ETS2. This is expected to generate indirect price effects for households, as these firms will likely pass higher fuel costs on to final consumers, leading to increases in the prices of goods and services. In this sense, there are two parallel channels through which ETS2 will exert upward pressure on the prices paid by households. For this reason, ETS2 implementation should be accompanied by measures that improve transport efficiency, accelerate fleet modernisation, and support organisational changes that reduce the consumption of fossil fuels.

To mitigate the increase in fuel costs resulting from ETS2, the establishment of the Social Climate Fund (SCF) was proposed, with a budget of EUR 65 billion (EUR 86.7 billion when national co-financing is included)[6]. Fund resources will be allocated on the basis of an algorithm that takes into account, inter alia, GHG emissions per capita, and will be disbursed in line with national Social Climate Plans. Poland is set to receive 17.6% of the Fund (i.e. around EUR 11.4 billion, excluding national co-financing), making it the largest beneficiary of SCF resources. At the same time, as shown in Figure 1, household expenditure on transport fuels differs markedly across EU Member States, which is highly relevant for the SCF's effective capacity to cushion cost impacts in individual countries. This may raise questions as to how evenly the SCF's mitigating effect will be distributed across households – especially if national allocations do not fully reflect households' actual exposure to rising transport fuel costs (cf. Perdana and Vielle, 2026). Reducing such potential inequalities is therefore important.

Crucially, SCF resources – beyond providing temporary support to households affected by energy poverty during the transition – should act as a "transformational lever" and be directed towards investments that durably reduce energy bills and fuel consumption, thereby supporting both the energy and transport transitions. Properly targeted, these resources can, in practice, strengthen the resilience of the most vulnerable households to energy poverty and the risk of transport exclusion[7]. In the domestic expert debate, it is emphasised that the social acceptability of ETS2 will depend on the quality of compensatory instruments and on the effective targeting of funds towards investments and support for vulnerable households (Jeszke, 2025a; Jeszke, 2025b). Against this backdrop, the data below illustrate how large a share of household budgets is accounted for by expenditure on fuels and energy carriers.

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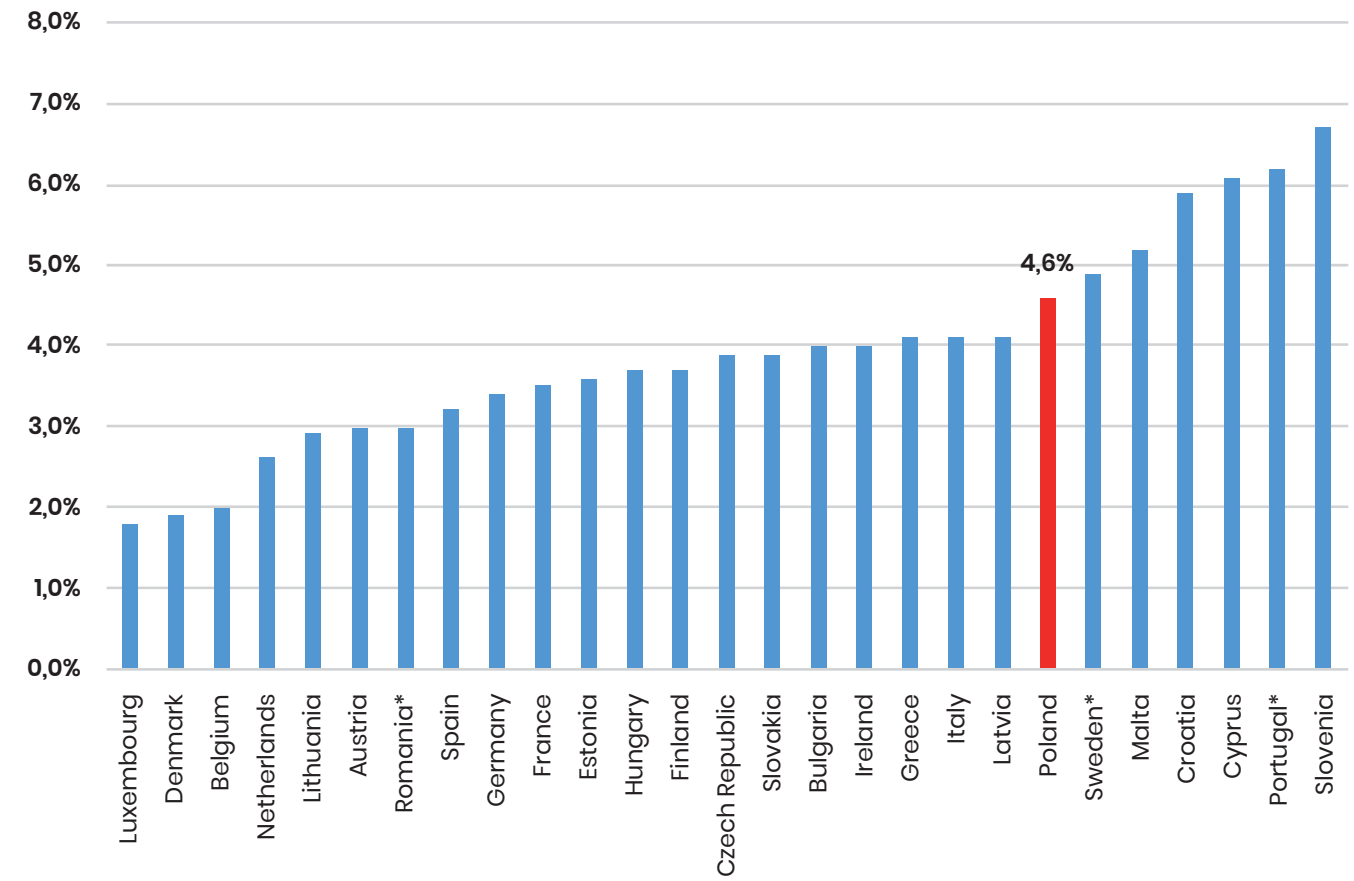
6 Regulation (EU) 2023/955 of the European Parliament and of the Council of 10 May 2023 establishing a Social Climate Fund and amending Regulation (EU) 2021/1060. Official Journal of the European Union L 130.

7 In terms of scale, it can be regarded as an instrument comparable to Poland's National Recovery Plan (KPO), under which Poland receives EUR 25.27 billion in grants (National Recovery Plan. (2025). Poland received PLN 26 billion from the KPO. (https://www.kpo.gov.pl/strony/aktualnosci/polska-otrzymala-26-mld-zl-z-kpo/, accessed 19 December 2025).

Fig. 1. Share of expenditure on fuels for private transport in total household disposable income, 2020.



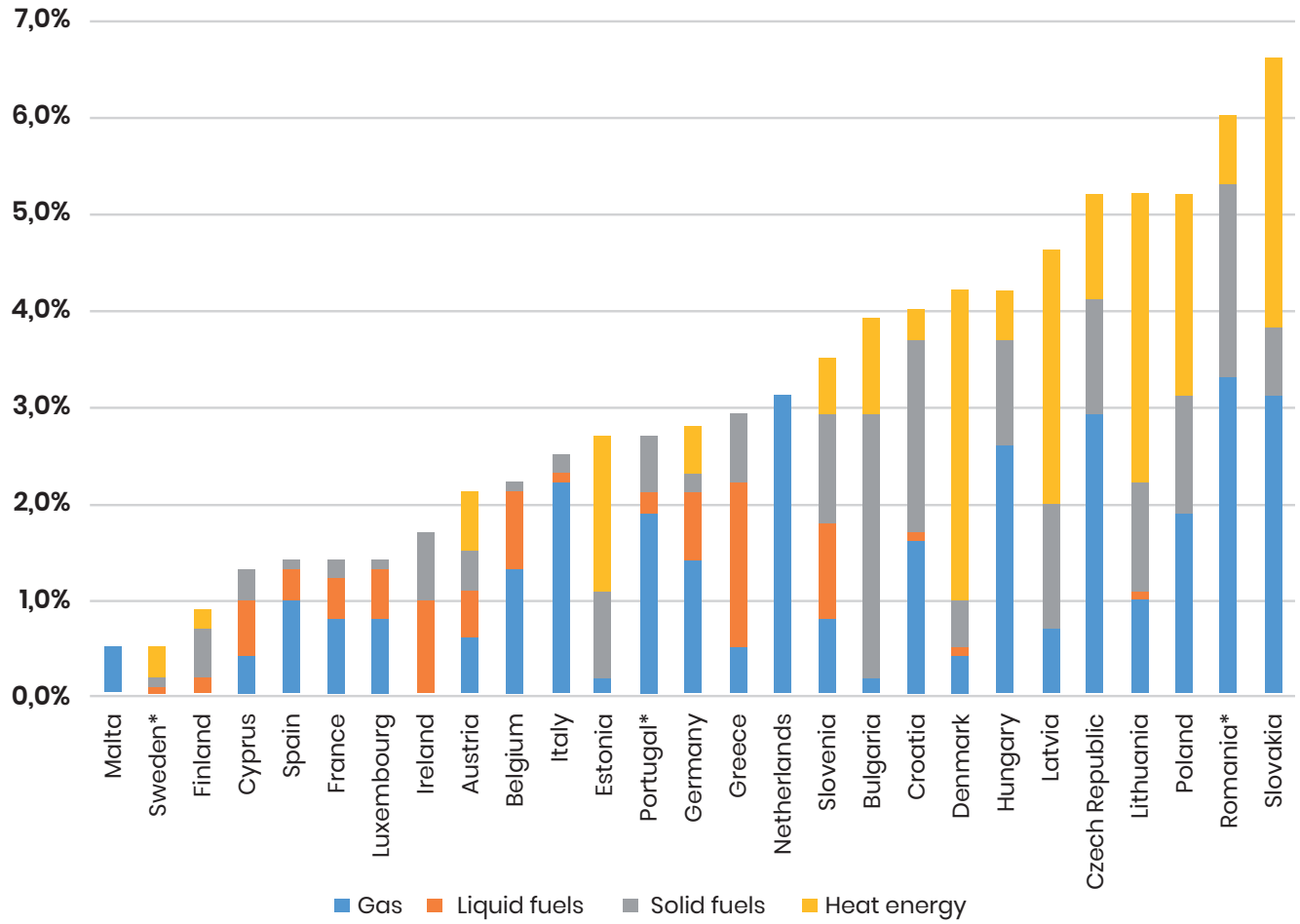
Source: Structure of consumption expenditure by COICOP consumption purpose [hbs_str_t211], Eurostat.

*Note: * indicates data for 2015.*

In Poland, household expenditure on space heating as a share of disposable income exceeds 5% on average, placing the country among the EU Member States with a high level of such spending (see Figure 2). This raises concerns that households may be more exposed to rising energy-carrier prices than in many other EU countries. Moreover, Polish households' expenditure on solid fuels – coal and coke, which are highly emission-intensive – accounts for around 1.2% of disposable income (Figure 2). Together with household spending in Latvia and Romania, this is among the highest values in the EU. As a result, households that rely on coal to heat their homes will be particularly sensitive to increases in heating costs (cf. Haywood and Jakob, 2023).

At the same time, this pattern of household spending underscores both the scale of investment needs and the potential benefits of accelerating the energy transition in the buildings sector – particularly through improving energy efficiency and replacing high-emission heat sources. In this context, the effective use of available financing mechanisms is crucial – especially resources from the Social Climate Fund, building renovation and energy-efficiency programmes, and revenues from ETS2 allowance auctions – which can reduce the risk of energy poverty and, over the longer term, lead to a lasting decline in the burden that heating-related costs place on household budgets.

Fig. 2. Share of expenditure on energy carriers for space heating and district heating (heat energy) in total household disposable income, 2020.



Source: Eurostat. Structure of consumption expenditure by COICOP consumption purpose (hbs_str_t211).
*Note: * indicates data for 2015.*

From a public policy perspective, the cost of not implementing ETS2 is also important. Bringing the buildings and transport sectors into emissions trading generates substantial auction revenues which – depending on national arrangements – can be used to finance modernisation investments and targeted support instruments for the lowest-income households. Failure to transpose ETS2 provisions into national law in a timely manner would imply not only a delay in securing these funds, but also the risk of a suspension of the sale of allowances allocated to the Member State concerned, thereby reducing fiscal capacity.

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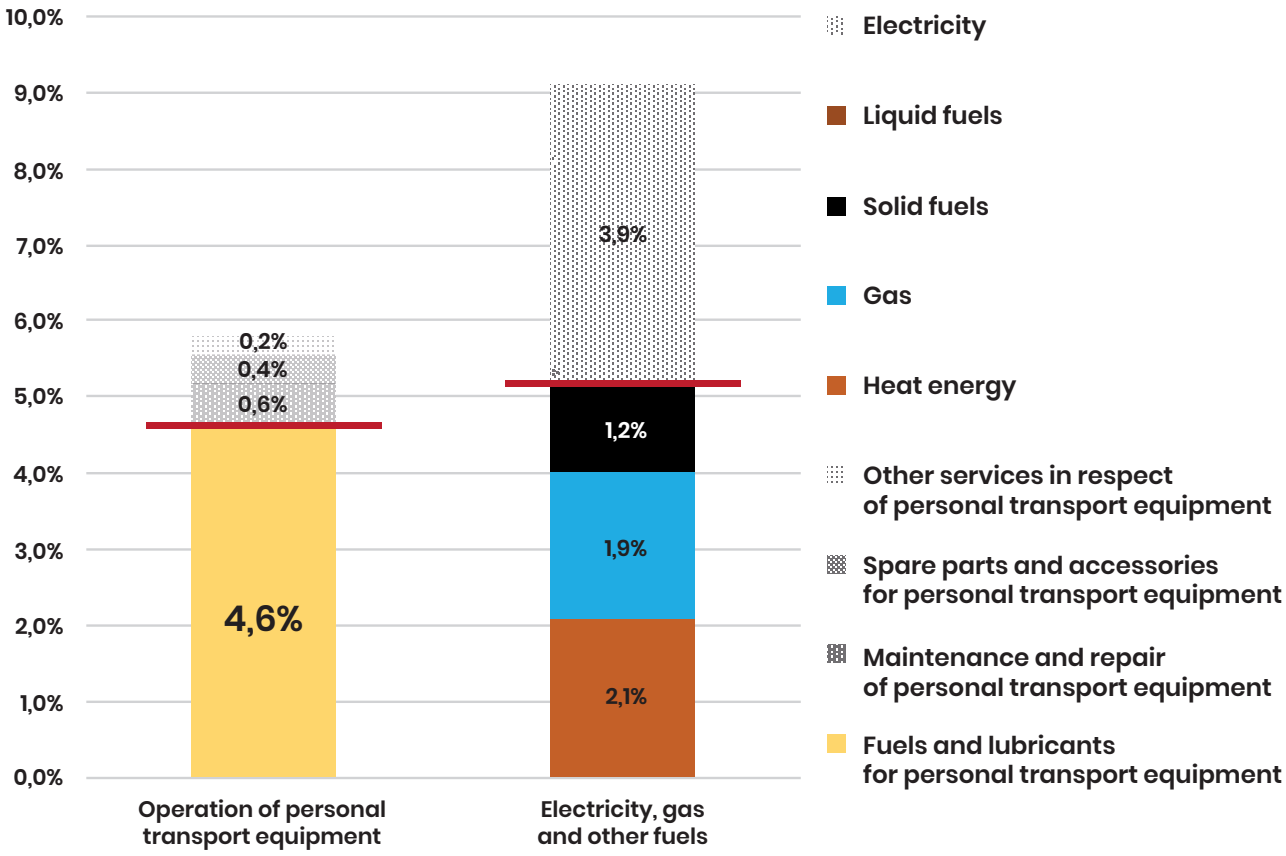
In the context of the ETS2 implementation timetable, particular importance attaches to the planned launch of so-called early auctions as early as January 2027[8]. Postponing the start of the system to 2028 mitigates the short-term cost shock for fuel users, but it does not remove the need for efficient national transposition of the EU ETS Directive provisions relevant to ETS2. Only the transposition of the appropriate rules will enable participation in the early auctions and, consequently, the earlier generation of revenues that can be used to prepare the economy and households – especially lower-income ones – for future increases in energy and fuel costs.

Scenario analysis for Poland

This article uses Poland as a case study to illustrate the impact of ETS2 on household budgets, with a particular focus on the costs of passenger car use. Figure 3 shows that the average Polish household allocates around 4.6% of its consumption expenditure to transport fuels, which is comparable to spending on heating fuels (5.2%). However, heating fuels are characterised by higher emissions intensity, suggesting that the potential ETS2-related burden may be relatively greater for households in the heating domain than for transport-related costs.

Fig. 3. Average consumption expenditure of Polish households on transport (operation of personal transport equipment) and on household energy (electricity, gas and other fuels), 2020.

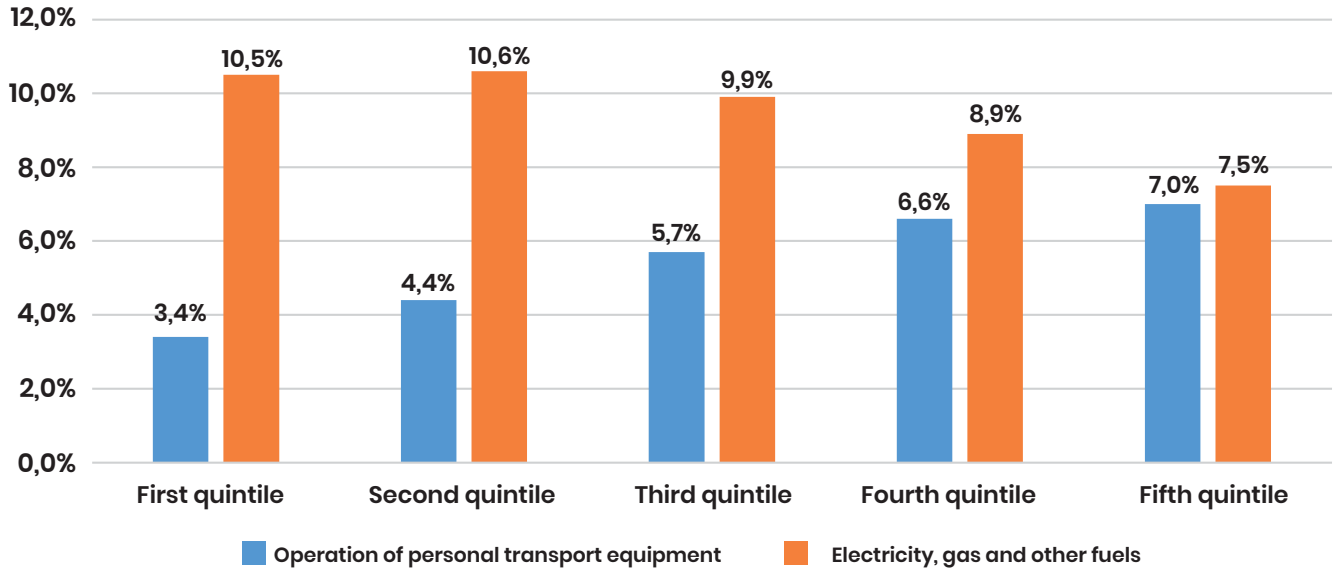


Source: Eurostat. Structure of consumption expenditure by income quintile and COICOP consumption purpose (hbs_str_t223).
Note: Electricity covers both space heating and other uses, such as lighting and powering household appliances.

8 European Commission. (2025). EU emissions trading system (ETS2) – early auctioning of allowances. (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/15472-EU-emissions-trading-system-ETS2-early-auctioning-of-allowances_en), accessed 16 December 2025).

The fuel expenditure shares presented above refer to the statistically average household. In practice, however, there are substantial differences depending on household income. For example, the poorest 20% of households spend on transport fuels around three times less than on heating, whereas among the richest 20% of households, expenditure on transport and heating fuels is broadly similar (Figure 4).

Fig. 4. Consumption expenditure of Polish households on transport (operation of personal transport equipment) and on household energy (electricity, gas and other fuels), 2020, by income quintile.



Source: Eurostat. Structure of consumption expenditure by income quintile and COICOP consumption purpose (hbs_str_t223).

ETS2 costs borne by private car users are calculated as the product of emissions and the CO_2 allowance price under ETS2 (in line with allowance price assumptions in the National Energy and Climate Plan – uNECP; see Table 1)[9]. Charges incurred by households and firms as a result of ETS2 depend on the level of petroleum-based fuel consumption (transport work performed – distance travelled, engine displacement, and engine fuel efficiency). Simulation results indicate that the current stock of zero-emission cars (100,000 units) could increase from 0.5% to at most 4% of the total passenger car fleet over the period analysed. Consequently, between 2028 and 2032 no major shift in the passenger car fleet towards zero-emission vehicles should be expected; therefore, ETS2 costs will be driven primarily by the allowance price.

Table 1. Assumed ETS2 CO_2 allowance price in 2028–2032 (EUR'2024 per tonne of CO_2).

2028	2029	2030	2031	2032
48	54	96	104	113

Source: Draft updated National Energy and Climate Plan (uNECP).

9 Ministry of Climate and Environment (Poland). (2025). Draft update of the National Energy and Climate Plan (uNECP), Annex 3: Forecast assumptions and forecasting methodology. (https://www.gov.pl/attachment/fe392b99-f36b-46e5-a984-6d25bbaa83c8, accessed 19 December 2025).

Assumptions for converting the EUA2 price into afuel price component:

1. Fuel prices were increased by:
$$\Delta \text{ fuel price} \approx EUA2 \text{ price } [\text{EUR/t } CO_2] \cdot EF\_fuels [\text{t } CO_2/\text{l}]$$
2. EF_fuels – reference values for emissions from fuel combustion in passenger cars; indicative values: petrol ~2.3 kg CO_2/l; diesel ~2.6 kg CO_2/l; LPG ~1.6 kg CO_2/l.
3. The analysis assumes pass-through ofCO_2 costs into fuel prices in line with the TR3E model mechanics, in which emissions factors expressed in g CO_2 per kilometre depend on the composition ofthe vehicle fleet.
4. Results are reported mainly as percentage changes in the fuel cost per kilometre driven an-din total cost ofownership (TCO). In the model, these are expressed in constant prices ofthe 2015 base year andthen converted to2024 prices.

Charges incurred by households and firms as a result of ETS2 depend on the level of petroleum-based fuel consumption (transport work performed – distance travelled, engine displacement, and engine fuel efficiency). Simulation results indicate that the current stock of zero-emission cars (100,000 units) could increase from 0.5% to at most 4% of the total passenger car fleet over the period analysed. Consequently, between 2028 and 2032 no major shift in the passenger car fleet towards zero-emission vehicles should be expected; therefore, ETS2 costs will be driven primarily by the allowance price.

Simulations conducted using the TR3E transport sector model[10], incorporating the assumed allowance price pathway described above, indicate that the total estimated ETS2 costs for Polish households and firms resulting from the use of passenger cars will amount to 11.9% of total expenditure on petroleum-derived fuels in 2028–2032 (Figure 5). Given that under the SCF only 37.5% of available resources (around EUR 5.7 billion in Poland) can be spent on direct support for households and transport users in financial difficulty, these funds alone will not fully compensate the aggregate costs borne by all car users.

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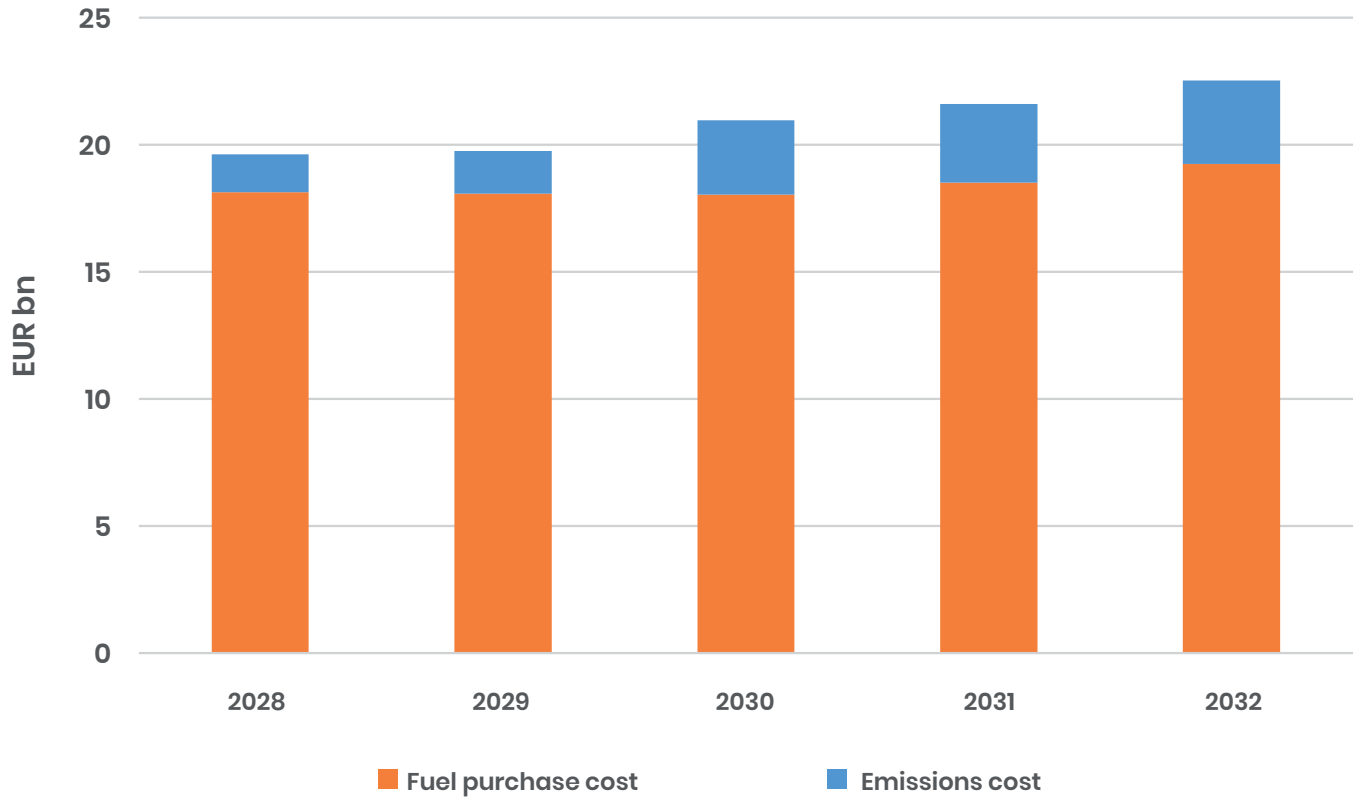
The ultimate burden on households – especially those with the lowest incomes – will, however, depend on how both SCF resources and ETS2 auction revenues are allocated; with appropriately targeted support, it is possible to substantially reduce the net costs borne by households in the lowest income groups. It is also worth noting that the draft Polish Social Climate Plan (SCP) submitted for public consultation envisages using the

10 Rabiega, W., Sikora, P., Gąska, J., Gorzałczyński, A. (2022). The TR3E Model, ver. 2.0. IOŚ-PIB/KOBiZE, Warsaw.

direct income support component exclusively to cover household electricity and heating costs through the introduction of an energy voucher[11]. If, therefore, the final version of the SCP is not complemented with instruments that directly support vulnerable users of emission-intensive transport (in particular, private internal-combustion passenger cars), the additional cost burden associated with ETS2 may remain salient for this group – especially for lower-income households with limited capacity to adjust to the new conditions.

Fig. 5. Estimated additional costs resulting from ETS2 implementation for Polish households and firms, related to passenger car use in 2028–2032, relative to fuel purchase costs.



Source: Author's own calculations based on TR3E model results and uNECP assumptions.

The planned inclusion of fuels used by internal combustion engine vehicles in ETS2 will increase operating costs, which may translate into changes in vehicle total cost of ownership (TCO) and, to some extent, influence consumer decisions regarding mode choice or the type of powertrain (emitting vs zero-emission) used for everyday travel. In the initial phase of ETS2 implementation (2028–2029), the impact on transport fuel prices is expected to remain moderate – no more than 10% of the retail price for petrol and diesel, and 15% for LPG. This would increase TCO by 2.4% for diesel vehicles, 1.6% for petrol vehicles, and 3.2% for LPG vehicles, which are characterised by the highest emissions intensity[12].

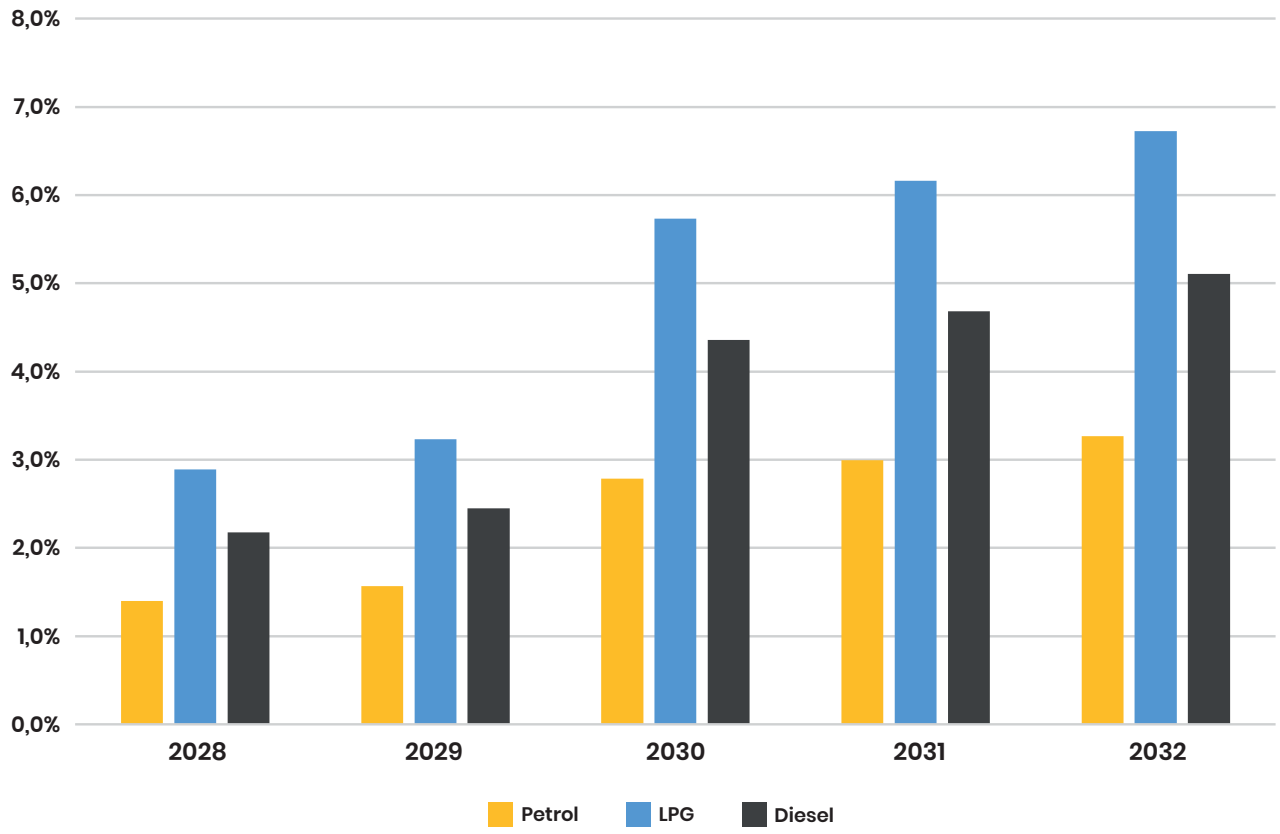
11 Draft Polish Social Climate Plan (SCP) submitted for public consultation. (2025). (https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/spoleczny-fundusz-klimatyczny/plan, accessed 14 October 2025).

12 Emissions factors were adopted from the Central-2018 scenario of the POTEnCIA model for Poland (cf. Mantzos, L., Wiesenthal, T., Neuwahl, F., and Rózsai, M. (2019). The POTEnCIA Central scenario: an EU energy outlook to 2050. Publications Office of the European Union, Luxembourg).

In the initial phase of ETS2 implementation (2028–2029), the impact on transport fuel prices is expected to remain moderate – no more than 10% of the retail price for petrol and diesel, and 15% for LPG. This would increase TCO by 2.4% for diesel vehicles, 1.6% for petrol vehicles, and 3.2% for LPG vehicles, which are characterised by the highest emissions intensity

Under the uNECP assumptions, from 2030 onwards the ETS2 allowance price could approach EUR 100 per tonne of CO_2 (Table 1), which would increase fuel prices by around 13% for petrol, 15% for diesel, and 24% for LPG. Higher CO_2 costs would translate into a further increase in the TCO of internal combustion vehicles – estimated at around 3.0% for petrol vehicles, 4.7% for diesel vehicles, and 6.2% for LPG vehicles (Figure 6).

Fig. 6. Projected change in the total cost of ownership (TCO) of internal combustion engine passenger cars in 2028–2032, by fuel type.



Source: Authors' own calculations based on TR3E model results and uNECP assumptions.

Simulations of transport sector development scenario following the introduction of ETS2 indicate that higher TCO for internal combustion vehicles will lead to a gradual increase in the number of new zero-emission vehicles (hydrogen and battery-electric) in use in Poland. By 2029, when the CO^2 allowance price is expected to be around EUR 50 per tonne, roughly 75,000 diesel- and LPG-fuelled ICE cars are projected to be replaced by electric, hybrid, and petrol vehicles. In 2030–2032, as the allowance price rises to around EUR 100/t CO_2, the number of the most emission-intensive vehicles – diesel and LPG – that are replaced by more environmentally friendly transport options is projected to increase by 50%.

Electric vehicles are purchased primarily by households in the fifth income quintile, which allocate around 1.2% of their disposable income to the purchase of transport equipment. However, higher operating costs for internal combustion vehicles will not only accelerate EV uptake among better-off households – it will also affect mobility preferences among lower-income groups.

An increase in the total cost of using internal combustion cars may encourage consumers to purchase electric vehicles and to forgot buying ICE vehicles even before the ban on the sale of new ICE cars comes into force in 2035. In 2028–2029, the additional number of zero-emission vehicles (hydrogen and battery-electric) could be just under 20,000 units per year, and in 2030–2032 below 30,000 units per year (Figure 7)[13]. Cumulatively, the number of additional zero-emission cars on Polish roads attributable to ETS2 could reach around 120,000 over 2028–2032. This can be considered a positive effect of ETS2 in terms of transport decarbonisation and stimulating the development of electromobility in Poland.

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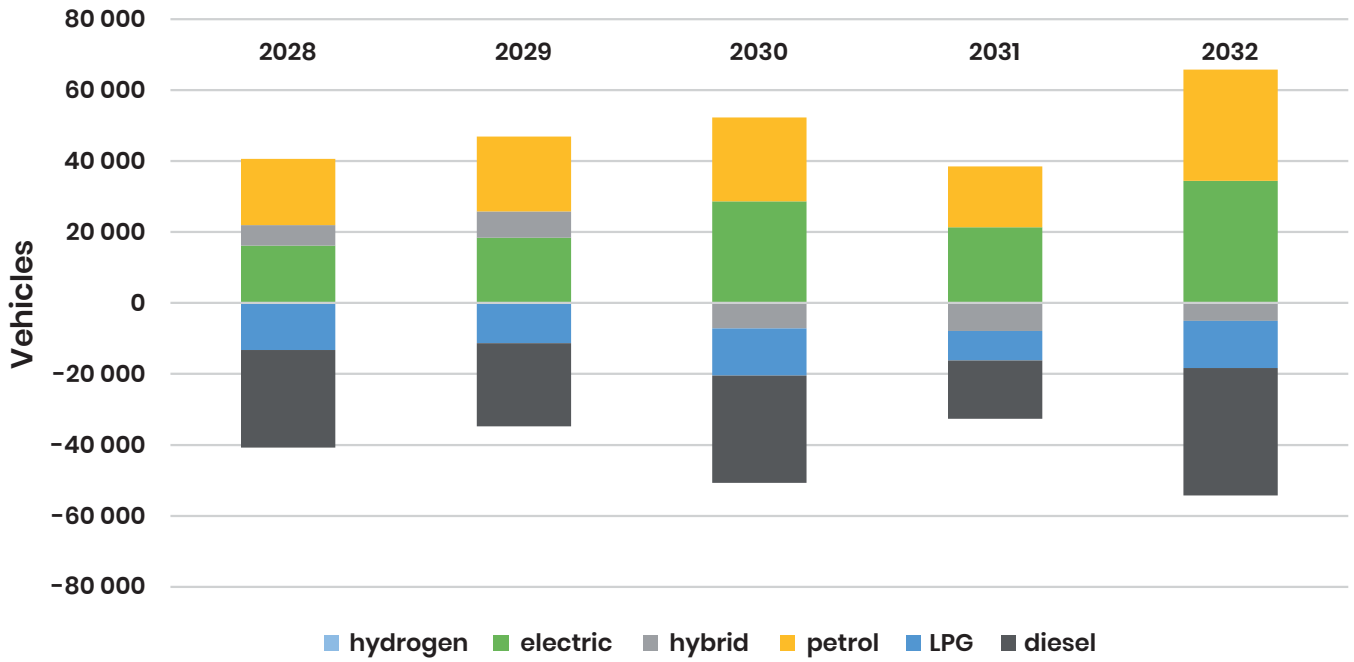
It is also worth noting that the projected price signal associated with ETS2 will not translate immediately into consumer decisions regarding the type of newly purchased cars. Overall, the simulation results suggest that, taking into account both the baseline pace of electromobility uptake in Poland (the baseline scenario) and the introduction of ETS2, the average annual pace of passenger car fleet electrification will be around 130,000 vehicles per year, implying more than 1 million electric cars in Poland by 2032.

13 It should be borne in mind that the shifts in the composition of new vehicles shown in Figure 7 should be interpreted relative to the baseline scenario, which assumes that ETS2 is not introduced.

Fig. 7. Projected change in the number of new vehicles entering service in 2028–2032 compared with the baseline scenario (no ETS2).



Source: Authors' own calculations based on TR3E model results and uNECP assumptions..

Summary

The purpose of the analysis presented above was to assess the implications of introducing ETS2 in Poland in terms of changes in the operating costs of passenger cars. The results are based on a transport sector decarbonisation scenario developed within the TR3E transport sector model, incorporating assumptions from the updated National Energy and Climate Plan (uNECP).

The results show that, in the initial phase of ETS2, its impact on road transport in Poland will be driven primarily by higher fuel costs, which will translate into higher vehicle total cost of ownership (TCO) over the 2028–2032 horizon. The magnitude of the effect depends on the EUA2 price pathway and on assumptions regarding the pass-through of CO_2 costs into final fuel prices. In the short term, this does not necessarily imply a rapid shift in the share of zero-emission cars in the passenger vehicle stock; rather, it is more likely to gradually strengthen incentives for fuel savings, efficiency improvements, and lower-emission choices.

Modelling outcomes indicate that during the first years of ETS2 implementation (2028–2032), system costs will amount to 11.9% of total expenditure on petroleum-derived fuels. The total cost of ownership of internal combustion vehicles will increase over 2028–2032, with the pace of growth depending on the baseline level of TCO. For petrol cars, baseline TCO is the highest (low annual mileage and high fuel costs), which translates into the smallest ETS2-driven cost increase, whereas the opposite pattern is observed for LPG vehicles. Higher operating costs are expected to reduce new registrations of petrol, diesel, and LPG cars. In turn, new registrations of zero-emission vehicles (hydrogen and battery-electric) are projected to rise, potentially reaching a cumulative increase of up to 120,000 vehicles over 2028–2032.

It is worth emphasising that the results presented in the article are based on the allowance price pathway adopted in the draft update of the National Energy and Climate Plan (uNECP). The European Council conclusions of 23 October 2025 noted that the European Commission plans to adopt measures to facilitate the entry into force of ETS2, including price-stabilisation mechanisms and a two-year review of progress towards meeting intermediate targets . At the time this analysis was prepared, the detailed scope of these measures was not yet known and therefore was not reflected in the scenario.

When interpreting the findings, it is important to recognise their sensitivity to the assumed allowance price pathway; applying a different scenario could lead to different results. Given that, in the short run (2028–2032), the impact of changes in allowance prices will largely operate through changes in fuel costs – and with only limited changes in transport behaviour – the differences in aggregate costs would be approximately proportional to the change in allowance prices.

Rising costs of individual, fossil-fuel-based mobility may encourage low-income households to use public transport more often – provided that it is available and reliable. In areas where such alternatives are lacking, there is a risk of deepening transport exclusion among vulnerable households. This is particularly relevant in the context of Poland's Social Climate Plan, which – as it stands – appears to require supplementation with an allocation of resources aimed at cushioning the increase in vehicle operating costs, especially for households in the lowest income groups.

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A key implication for public policy is that ETS2 should be treated not as a "cost in itself", but as part of a broader transition architecture in which compensatory and investment mechanisms are deployed in parallel (including the Social Climate Fund and national support instruments). The ultimate socio-economic outcome therefore depends on the quality of implementation: targeting support to the most vulnerable groups, increasing the availability of alternatives (public transport, energy efficiency, low-emission mobility), and minimising the risk of price shocks.

14 European Council. (2025). European Council conclusions on competitiveness and twin transition (23.10.2025). (https://www.consilium.europa.eu/pl/press/press-releases/2025/10/23/european-council-conclusions-on-competitiveness-and-twin-transition/), accessed 16 December 2025.

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How did greenhouse gas emissions in Poland change since 1988?

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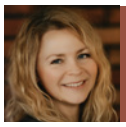
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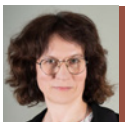
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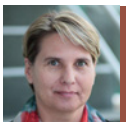
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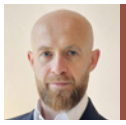
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Keywords: greenhouse gas emissions, CO_2 removals, greenhouse gases, CO_2, national emission inventory, UNFCCC convention, Paris Agreement

Abstract

Greenhouse gas emissions are an extremely topical subject in the context ofongoing climate change andthe resulting threats. Therefore, the availability ofreliable, comparable, andannual data on the magnitude ofthese emissions is crucial. The National Inventory ofGreenhouse Gas Emissions andRemovals is afundamental, official document containing such information. It forms the basis for accounting for existing international obligations andfor planning further national actions. This article presents key information on the national inventory ofgreenhouse gas (GHG) emissions andremovals, along with its latest official results for the years 1988–2023. The focus is on analysing GHG emission trends, showing their changes, andindicating the main reasons for the significant reduction in GHG emissions that occurred during the analysed period. The emission structure is presented by gas and by sector.

Basic legal andmethodological aspects indicating international reporting obligations and principles are also mentioned.

Abbreviations:
AR5 - IPCC Fifth Assessment Report
CRT - Common Reporting Tables
f-gases - fluorinated gases (HFC, PFC, SF_6 and NF_3)
GC - greenhouse gases
GWP - Global Warming Potential
IPCC - Intergovernmental Panel on Climate Change
LULUCF - Land Use, Land Use Change and Forestry
NID - National Inventory Document
UN - United Nations
PA - Paris Agreement
UNFCCC - United Nations Framework Convention on Climate Change

An element of transparency in the implementation of the Paris Agreement, described in the previous issue of $GO_2$50, is the preparation of annual national inventories of greenhouse gas (GHG) emissions and removals. In Poland, the entity responsible for the preparation of these inventories - in accordance with the Act of 17 July 2009 on the system to manage the emissions of greenhouse gases and other substances (Journal of Laws 2022, item 673, as amended) - is the National Centre for Emissions Management (KOBiZE), operating within the Institute of Environmental Protection – National Research Institute, supervised by the Minister of Climate and Environment, while their acceptance (enabling further processing at the international forum) takes place at the level of the Committee for European Affairs at the Chancellery of the Prime Minister. The article presents key information on the national inventory of greenhouse gas emissions and its latest results for the years 1988–2023, developed in 2025.

> *The essential elements of reporting national greenhouse gas inventories are: the National Inventory Document (NID) and the Common Reporting Tables (CRT).*

National inventories of greenhouse gas emissions and removals are reported by Parties to the UNFCCC annually for the entire period from the base year, not for single years. Thus, for example, in 2025, countries submitted their inventories for the year 2023 along with the trend from the base year (i.e., from 1990, and in the case of Poland - 1988).
NID reports are prepared in one of the 6 official UN languages (English, French, Spanish, Russian, Arabic, or Chinese) and contain a detailed description of the results and the methodology used for estimating GHG emissions and removals in a format agreed upon at the UNFCCC forum. The entire information package, containing data on GHG emissions and additional methodological parameters, is imported by countries into a system developed and managed by the UNFCCC Secretariat. After verifying the correctness of the data, Excel tables are generated in the system in the standardized format of Common Reporting Tables (CRT), identical for all countries.

Since 2023, Global Warming Potential (GWP) values from the 'IPCC Fifth Assessment Report' (AR5) with a 100-year time horizon have been used to convert emissions of greenhouse gases other than carbon dioxide into CO_2 equivalents.

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A very important element of national inventories is maintaining the methodological consistency of the inventoried and reported data series regarding greenhouse gas emissions and removals. Any changes to historical data or the methodology applied to the inventory result in the necessity of recalculating historical data (i.e., the entire series of inventoried data, starting from 1988). As a result of the data series recalculation process, emissions estimated from the base year may be subject to updates in subsequent iterations of the inventory report.

Before the national inventories of greenhouse gas emissions and removals of EU Member States are

submitted to the UNFCCC Secretariat by 15 April, they are uploaded - in a preliminary version by 15 January and a final version by 15 March - to the servers of the European Environment Agency (EEA).

Reporting under the climate convention covers only greenhouse gas emissions and removals resulting from anthropogenic activities.

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According to the mandatory guidelines, the following gases and groups of greenhouse gases are reported: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), the group of HFC gases (hydrofluorocarbons), the group of PFC gases (perfluorocarbons), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Emissions are reported according to the classification and format of the so-called Common Reporting Tables (CRT) in five main source categories: 1. Energy, 2. Industrial Processes and Product Use (IPPU), 3. Agriculture, 4. Land Use, Land Use Change and Forestry (LULUCF), and 5. Waste.

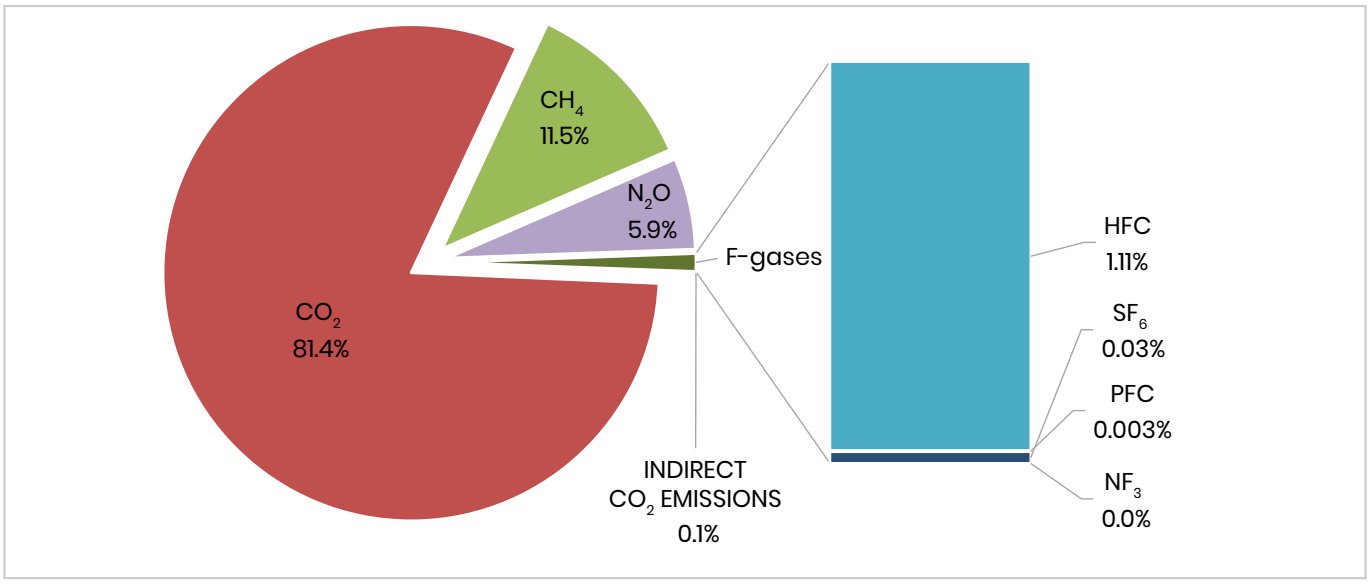
One of the significant principles of greenhouse gas emission reporting is that CO_2 emissions resulting from biomass and biofuel combustion are reported for information purposes only but are not included in sectoral or national totals. This is because it is assumed that the CO_2 emitted during the biomass combustion is subsequently reabsorbed from the atmosphere by plants in the process of photosynthesis.

To more accurately reflect the impact of emissions on the climate, reporting also covers the so-called indirect CO_2 emissions. This is - small on a national scale - emission originating from the degradation and oxidation of non-methane volatile organic compounds (NMVOCs) emitted into the atmosphere.

In the process of estimating greenhouse gas emissions and removals, the methodology published in 2006 by the Intergovernmental Panel on Climate Change (IPCC), titled '2006 IPCC Guidelines for National Greenhouse Gas Inventories', is mandatory at the UNFCCC forum. Countries may additionally on voluntary basis use its update titled: '2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories'. The aforementioned guidelines allow for estimating emissions at various levels of detail, depending on the availability of national data as well as applicable emission parameters and factors. In the context of data quality, it should be emphasized that national emission inventories undergo periodical international reviews, organized within the framework of the UNFCCC Secretariat and the European Union. Methodological recommendations obtained from these reviews are implemented in subsequent iterations of GHG inventory submissions.

Carbon dioxide has a dominant share in greenhouse gas emissions in Poland - over 81%, while the share of methane and nitrous oxide is 11.5% and 5.9%, respectively. Industrial fluorinated gases (so-called f-gases) have a small share in national GHG emissions - totaling approx. 1.1% in 2023 (Figure 1).

Figure 1. Share of each GHG in national total emission (without LULUCF) in year 2023



Source: KOBiZE

The largest share in total greenhouse gas emissions in Poland in 2023 belongs to fuel combustion processes in stationary and mobile sources (77.3%), agriculture accounts for 9.8%, fugitive emissions for 5.9%, industrial processes for 5.6% and waste for 1.2% of total greenhouse gas emissions (Figure 2).

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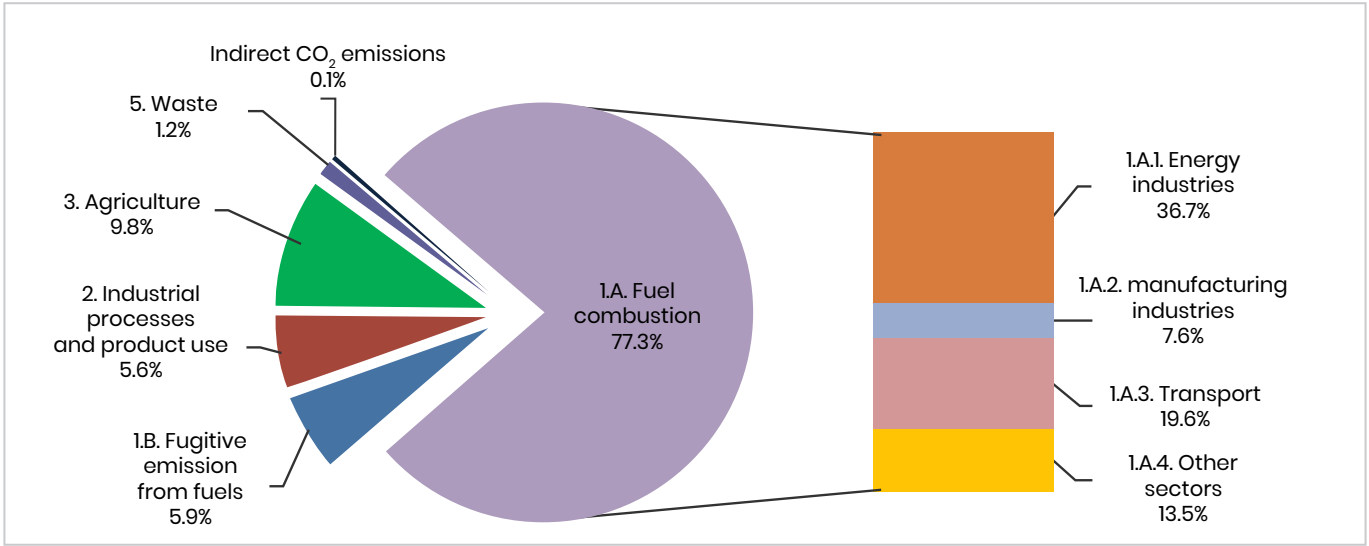
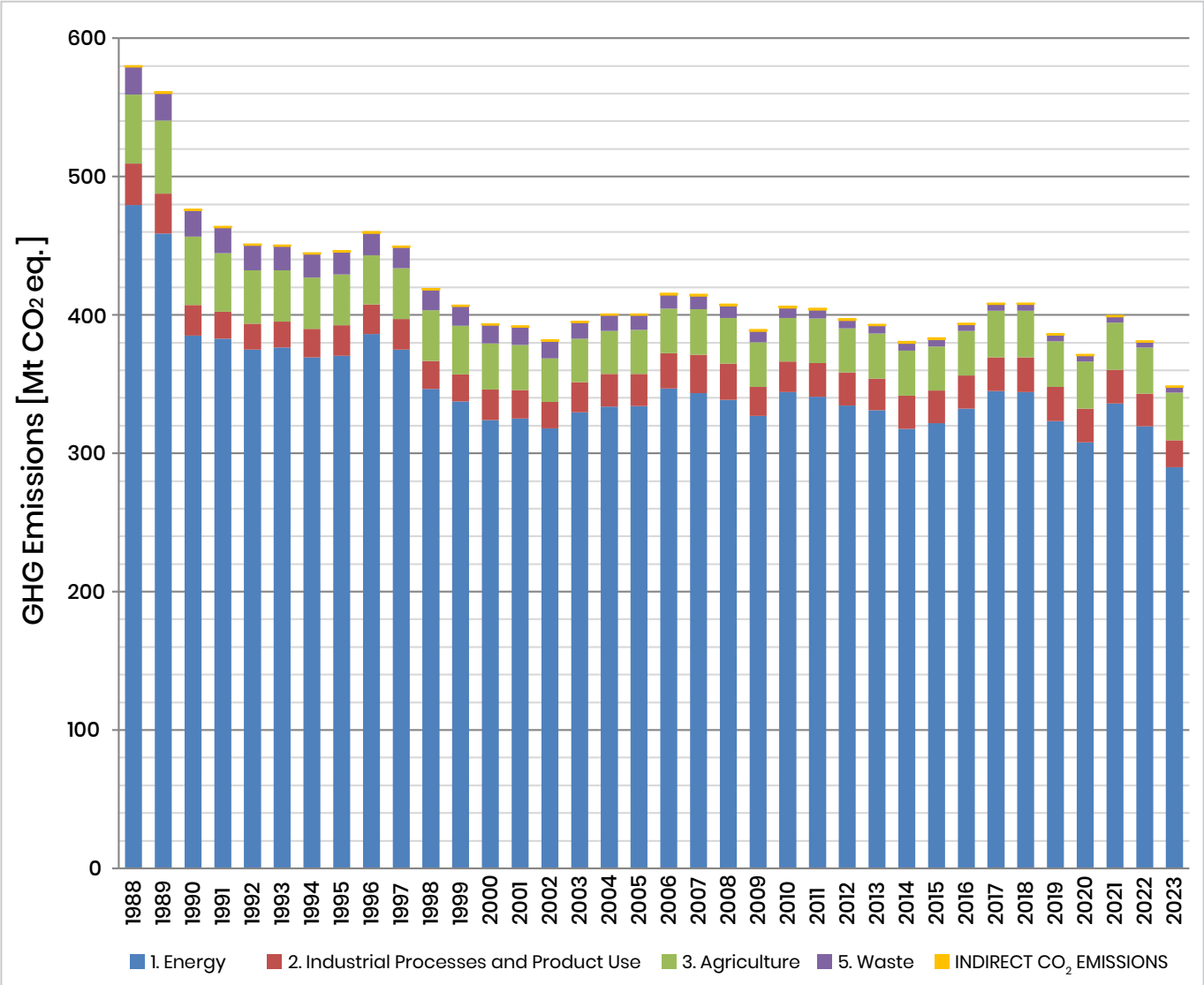
Figure 2. Shares of main categories in GHG national total emission (excluding LULUCF) in 2023



Source: KOBiZE

Total national greenhouse gas emissions in 2023 amounted to 348.4 million tonnes of CO_2 equivalent (excluding greenhouse gas emissions and removals from category 4. Land Use, Land Use Change and Forestry (LULUCF)) and decreased by 39.9% compared to 1988, and by 26.8% compared to 1990 (Figure 3). The emission trends by main categories of GHG emission sources and removals are described below.

Figure 3. Aggregated GHG emissions (excluding LULUCF) in years 1988-2023 with main IPCC sectors share

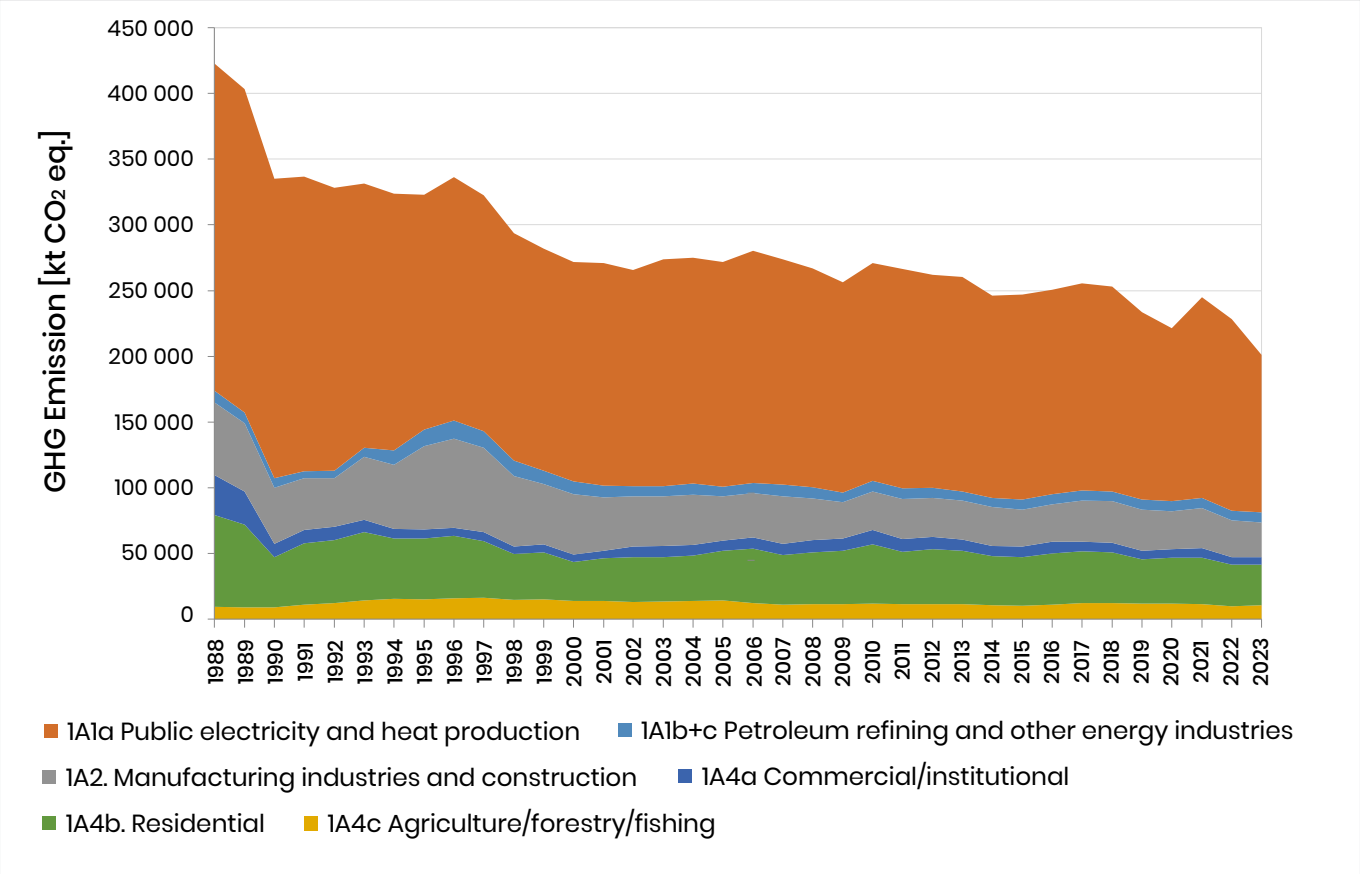


Source: KOBiZE

Fuel combustion in stationary sources

GHG emissions from fuel combustion in stationary sources amounted to 201 million tonnes of CO_2 equivalent and accounted for nearly a 60% share in the national greenhouse gas emissions in 2023. This share decreased over the years 1988–2023 to the aforementioned value from a level exceeding 70%, which occurred at the turn of the 1980s and 1990s. The structure regarding GHG emission sources from energy fuel consumption, excluding transport, is presented in Figure 4.

Figure 4. Share of main GHG sources from stationary fuel combustion (including agricultural machinery and fishery, which are not included in transport)



Source: KOBiZE

In GHG emissions from stationary fuel combustion sources, emissions from public electricity and heat production (1.A.1.a) dominate, accounting for approx. 60% in the analysed subcategory (Figure 4). In the years 1988–2023, a decrease in GHG emissions in category 1.A.1.a of approx. 52% occurred (from 249 to 120 million tonnes of CO_2 equivalent), which had a crucial impact on the noticeable reduction of over 52% in GHG emissions from the entire category of stationary fuel combustion in the presented period (Figure 4). Such a significant decrease in greenhouse gas emissions resulted mainly from the diminish in fuel consumption by nearly 40% and a change in the fuel structure (Figure 5). A considerable increase in biomass consumption is visible.

Biomass combustion is treated as carbon-neutral for CO_2 because the carbon released is assumed to be subsequently reabsorbed by the plants that will regrow, creating a long-term "zero net" effect.

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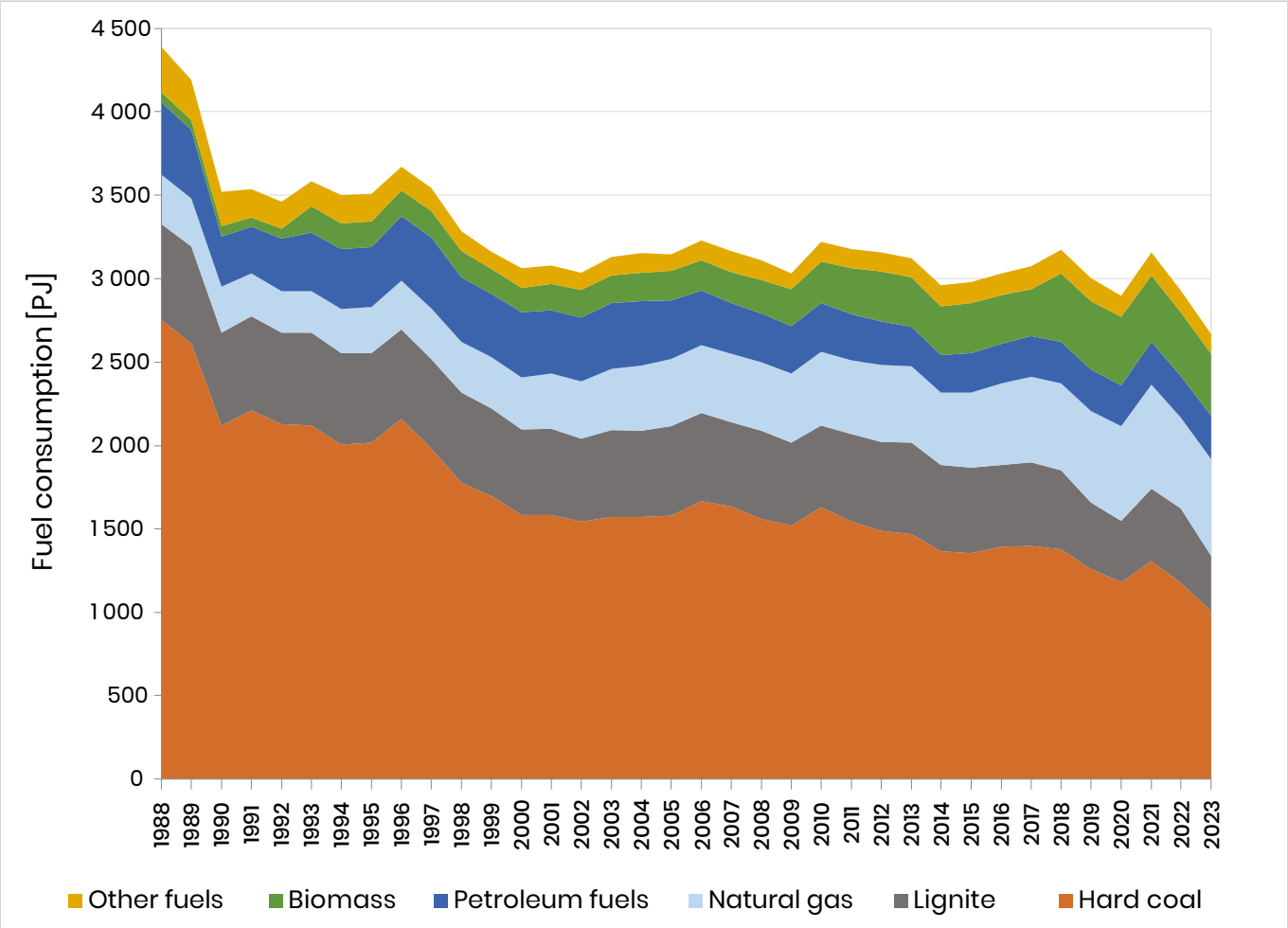
A decrease in coal consumption is also evident: hard coal by approx. 63% and lignite by nearly 43%. In the public electricity and heat production sector alone, the reduction in hard coal consumption amounted to over 58%, and lignite approx. 43%.

Figure 5. Fuel structure in category 1A Fuel combustion excluding transport (1A3)

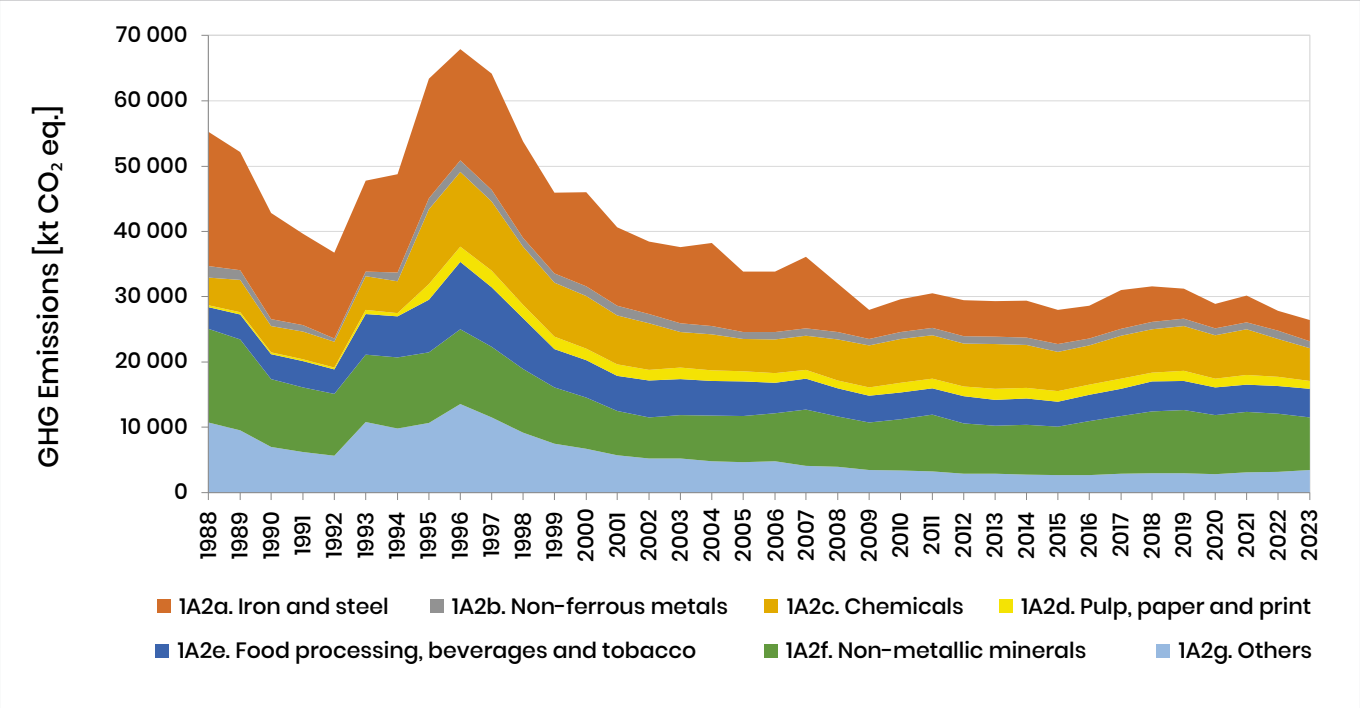


Source: KOBiZE

Households (1.A.4.b) have a significant share, reaching a dozen or so percent, in greenhouse gas emissions from stationary fuel combustion (Figure 4). Here a significant reduction in greenhouse gas emissions occurred as well, in the period 1988–2023 - by nearly 56%. This is primarily the effect of reducing fuel consumption by over 27%, including hard coal by 69%, which has been largely replaced by natural gas and biomass.

Fuel combustion in Manufacturing industries and construction (1.A.2) in the years 1988–2023 accounted for 11–20% of GHG emissions in the entire category 1.A excluding transport. A significant decrease in greenhouse gas emissions occurred in the period 1988–1992 (particularly large up to 1990) (Figure 6). It was caused by changes in the Polish economy, especially in heavy industry, resulting from the commenced economic transformation and the transition from a centrally planned to a free-market economy. In the years 1993–1996, an increase in GHG emissions took place, resulting from economic growth, and in the subsequent period a decrease, with slight fluctuations, until 2009, when a noticeably lower value of greenhouse gas emissions was associated, among others, with the global economic recession. In subsequent years, the value of GHG emissions within category 1.A.2 remained at the level of 28–31 million tonnes of CO_2 equivalent, with a visibly lower value in 2020 resulting from the COVID-19 pandemic, and since 2021 with a downward trend associated mainly with the situation in the iron and steel industry and in the chemical sector.

Figure 6. Share of branches in GHG emission from fuel combustion in category 1A2 Manufacturing industry and construction



Source: KOBiZE

The GHG emissions presented in the figure for category 1.A.2 do not include emissions from fuel combustion for electricity and commercial heat production, because this is included in the category of public electricity and heat production (1.A.1.a). Process emissions (i.e., other than from fuel combustion for the energy purpose of the process) are included in category 2. Industrial processes and product use.

Fuel combustion in transport

Greenhouse gas emissions from the transport sector amounted to 68.3 million tonnes of CO_2 equivalent and accounted for nearly 20% of national emissions in 2023. Notably, these emissions increased more than three times between 1988 and 2023. The dominant emission source here is road transportation, responsible for over 99% of GHG emissions in the transport sector in 2023. The remaining, less than 1% of GHG emissions in this sector, is accounted for by domestic aviation, railways (excluding electric), domestic navigation, and pipeline transport.

Road transportation has a key impact on the rising GHG emission trend since 1988, driven by the significant increase in the number of road vehicles, e.g. passenger cars from 4.3 million units in 1988 to 20 million units in 2023, or heavy duty trucks - from 138 thousand units to 831 thousand units in the same period, and the accompanying increase in transport fuel consumption.

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Apart from short periods with a slight decrease in GHG emissions from transport, including in 2020, which resulted from restrictions related to the COVID-19 pandemic, emissions began to stabilize only in 2023, when a slight decrease in greenhouse gas emissions was recorded compared to the previous year, mainly influenced by a 3.4% reduction in diesel oil consumption in road transportation.

Fugitive emissions

Fugitive emissions are a specific subsector of category 1. Energy. They constituted 5.9% of national greenhouse gas emissions and amounted to 20.6 million tonnes of CO_2 equivalent in 2023. The main emission source here is activity related to hard coal and lignite mining, which accounts for 79% of emissions in this sector.

In 2023, a decrease in fugitive emissions of 46% was recorded compared to 1988, the main cause of which is a 75% decrease in the volume of hard coal mining and a 45% decrease in lignite mining in this period.

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Industrial processes and product use

Greenhouse gas emissions from category 2. Industrial processes and product use amounted to 19.6 million tonnes of CO_2 equivalent and constituted 5.6% of national greenhouse gas emissions in 2023 (Figure 2), and throughout the 1988–2023 period, their share remained in the range of 4–7%.

GHG emissions from fuel combustion in industry are separated from process emissions and reported in other inventory subcategories.

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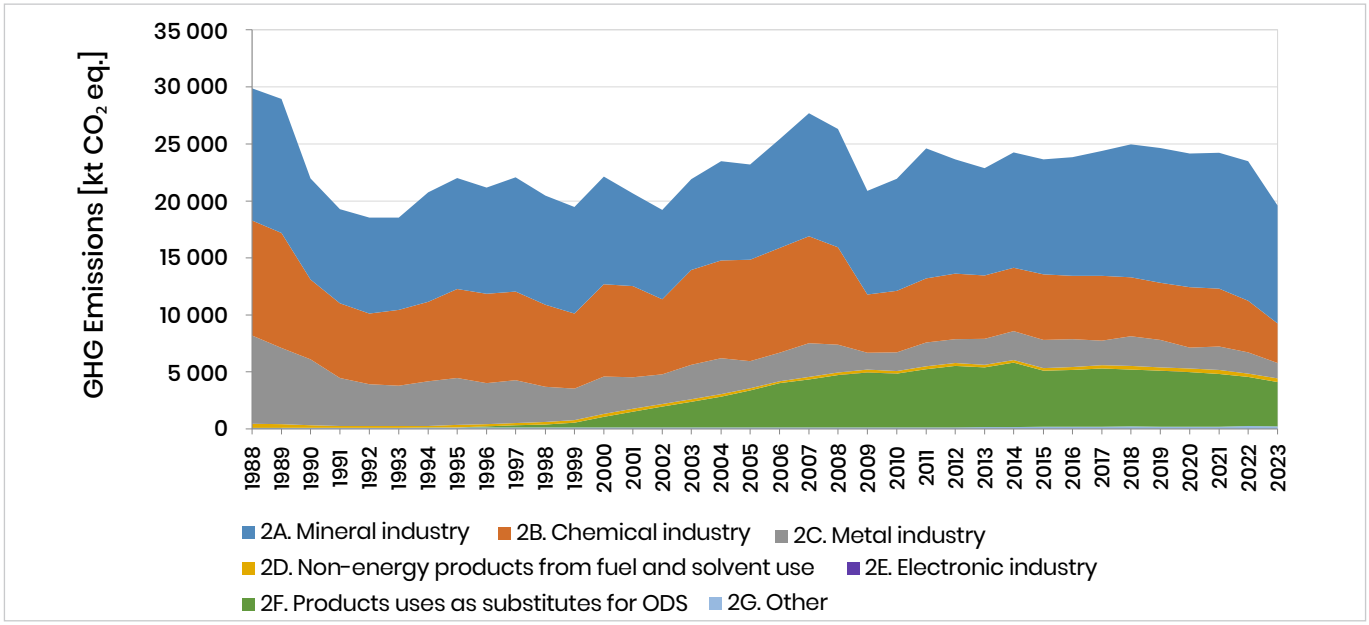
GHG emissions from the presented category do not include emissions from electricity and heat production, which is included in category 1.A. Energy. The largest and constantly growing share in emissions from industrial processes in the analysed years belongs to the Mineral industry (2.A) - 36–53% (Fig. 5). The chemical industry (2.B) and metal industry (2.C) processes, especially iron and steel production, also have a significant share, but in the case of these branches, the share in GHG emissions has decreased recently (Figure 7). This is the effect not only of production limitation but also, e.g., in the case of the chemical industry, of N_2O emission reduction thanks to the use of efficient catalysts. After 2000, subcategory 2.F. Product uses as substitutes for ODS, described below, also became a quite significant source of GHG emissions.

With regard to individual industrial processes, the dominant sources of greenhouse gas emissions are cement clinker and ammonia production. The share of process GHG emissions from the manufacture of these products in 2023 amounted to: 34% and 12%, respectively, in emissions from the entire category 2.

In the years 1988–2023, an over 34% decrease in greenhouse gas emissions from Industrial processes and product use occurred. For individual subcategories, GHG emission reductions compared to 1988 are as follows: 2.A. Mineral industry – approx. 11%, 2.B. Chemical industry – nearly 66%, 2.C. Metal industry – over 82% (including 2.C.1. Iron and steel production – over 85%). The main causes of changes in the GHG emission trend are analogous to those described in the presentation of category 1.A.2. Manufacturing industries and construction, i.e., at the turn of the 1980s and 1990s – political transformation and change in ownership forms, then rapid economic growth until 1996–1997, then a decrease associated with the global recession, the peak of which fell on the years 2008–2009, and a noticeable 'dip' in 2020 – the result of the COVID-19 pandemic. After a slight increase in 2021, a slight decrease in emissions has occurred in recent years, which is associated, among others, with production limitation in the iron and steel, chemical, as well as mineral industries.

Figure 7. Structure of GHG emission sources in IPCC category 2. Industrial processes and product use



Source: KOBiZE

Figure 7 shows the growing share of industrial fluorinated gases (HFCs, PFCs, and SF_6) over the last 25 years. Their total emissions in 2023 amounted to 4 million tonnes of CO_2 equivalent, which constitutes only 1.1% of total GHG emissions in 2023. However, it is interesting to note that f-gas emissions in 2023 increased nearly 30 times compared to 1988.

F-gases are characterized by being emitted in small quantities; however, due to their very high Global Warming Potential (GWP), they cannot be omitted from the GHG inventory. The application of f-gases is very broad; they can be found, among others, in refrigeration equipment, advanced electronics, but are also used in metallurgy or the production of shoe soles.

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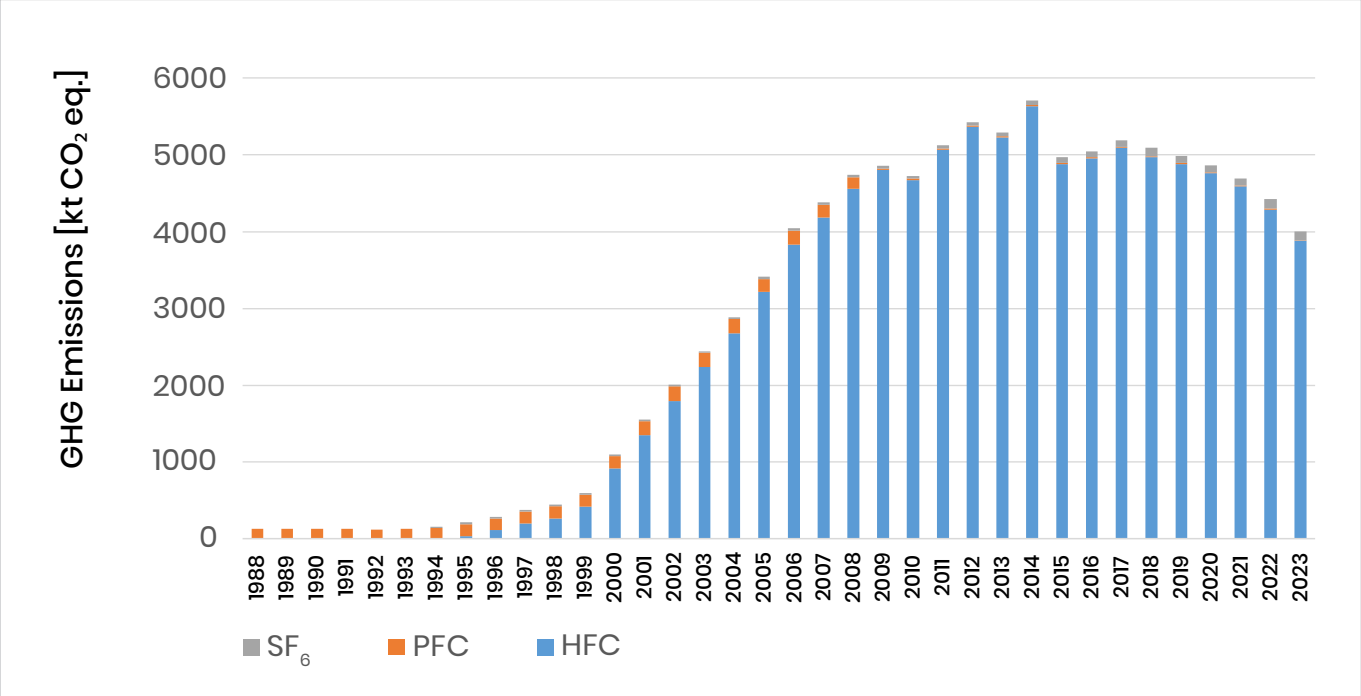
Main factors influencing the level of f-gas emissions and an explanation of the causes of the changes occurring are presented below. Figure 8 presents the trend of f-gas emissions in the years 1988-2023 by main gas groups and SF_6.

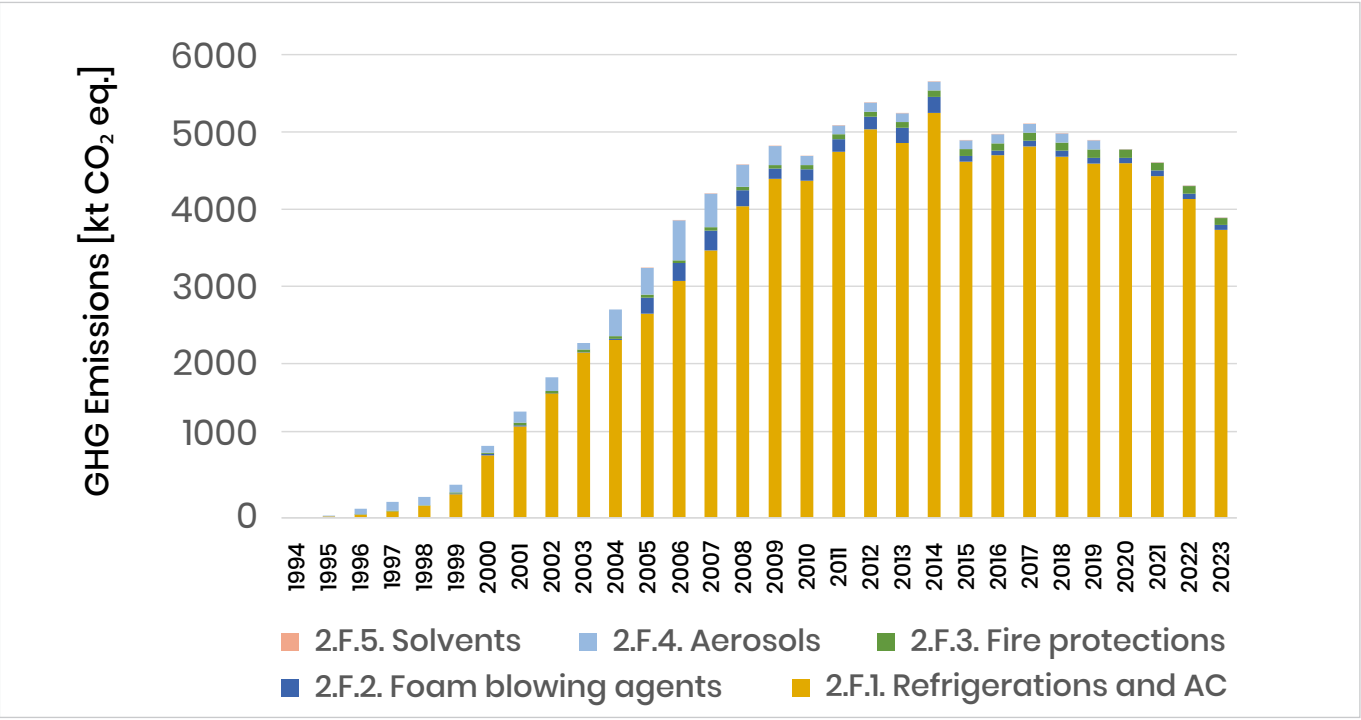
Figure 8. F-gases emission trend in years 1988 - 2023



Source: KOBiZE

An increase in f-gas emissions is evident since 1996, significantly accelerating since 2000 and reaching a peak around 2014. Initial low f-gas emissions are the result of the use of PFCs in metallurgy, while the emission increase following 1996 is associated with growing HFC emissions.

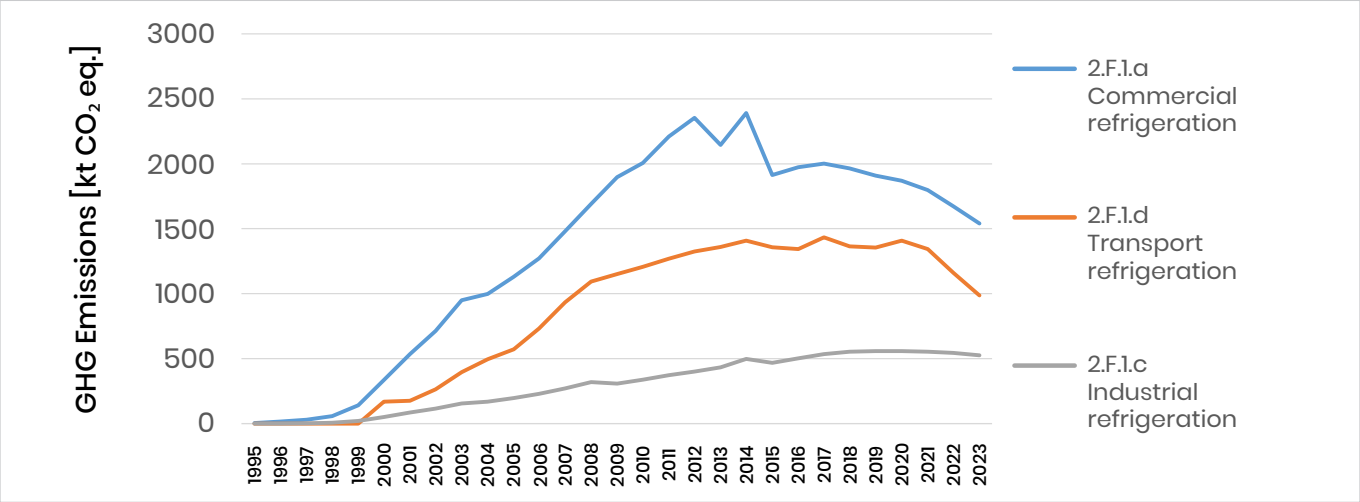
Figure 9. HFC emission trend from 1994 to 2023



Source: KOBiZE

The driving factor for the trend of emissions from the HFC group (having a dominant share in f-gas emissions) is the increase in emissions caused by the growing number of refrigeration and air conditioning equipment (Figure 9). After the opening of the market to Western refrigeration technologies, a significant increase in the number of these devices occurred. How, then, to explain the decreases in f-gas emissions after 2014? This is the result of coordinated regulatory actions aimed at achieving EU climate goals by removing f-gases with a high Global Warming Potential (GWP) from the market. Key in this aspect are the EU regulations on fluorinated greenhouse gases (previously Regulation No 517/2014[1], currently - No 2024/573[2]).

Figure 10. HFC emission trend from main activities related to refrigeration form 1995 to 2023



Source: KOBiZE

Three dominant refrigeration sectors can be identified, whose development alongside technological changes has the greatest impact on the shape of national HFC emission trends (Figure 10). The most important of these, Commercial Refrigeration, includes, among others, refrigerated counters and display cabinets, freezers and shop refrigerators, or so-called chillers.

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The second sector in order is Transport Refrigeration, including, among others, the refrigerated parts of trucks and railway wagons. It is worth noting that emissions from passenger cabin air conditioning equipment are not covered by the scope of this sector and are reported, together with passenger cars, as the so-called MAC (Mobile Air-Conditioning) sector. The last of the key sectors is Industrial Refrigeration, covering equipment used, among others, in cold stores, freezing halls or cooling tunnels.

Analysing f-gas emission trends, the impact of restrictive EU environmental policies implemented since 2014 is clearly visible. According to EU guidelines, the almost complete removal of f-gases from the market is planned by 2050.

1 Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

2 Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014

Agriculture

The share of greenhouse gas emissions from agriculture in Poland amounted to less than 10% in 2023, while their total emissions amounted to 34.2 million tonnes of CO_2 equivalent and decreased in the years 1988–2023 by approximately 32%, with the largest emission drop recorded in the period 1988–1992, by as much as 23% (Figure 11).

The share of greenhouse gas emissions from agriculture in Poland amounted to less than 10% in 2023, while their total emissions amounted to 34.2 million tonnes of CO_2 equivalent and decreased in the years 1988–2023 by approximately 32%, with the largest emission drop recorded in the period 1988–1992, by as much as 23% (Figure 11).

After 1989, Polish agriculture underwent fundamental changes, just like the entire economy. Until 1989, agricultural production was largely subsidized by the state. From 1990, prices of agricultural products, as well as agricultural means of production (mineral fertilizers or machinery) were marketized, subsidies were eliminated, and credit costs increased significantly. The deterioration of macroeconomic conditions for agricultural production at the beginning of the 1990s, during the restructuring of the state economy, caused changes in the structure of agricultural holdings since 1989, including the liquidation of economically inefficient State Agricultural Farms. Poland's accession to the European Union in 2004 significantly accelerated the modernization and restructuring processes of Polish agriculture Since then, the key factor influencing Polish agriculture and rural areas is the EU Common Agricultural Policy (CAP), influencing the stabilization of the agricultural market.

The effect of structural changes in agriculture was primarily a reduction in the livestock population: cattle by 38% (with dairy cattle by as much as 51%), pigs by 52%, sheep by as much as 94%, goats by 66%, and horses by 85%. Significant changes also occurred in crop production, e.g., potato production fell by 84% with a simultaneous huge (44-fold) increase in maize production, while rape production more than doubled.

The main greenhouse gases emitted by the agriculture sector are methane and nitrous oxide. Enteric fermentation of livestock contributes most to methane emissions - here, cattle breeding is responsible for 95% of emissions, as the most methane is produced by ruminants (with a multi-chambered stomach – i.e., cows, as well as sheep, goats), in whose stomachs a large number of microorganisms live, anaerobically decomposing plant fibre resistant to digestive enzymes.

To a lesser extent, methane is produced by monogastric animals (e.g., pigs, horses)[3]. It should be noted that despite the drop in the dairy cattle population by over 50%, emissions from enteric fermentation of cows fell during this time by 36%, which results from changes in animal breeding and feeding. During this time, milk yield of cows more than doubled, which entailed increased energy demand in feed and thus - an increase in the unit CH_4 emission factor (i.e., CH_4 emission per animal).

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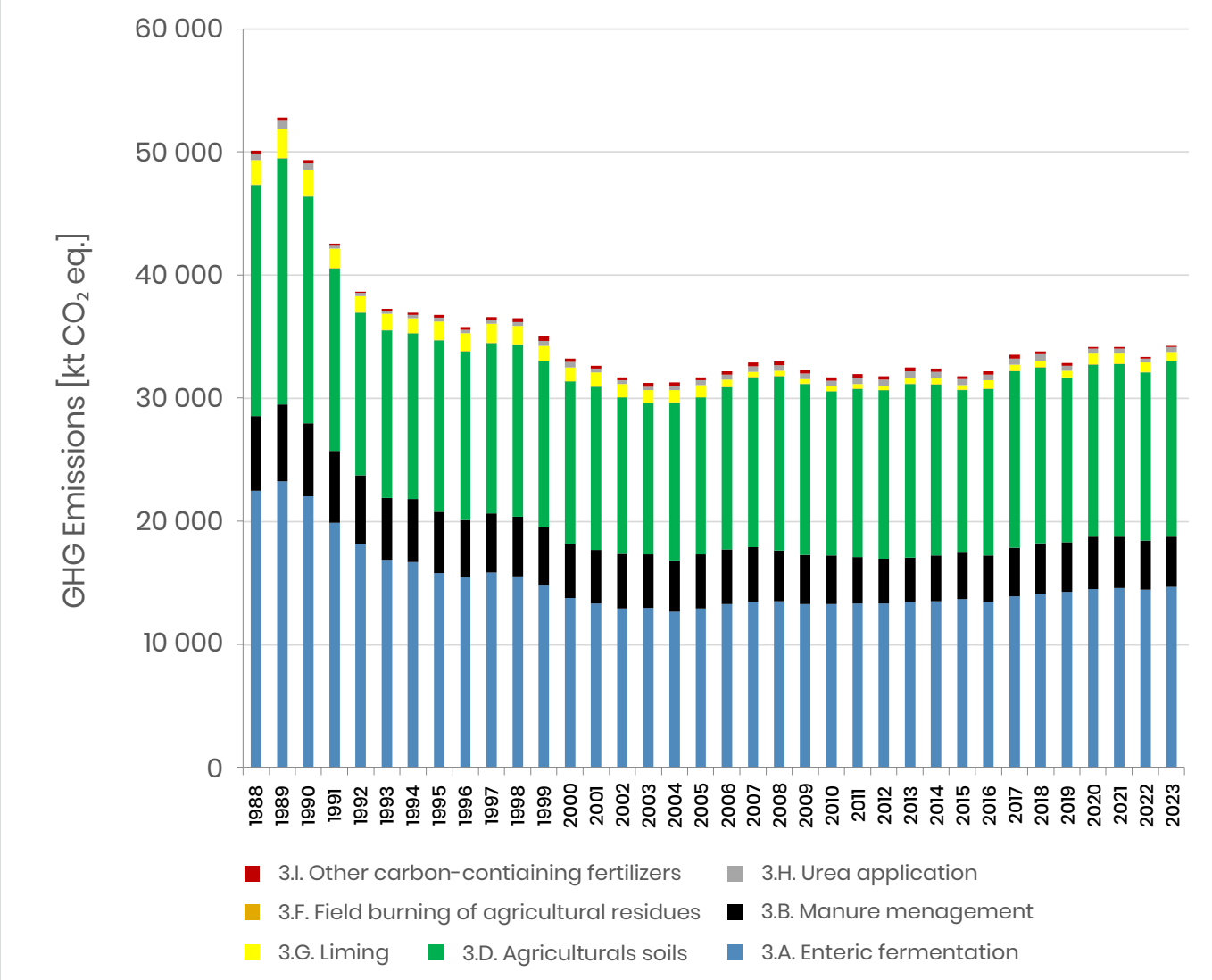
The second significant source of methane emissions is manure management (solid manure, slurry). Here it is worth noting that the transition from straw-based systems (solid manure) of cattle or pig housing to slurry-based systems (liquid manure), used in larger farms, increases unit CH_4 emissions. In turn, the most significant source of N_2O emissions are agricultural soils, including the anthropogenic nitrogen load to the soil associated, for example, with the application of mineral or natural fertilizers. However, CO_2 emissions from agriculture are small and associated with the application of lime fertilizers or urea. Trace CH_4 and N_2O emissions are also reported from the burning of agricultural residues.

Figure 11. GHG emission trend from agriculture in years 1988-2023 with main categories shares



Source: KOBiZE

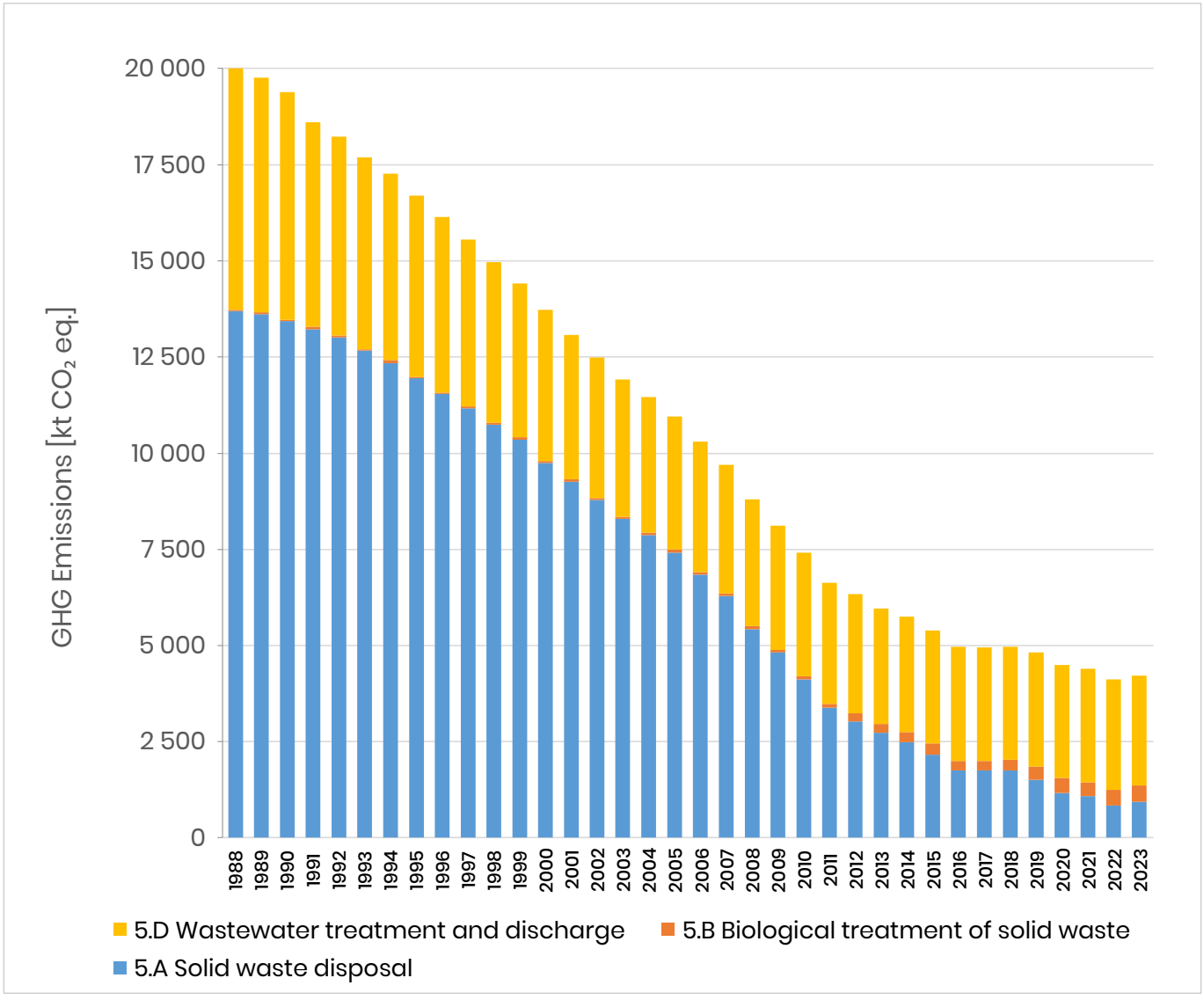
3 Z. Jarosz, A. Faber. Wpływ zmian w metodyce szacowania na emisje metanu z rolnictwa w Polsce. Instytut Uprawy Nawożenia i Gleboznawstwa – Państwowy Instytut Badawczy w Puławach. STUDIA I RAPORTY IUNG-PIB. ZESZYT 65(19), 2021, s. 163-172.

Waste

Greenhouse gas emissions from the waste sector amounted to 4.2 million tonnes of CO_2 equivalent in 2023 and decreased by nearly 79% since 1988. The main sources contributing to emissions from this sector are solid waste disposal and wastewater treatment, which in 2023 accounted for 0.3% and 0.8% of national emissions. GHG emissions from solid waste disposal decreased by 93.2% during the analysed period, thanks to the development of segregation, recycling, and other waste treatment methods, primarily thermal treatment and composting, as well as the development of the biogas sector. GHG emissions from wastewater treatment decreased by 54.5% as a result of the development and modernization of installations, as well as the decline in the country's population, resulting in a reduction in the amount of municipal wastewater generated.

> *GHG emissions from solid waste disposal decreased by 93.2% during the analysed period, thanks to the development of segregation, recycling, and other waste treatment methods...*

Figure 12. GHG emission trend from waste in years 1988-2023 with main categories shares



Source: KOBiZE

Land Use, Land Use Change and Forestry (LULUCF)

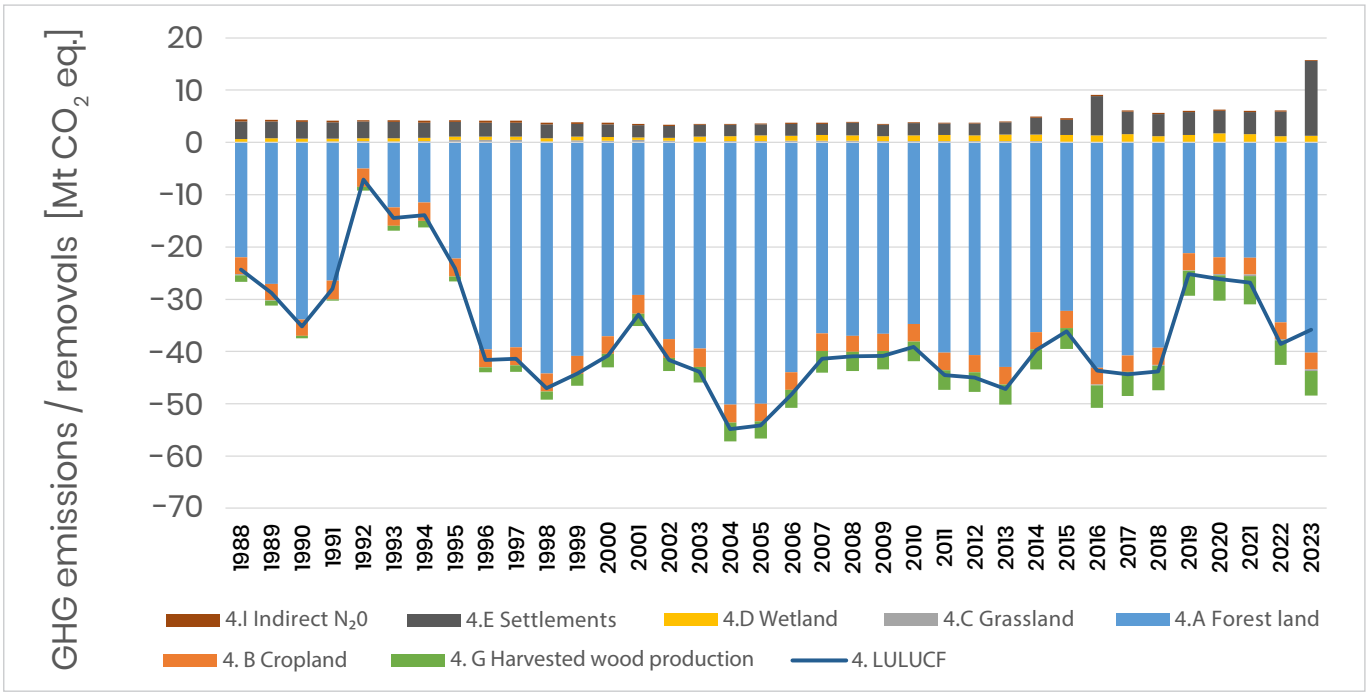
The value of the balance of greenhouse gas emissions and removals in LULUCF throughout the 1988-2023 trend is negative, which means that CO2 removals exceed GHG emissions in this category.

> *The value of the balance of greenhouse gas emissions and removals in LULUCF throughout the 1988-2023 trend is negative, which means that CO_2 removals exceed GHG emissions in this category.*

Net removals (i.e., the negative value of the emissions and removals balance) of greenhouse gases in the LULUCF sector amounted to - 32.7 million tonnes of CO_2 equivalent and increased in 2023 by nearly 47% compared to 1988 and by approx. 31% compared to 2021 (Fig. 12). The main sources of greenhouse gas emissions or removals in this category primarily include Forest land (4.A), as well as Settlements (4.E) and carbon accumulation in wood products (4.G).

Among the main reasons for fluctuations in net removals observed in the years 1988–2023 are, among others, the long-term effects of natural disasters — including the catastrophic forest fire in the Kuźnia Raciborska area in 1992, droughts occurring since 2014, and hurricane-force winds (and associated windthrows) in particular in 2017 (which directly caused changes in estimated standing timber resources), aging of forest stands affecting the reported level of annual current increment, and - importantly - significant changes in the dynamics of deadwood development. The lower net balance of greenhouse gas emissions and absorption observed in 2019-2021 resulted from significant transformations of forest area for non-agricultural and non-forest purposes. These changes were mainly related to the development of transport and construction infrastructure, particularly road infrastructure, as well as actions aimed at expanding urban infrastructure (Fig. 13).

Figure 13. GHG emissions and removals trend from LULUCF in years 1988-2023 in LULUCF sector by main categories



Source: KOBiZE

Summary

The information presented in the article shows that the inventory of greenhouse gas emissions from anthropogenic sources is something more than the sum of emissions reported by industrial installations. It consistently covers emissions from energy, industry, soil use, waste, agriculture, and also takes into account chemical reactions occurring in the atmosphere.

The nearly 40% reduction in greenhouse gas emissions in Poland in the period 1988–2023 was mainly influenced by the following factors: economic transformation, technological development, improvement of energy efficiency, and the increase in the use of renewable energy sources.

It is worth mentioning that the results of the initial GHG inventory for 2024 show a further downward trend in greenhouse gas emissions in Poland after 2021, increasing the emission reduction to 41% compared to 1988.

The nearly 40% reduction in greenhouse gas emissions in Poland in the period 1988–2023 was mainly influenced by the following factors: economic transformation, technological development, improvement of energy efficiency, and the increase in the use of renewable energy sources.

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3 Poland's National Inventory Document 2025. Greenhouse Gas Inventory 1988-2023. Submission under the United Nations Framework Convention on Climate Change and Paris Agreement. Warsaw, 2025. National Centre for Emission Management (KOBiZE), Institute of Environmental Protection – National Research Institute: https://unfccc.int/ghg-inventories-annex-i-parties/2025

4 Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006; (https://eur-lex.europa.eu/legal-content/PL/ALL/?uri=CELEX%3A32014R0517)

5 Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014; (https://eur-lex.europa.eu/eli/reg/2024/573/oj?locale=pl)

6 Z. Jarosz, A. Faber. Wpływ zmian w metodyce szacowania na emisje metanu z rolnictwa w Polsce. Instytut Uprawy Nawożenia i Gleboznawstwa – Państwowy Instytut Badawczy w Puławach. STUDIA I RAPORTY IUNG-PIB. ZESZYT 65(19), 2021, s. 163-172. doi: 10.26114/sir.iung.2021.65.11.

The social climate fund and its role in a just energy transition

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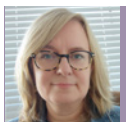
The social climate fund and its role in a just energy transition



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Dr Joanna E. Bukowska

Keywords: social climate fund, social climate plan, ETS2, transformation

Summary

The Social Climate Fund was established as a measure to mitigate the effects of implementing the second pillar of the Emissions Trading System (ETS2), as set out in Directive 2003/87/EC. The fund aims to ensure that the energy and climate transition is fair and does not marginalise social groups, particularly households affected by or at risk of energy or transport poverty.

Tackling energy poverty is essential for the success of the energy transition, yet it is also the greatest risk factor posed by climate policy. It is therefore extremely important to have appropriately planned measures in place to mitigate the negative effects of this policy while responding to the essential needs of the most vulnerable social groups. The Social Climate Fund and the social and climate plans, which set out how Member States will spend the Fund's resources, are intended to address these challenges.

1. Challenges related to the implementation of ETS2

The Social Climate Fund (hereafter referred to as the 'SCF' or 'Fund') was established as a tool to mitigate the negative effects of implementing the second pillar of the emissions trading system (ETS2), as set out in Directive 2003/87/EC[1]. However, the Fund's role is greater than merely mitigating the negative consequences of ETS2; it is also intended to contribute to a fair and inclusive energy transition process. In order to fulfil this role, the Fund must be properly programmed to support the most vulnerable social groups and regions in the energy transition process.

The major concerns associated with the introduction of ETS2 relate to the predicted social impact. Until now, the effects of the implementation of climate policy (the ETS1 component) have manifested themselves in the form of price increases for products and energy produced in installations covered by the EU ETS. However, these effects were not so directly encountered by the general public and did not clearly impact the public's ability to meet their basic needs. The impact of rising commodity and energy prices has been mitigated through various measures, such as reducing consumption, alternative supply sources, implementing protective programmes, and employing traditional administrative measures like tariffs to limit energy price increases.

The implementation of the ETS2 system will pose new challenges. Firstly, households will directly bear the direct burden of the carbon price imposed by this mechanism, which will be transferred into fuel prices. As consumers of these fuels, they will incur increased expenses for fuel purchases and for meeting basic needs such as heating and road transport. The increase in fuel prices will affect people's ability to meet other needs, such as those relating to education, work and other aspects of life, including culture and health. These areas may suffer as a result of increased transport costs, especially in regions with limited access to public transport[2]. ETS2 will contribute to an increase in the cost of living, and rising fossil fuel prices will lead to increased household expenditure, hitting those on the lowest incomes hardest. In this respect, ETS2 will be a regressive mechanism that exacerbates existing social inequalities, particularly in economic terms[3]. Low-income households, who already allocate a substantial fraction of their income to energy and transport expenditures, will be disproportionately affected by the costs imposed by the system.

Residents of rural areas with restricted or non-existent public transport options face significant limitations in their access to alternative forms

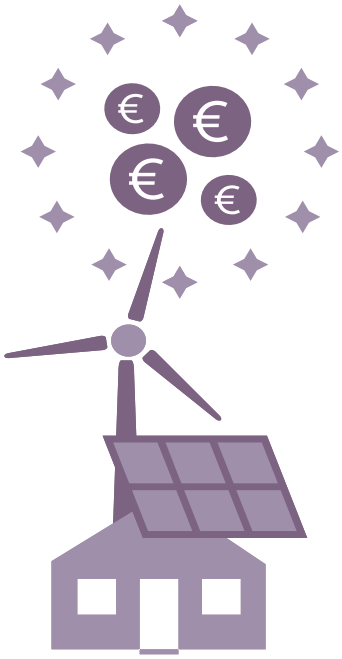
1 REGULATION (EU) 2023/955 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 May 2023 establishing a Social Climate Fund and amending Regulation (EU) 2021/1060 OJ L 130, 16.5.2023, p. 1.

2 Households and other fuel users (including motorists) will have to limit their fuel consumption, especially of the most polluting fuels (e.g. coal), or change their heating sources, reduce their heat demand, switch to less emission-intensive means of transport, and so on, due to the price factor that will necessitate the reduction of emissions. Consequently, for the first time in EU climate policy history, households are the target of emissions reduction mechanisms, and they must undertake the transformational effort in this area in financial and organisational terms. The fact that fuel suppliers will be responsible for monitoring and accounting for emissions is of little significance here. They will simply collect a fee to cover the cost of accounting for emissions associated with the combustion of purchased fuel, and these emissions will be accounted for in a registry account.

3 As emphasised in the literature, carbon pricing is generally an effective decarbonisation policy, but it can have regressive effects, placing a greater burden on lower-income households. This applies to both direct charges imposed on households and indirect taxes, through which industry passes on costs to consumers. See M. Wier, K. Birr-Pedersen, H. Klinge Jacobsen, M. Wier, K. Birr-Pedersen, H. Klinge Jacobsen, J. Klok, Are CO2 taxes regressive? Evidence from the Danish experience, Ecological Economics 52(2), access https://doi.org/10.1016/j.ecolecon.2004.08.005. [access 11.11.2025]

of transportation. By increasing the cost of car maintenance, which is often the main means of getting to school or work, ETS2 may affect people's ability to continue their education or find employment, or even lead to job loss.

Furthermore, the number of entities that will be affected by the introduction of ETS2 is enormous (unprecedented in the 20-year history of the EU ETS system),[4] including households, users of combustion vehicles, and smaller manufacturing plants. Providing support for citizens who cannot cope with the costs generated by ETS2 or who will struggle to adapt to the new conditions will be a test of the state's effectiveness.



If this proves unsuccessful, whether due to inefficient organisation or procedures, or insufficient resources, and the effects of ETS2 are not mitigated, this mechanism may trigger discontent or even social protests[5]. For this reason, the challenges facing Member States, particularly Poland, where the social impact will be significant, are serious and cannot be underestimated.

2. Regulatory assumptions of the ETS2 system

Unlike the existing EU ETS system, which targets direct emitters[6] and encourages them to reduce greenhouse gas emissions, ETS2 is presented as a carbon tax solution[7]. ETS2 imposes fiscal charges on fuels offered for sale, such as motor and heating fuels, as defined in Article 3(af) of the ETS Directive. Therefore, it is a form of indirect taxation on the consumption of certain types of fuel, which is paid by ETS2 participants (also known as regulated entities, as defined in Article 3(ae) of the Directive)[8]. Ultimately, the burden is borne by the consumers of these fuels, i.e. the entities that generate emissions[9]. However, since ETS2 is also a market mechanism, the level of this burden, in the form of the cost of purchasing allowances for emissions trading, is not fixed as it is with traditional taxes. The allowance price is determined

4 It is estimated that approximately 1.4 million households will be affected to varying degrees by the negative consequences of the implementation of ETS2. This includes households that will experience energy poverty as a result of this mechanism coming into force, as well as those who will find themselves in a difficult situation and unable to afford the costs of modernisation that would improve their circumstances.

5 Such protests seem a realistic possibility, as evidenced by France's experience in November 2018, when the so-called 'yellow vest' protests (gilets jaunes) broke out and quickly spread across the country. The immediate cause of the protests was the government's announcement of an increase in fuel duty, intended to reduce consumption and protect the climate. The protesters contested the resulting increase in the cost of living.

6 Currently, the operators to which the EU ETS regulations apply are operators of the installation, aircraft operators, and shipping companies.

7 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: 30.11.2025]. While one must agree with the assessment of the nature of the ETS2 system as a solution akin to indirect taxes, the author does not accurately evaluate the importance of the aforementioned price criterion of €45/t CO2. This is not actually a maximum price limit, but rather a threshold at which stabilisation measures are triggered (i.e. the release of additional allowances from the reserve) to prevent extraordinary increases in allowance prices on the market.

8 J. Bukowska, A. Borek, New component of the emissions trading system for the road transport and buildings sectors – legal conditions of the ETS2 system, GO2'50. Climate. Society. Economy, No. 4/2024, p. 44.

9 We wrote more extensively about the assumptions and structure of the ETS2 system in GO2'50 issue 4. Climate: Society. Economy Magazine in 2024.

by market forces and therefore generates risks associated with unpredictable price increases. A sharp increase in the price of allowances could lead to a rapid rise in fuel prices and the associated consequences such as intensified social effects (e.g. transport costs, heating costs and living costs, and a deterioration in the economic situation of households).

The Directive aims to address these risks by introducing mitigation measures, such as releasing additional volumes of allowances when their value exceeds a certain threshold (€45)[10]. However, this stabilisation mechanism is time-limited. Once the 'protection period' has expired, therefore, allowance prices will rise and the consumer protection offered by the Directive will be limited to preventing sharp price increases rather than stabilising them at a predetermined level[11].

The most important systemic solution, however, is the Social Climate Fund, which is aimed not so much at counteracting sharp increases in allowance prices as at limiting the social impact of such price increases. The Directive provides solutions to secure the financial resources needed to achieve this objective. These resources will come from the sale of emission allowances created in the ETS2 system and the ETS1 system. Proceeds from the sale of 50 million allowances at auctions organised under ETS1 will provide the initial funding for the Fund (commonly referred to as frontloading), after which the Fund will be financed by 150 million allowances created under ETS2. It is worth noting that Member States – the beneficiaries of the SCF – must supplement the funds from the sale of emission allowances with a national contribution to support the most vulnerable fuel consumers, such as households in difficult situations and micro-enterprises. The structure of CCF funding sources will be discussed later in this study.

3. Energy Just Transition

The concept of a just transition originates from the EU and refers to the implementation of profound systemic changes in the economy, including the energy sector. The aim is to achieve the goals of a low-carbon economy while ensuring a balance between environmental, economic and social objectives[12].

The concept first appeared in the climate policy agenda in the 2015 Paris Agreement, latter being developed in subsequent UNFCCC Conference of the Parties documents[13].

The just transition concept is also linked to the EU's Green Deal strategy and its central goal of

10 Under the current provisions of Directive 2003/87/EC, protection is only guaranteed for the first three years of the mechanism's operation, until 2030.

11 While working on the amendment to Regulation (EU) 2021/1119 of the European Parliament and of the Council — the European Climate Law — which aimed to set a carbon dioxide emission reduction target for 2040, a proposal was made to amend Directive 2003/87/EC. These amendments concerned certain aspects of the ETS2 system's functioning. The key change proposed by the Council of the EU and agreed as part of the general approach at the beginning of November 2025 was to postpone the obligation to account for emissions from fossil fuel consumption until 2028. The changes will also cover the price control mechanism in ETS2. At the time of submitting this article to the magazine's editorial office, the future changes to the directive on price control were not yet known.

12 The term 'just transition' was coined by trade unions in the United States in the 1980s to describe a support system for workers who lost their jobs due to environmental policies. See G. Galanis, M. Napoletano, L. Popoyan, A. Sapio and O. Vardakoulias, 'Defining Just Transition', Ecological Economics, Vol. 227, January 2025, https://doi.org/10.1016/j.ecolecon.2024.108370 [accessed 9 November 2025].

13 The concept of a just transition was included in the preamble to the 2015 Paris Agreement, which points to 'the need for a just transition of the workforce and the creation of decent work and high-quality jobs in line with national development priorities', thereby including it in the international climate policy agenda. A declaration on just transition was made at the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP24) in 2018, and a set of principles for just transition were signed by countries at COP26 in 2021. At COP28 in 2023, countries established a programme of work on implementing just transition pathways through international cooperation.

achieving climate neutrality by 2050. This objective is enshrined in EU law through Regulation (EU) 2021/1119 of the European Parliament and of the Council, which establishes a framework for achieving climate neutrality and is known as the European Climate Law[14].

The concept of a 'just transition' is based on the idea that alongside strategies aimed at achieving economic and environmental goals, public policies will be designed and implemented to protect workers, support regions that depend on fossil fuels, reduce energy poverty and ensure the fair sharing of costs and benefits resulting from the implementation of ambitious environmental policies. Therefore, this idea assumes that changes to the economy and its various sectors, which are intended to achieve environmental protection goals, will be implemented in a manner that ensures the fair treatment of workers, communities and regions affected by these changes.

A just transition is based on the paradigm of inclusiveness, which counteracts the marginalisation of disadvantaged social groups. These groups will also benefit from the upcoming changes through various support systems.

A just transition is based on the paradigm of inclusiveness, which counteracts the marginalisation of disadvantaged social groups. These groups will also benefit from the upcoming changes through various support systems.

In terms of economic transformation, the aim is to create alternative economic sectors that can replace the coal industry (i.e. coal mining and processing), while ensuring that those who lose their jobs as a result of coal mine and power plant closures are able to find alternative employment.

As an element of climate policy, just transition extends the objectives of this policy beyond emission reduction and technological transformation to include the fair and equitable allocation of the costs and benefits of climate action[15]. The concept of just transition is reflected in public policies that aim to minimise the negative effects of the transition and finance the creation of new jobs. It is also reflected in social support systems, especially for social groups that will be most affected by these effects, such as households in difficult economic situations or affected by energy poverty.

As an element of climate policy, just transition extends the objectives of this policy beyond emission reduction and technological transformation to include the fair and equitable allocation of the costs and benefits of climate action[15].

A just transition must become an integral part of climate policy, rather than being seen as an add-on[16]. EU climate policy has so far focused on setting emission reduction targets and has recently expanded to include protecting the

14 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.

15 See Por. R. Heffron, D. McCauley, What is the just transition? Opens external. Geoforum; Journal of Physical, Human, and Regional Geosciences, 88, 74–77. https://doi.org/10.1016/j.geoforum.2017.11.016

16 See Por. B. Galgóczi, From Paris to Katowice: the EU needs to step up its game on climate change and set its own just transition framework', [online]. ETUI Policy Brief, European Economic, Employment and Social Policy, n. 4/2018, pp. 1-5. https://www.etui.org/sites/default/files/Greenhouse%20gas%20Galgoczi%20Policy%20Brief%202018.04%20web.pdf [access: 12.10.2025].

competitiveness of EU production. EU industry has lost its competitive edge due to shortcomings in climate policy that focused almost exclusively on environmental goals without recognising the social and economic consequences of pursuing these goals. Examples include carbon leakage, the collapse of many plants and entire industries whose production has been displaced by goods from outside the EU. Despite climate policy also having serious social consequences, such as increased living costs, higher energy costs and job losses due to production relocation outside the EU, these issues have remained outside the remit of EU decision-makers, leaving their resolution to national authorities.

The aim of a just transition is to change the way we think about climate policy priorities, which until now have focused on environmental aspects and, to a lesser extent, certain economic aspects. Climate protection policy must be designed so that changes to the economy, particularly in the energy sector, are reasonable, socially acceptable and evenly distributed. This should include support programmes for households and small businesses, regional development programmes for regions dependent on fossil fuels, and support for developing alternative energy sources, making them more accessible.

In the context of energy, a just transition means that modernising the energy sector to move away from fossil fuels and towards renewable energy sources must not be at the expense of workers, mining regions or those at risk of energy poverty. This process must safeguard environmental protection requirements, the rights of workers in fossil fuel-related sectors, energy accessibility for the poorest and important strategic objectives such as energy security.

These changes should be implemented in a way that balances the costs and benefits for all social groups. In the energy sector, this means moving away from fossil fuels in favour of wider use of renewable energy sources, as well as taking measures to reduce energy demand. In the context of the energy transition, the 'fairness' component includes providing support to those affected by the consequences of this process. This support can take the form of investment, direct income support and retraining for workers in extractive industries, enabling them to find employment in other sectors of the economy.

This goal is a major challenge that requires significant economic effort from all Member States. However, the required effort and the costs of climate transition are not the same for all Member States. This is largely due to fundamental differences in the energy policies pursued by individual countries to date, which are based on different energy production structures, among other things. Poland is one of the countries that consumes the most fossil fuels for energy purposes[17].

4. Tasks of the Social Climate Fund

The Social Climate Fund provides various forms of support for vulnerable social groups by redistributing revenues from the sale of emission

17 As experts emphasise, the ETS2 mechanism, which sets a uniform price for CO2 emissions, does not take into account the different energy structures of individual countries. Poland accounts for over 70% of household solid fossil fuel consumption across the EU, meaning Polish households will be most affected by this mechanism. Solid fuels emit almost twice as much CO2 as gas. Although coal is gradually being replaced by gas as a household fuel, around 20% of Poles still use it for heating. For more information, see R. Jeszke: ETS2: How to approach it wisely and pragmatically, Pomorski Thinkletter No. 3(22)/2025 (ptl-22-robert-jeszke-ets2-jak-madrze-i-pragmatycznie-do-niego-podejsc.pdf).

allowances, helping them to become resilient to rising energy costs and other consequences of climate policy, preferably in a sustainable manner.

> *The Social Climate Fund provides various forms of support for vulnerable social groups by redistributing revenues from the sale of emission allowances, helping them to become resilient to rising energy costs and other consequences of climate policy, preferably in a sustainable manner.*

It is worth noting that the SFC is a complementary measure to the Just Transition Fund . As previously mentioned, the objectives of a just transition are to support not only households and micro-enterprises, but also to design and implement public policies that protect workers and support regions that depend on fossil fuels. The Just Transition Fund supports industrial regions in achieving this objective, while the SCF focuses on supporting individuals, micro-enterprises and households.

The Social Climate Fund is fuelled by revenues from the auctioning of allowances under ETS2. These funds will constitute the majority of the Fund's resources. However, as these allowances will only be sold once ETS2 is fully operational[19], the Fund will also be financed by the sale of allowances under ETS1. A pool of 50 million allowances has been set aside for this purpose and is expected to generate around €4–5 billion in revenue. These allowances will constitute the Fund's initial budget, which will be supplemented as the sale of allowances under ETS2 is phased in until the target pool of €65 billion (the total amount foreseen for the period 2026–2032) is reached[20].

It is worth noting that Member States are also expected to contribute to the Fund from their national funds. The co-financing rate is set at 25% of the value of the resources transferred to a given country from the Fund[21].

Pursuant to Article 1 of Regulation 2023/955, the general objective of the Fund is to contribute to a socially just transition towards climate neutrality by addressing the social impacts of including greenhouse gas emissions from the buildings and road transport sectors within the scope of Directive 2003/87/EC.

The SCF's specific objectives are to support vulnerable households, micro-enterprises and transport users by providing temporary direct income support, and by implementing measures and investments to increase the energy efficiency of buildings and reduce their heating and cooling emissions. This will be achieved by integrating renewable energy generation and storage into buildings and ensuring better access to zero- and low-emission mobility and transport.

18 The Just Transition Fund is a new financial instrument under cohesion policy, designed to support areas facing serious socio-economic challenges resulting from the transition to achieving EU climate neutrality by 2050. It was established by Regulation (EU) 2021/1056 of the European Parliament and of the Council of 24 June 2021 establishing the Just Transition Fund,OJ EU L 231 of 30 June 2021, p. 1.

19 At the turn of 2025 and 2026, a concept for amending Directive 2003/87/EC with regard to the assumptions governing the operation of ETS2 is to be developed. For some time, analysts have been pointing out, among other things, the need to increase the funds allocated to financing policies and programmes aimed at mitigating the impacts of this mechanism on the most vulnerable groups. These funds would be sourced from so-called early auctions, which would be launched before the obligation to purchase allowances arises (i.e. prior to the entry into force of the full-scale ETS2 mechanism). This idea is expected to become part of the ETS2 reform.

20 Poland is expected to be the largest beneficiary of funds from the SCF. Its share has been set at 17.60%, followed by France (11.19%), Italy (10.81%), Spain (10.52%) and Romania (9.25%) as the next largest beneficiaries.

21 Member States may allocate their own revenues from the auctioning of allowances created under ETS2 for this purpose.

As the SCF is intended to mitigate the negative effects of ETS2 implementation, it aligns with the paradigm of a just transition. The Fund is intended to finance the measures to protect vulnerable groups, offsetting the disproportionate impact of transition costs on people on low incomes who are at risk of energy or transport poverty.

Some sources suggest that the Fund's objectives range beyond the mitigation of the effects of climate policy, even recognising that they aim to address socio-economic inequalities resulting from widespread environmental changes in Europe[22]. Indeed, it is reasonable to assume that the concept of the SCF is rooted in a vision of social justice and a strategy for fostering economic resilience. The Fund's resources will focus precisely on social groups in difficult situations, thus mitigating existing social and economic differences and disparities that could worsen without adequate support. However, the idea that the SCF will solve social inequality problems is exaggerated and diverges from the assumptions on which the Fund was established. It should be noted that the Fund is intended to mitigate the inevitable effects of introducing charges related to the consumption of fossil fuels (ETS2) and will only affect specific groups of entities. There is no question of the Fund's resources being used in any broader way, nor of them responding to social needs other than solving the problems of energy poverty and transport exclusion, which are set to be the most serious consequences of the introduction of ETS2. It should be noted that the SCF's resources are too modest for it to have a real impact on building a vision of social justice. However, it is widely believed that the Fund's resources will not meet many of the needs, even in the countries that will benefit most from it[23]. Therefore, the idea that the Fund's activities contribute to equalising opportunities and economic inequalities in society is difficult to substantiate. Furthermore, this objective was not set out in Regulation 2023/955, which established the SKF.

Let us examine how the SCF mitigates the effects of ETS2 and implements demands for a just transition. The Fund focuses on three key areas:

1. Improving the energy efficiency of buildings and decarbonising them, which is understood as investing in changing energy sources to use renewable energy. Funds are also to be directed towards creating communities that use renewable energy.

2. Promoting sustainable mobility to reduce transport poverty by increasing access to affordable public transport, zero- and low-emission vehicles, on-demand mobility services and active travel.

3. Providing temporary direct income support to counteract the social impact of ETS2 on vulnerable households and users of combustion engine vehicles. This support will be

22 A. Frosinini, The Social Climate Fund: A Pathway to Socially Just Climate Transition, The Social Climate Fund: A Pathway to Socially Just Climate Transition | by Andrea Frosinini | Medium [access: 10.11.2025].

23 Low-income households typically focus on day-to-day consumption, face greater constraints in accessing credit, and spend a larger share of their limited income on basic goods such as heating, energy, or food. Increases in the prices of energy, fuels and heating as a result of ETS2 will further erode the incomes of such households. Low-income households are unable to invest in low-emission solutions such as electric vehicles or modern heating systems and therefore also benefit less from support programmes granted for the purchase of such solutions. Regulations aimed at reducing emissions have the greatest impact on household expenditures, particularly those of the lowest-income households. (see (Tak np. G. Zachmann, G. Fredriksson, G. Claeys, The Distributional Effects Of Climate Policies, Blueprint 28, Bruegel 2018, https://www.bruegel.org/book/distributional-effects-climate-policies, [access: 11.11.2025].

temporary and will gradually be phased out as structural measures, such as investments in energy efficiency, protect household incomes from increases in fuel prices.

The tool used to implement the SCF objectives is the social and climate plans. These are programme instruments developed by the Member State which define the scope, manner and conditions for implementing measures financed by SCF funds available to the Member State. Social climate plans must be developed in accordance with the guidelines set out in Regulation 2023/955, and their development and adoption by the EC is a formal condition for obtaining SCF funds.

Article 4(1) of Regulation 2023/955 specifies that the plans must contain a coherent set of measures and investments that explicitly consider the social impact of ETS2 on specific beneficiary groups, while Article 8 stipulates that the measures and investments must primarily target vulnerable households, transport users and micro-enterprises.

The social and climate plan should include an assessment of social and energy needs, identifying groups requiring support. It should also estimate the impact of price increases resulting from ETS2 on households, particularly on energy and transport poverty indicators, as well as on micro-enterprises.

It should also set out measures and investments aimed at reducing energy and transport poverty, including improving energy efficiency, decarbonising buildings and ensuring access to sustainable transport. Detailed financing mechanisms should also be included.

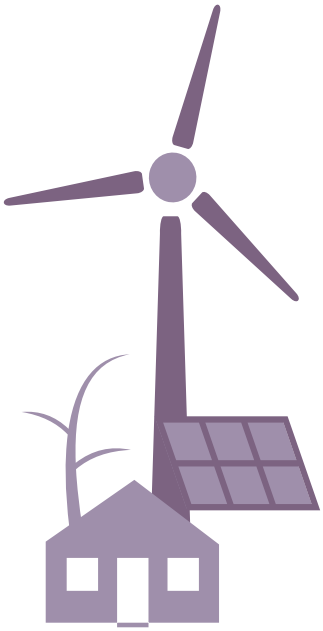
It is worth noting that energy and transport poverty are multidimensional phenomena. Poverty is usually caused by a combination of factors, such as low income, high energy prices, the technical condition of buildings and lack of access to alternative means of transport[24]. Therefore, solving these problems requires integrated tools and policies, such as building thermal modernisation programmes, developing energy communities (e.g. community renewable energy installations), reconstructing railway infrastructure and stimulating public transport development, and organising on-demand transport. Of course, such solutions cannot always be implemented, nor can they cover everyone in need. In such situations, poverty problems should be addressed through direct cash transfers.

It is worth noting that priority should be given to energy efficiency measures, especially in the building sector. These measures are considered effective in protecting households affected by energy poverty and in difficult situations. Improving the energy performance of buildings can mitigate the negative effects of fuel price increases, improve living conditions for families and counteract energy poverty[25].

The second challenge is transport poverty, which occurs when individuals or households have limited access to basic necessities such as

24 The situation of households struggling with energy poverty may also depend on geographical and climatic factors, the gender and health status of household members, as well as the household's specific energy and transport needs. Households with higher energy needs—including families with children, persons with disabilities and older people—are also more exposed to energy poverty and its effects. Women, in particular single mothers and older women, are especially affected by energy poverty due to structural inequalities in income distribution, socioeconomic status and the care gap, which is often determined by gender (women more frequently perform caregiving roles for children and are excluded from paid employment during this time).

employment, education, healthcare and public services due to restricted mobility. This may be due to economic constraints, such as high commuting costs; infrastructure constraints, such as a lack of accessible public transport; spatial constraints, such as scattered development and long distances to work, school, etc.; or institutional constraints, such as insufficient transport services and a lack of transport system integration. Sustainable mobility aims to provide accessible, cost-effective, low-emission and socially equitable transport options, thereby counteracting transport poverty. Solutions include the modernisation and development of public transport, intermodal transport and on-demand mobility, increasing accessibility for groups with limited financial resources, the elderly, people with disabilities and residents of peripheral areas.



However, temporary direct income support can only be provided to households and users of combustion engine vehicles at risk of transport poverty.

This type of support does not address the underlying causes of energy poverty, such as poor building insulation and income inequality. While measures providing direct income support can offset the effects of ETS2, Member States may introduce national policies covering other groups of households, not just those receiving SCF support. These policies could include subsidies for energy bills, social tariffs, protection against disconnection of electricity or heating and limiting price increases.

It should be emphasised that investments financed from the SCF must be completed by 2032. However, it is widely argued that this timeframe is inadequate given the scale of the investments required. The short timeframe for using SCF funds is one of this mechanism's shortcomings, hence the proposed changes. The currently negotiated postponement of the full-scale implementation of ETS2 seems to present an opportunity to review the SCF timeframe.

In the context of the planned activities, the social and climate plan should define specific, measurable milestones to be achieved within a given timeframe. Achieving the planned milestones is the basis for releasing subsequent tranches of EU funds.

Social and climate plans must also include a description of the management system, taking into account the division of tasks between the institutions implementing the plan. They must also include a monitoring and reporting system to enable the European Commission, among other

25 In 2023, the European Commission issued a recommendation setting out principles for addressing energy poverty in the policies of the Member States. It highlights the paramount importance of measures to improve the energy efficiency of buildings, which should take the form not only of investment actions but also of the need for Member States to develop complementary policies and legal frameworks that ensure real support for households in this area. See Commission Recommendation (EU) 2023/2407 of 20 October 2023 on energy poverty, OJ EU L 2023.2407.

things, to assess progress and compliance with the Fund's objectives.

The inclusive nature of the SCF is reflected in the categories of entities that benefit from the Fund. As previously mentioned, SCF funds are intended to support three categories of recipients: households; transport users in difficult situations or at risk of energy or transport poverty; and micro-enterprises in difficult situations. Energy poverty arises when a recipient is forced to bear high energy costs and has a low income, resulting in difficulty in ensuring an adequate level of heating and access to electricity[26].

Support is granted based on the economic situation of households or transport users, as well as their inability to finance the necessary investments independently. In the case of micro-enterprises in difficulty, support will be granted if energy costs represent a high proportion of the enterprise's expenses. Support will primarily concern the financing of investments in the thermal modernisation of buildings.

The key issue is qualifying the entities to which the support is directed. To this end, two categories of stakeholders have been defined: households and transport users in a difficult situation (Articles 2(10) and 2(12) of Regulation 2023/955). Both categories have two criteria: the requirement to be in energy or transport poverty[27] and the criterion of the impact of ETS2 on the economic situation of low- and medium-income households. This impact is expected to be significant, meaning these households will lack the funds required for the necessary investments.

In simple terms, it can be assumed that a household, transport user or micro-enterprise is considered to be in a difficult situation if they lack the funds to renovate their building, purchase zero- or low-emission transport or access public transport.

It should be noted that, with an energy poverty rate of 12%, Poland remains one of the countries with the highest rates in the EU[28]. The EU average is 6–7% of households. Romania, Bulgaria and Hungary have higher energy poverty rates than Poland.

Factors affecting the level of energy poverty include the financial condition of the household (pensioners, single-person households and large families are most affected), the age and size of the building (high heat demand) and lack of connection to the district heating network (affecting residents of rural areas and small towns in single-family housing).

26 Regulation 2023/955 refers to the definition of energy poverty introduced by Directive (EU) 2023/1791 of the European Parliament and of the Council of 23 September 2023 on energy efficiency (OJ EU L 231, 20.9.2023, p. 1). The Directive recognises that energy poverty means a household's lack of access to essential energy services where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting and energy for powering appliances, in the relevant national context, under applicable national social policy and other relevant national policies. This lack of access is caused by a combination of various factors, including at least excessively high prices, insufficient disposable income, high energy expenditure and low energy efficiency of residential buildings.

27 Users of transport in a vulnerable situation are persons and households—including those with low and lower-middle incomes—who are significantly affected by the impact of ETS2 on fuel prices and who lack the means to purchase zero- and low-emission vehicles or are unable to meet their mobility needs by using sustainable modes of transport, including public transport (Article 2(12) of Regulation 2023/955).

28 In 2023, 10.6% of the population of the European Union was unable to heat their homes adequately during the winter period. This represents a significant increase compared to 2021, when the energy poverty rate stood at 6.9%. Research on energy poverty in Poland has been conducted by numerous research centres. Among others, the Polish Economic Institute presented its findings on this issue in 2024 in the report Energy Poverty. The authors presented various sets of indicators for measuring energy poverty. A summary of research findings was also presented by the authors of the most recent study published in May 2025 in the journal Energies. J. Przywojska, A. Podgórniak-Krzykacz, M. Kalisiak-Mędelska, I. Rącka, Energy Poverty in Poland: Drivers, Measurement and National Policy, Energies 2025, 18(11), 2987; https://doi.org/10.3390/en18112987 [access: 21.11.2025].

Combatting energy poverty is essential for the success of the energy transition, yet it is also the biggest risk factor that can undermine even the best-designed climate policy goals and objectives. Therefore, appropriately programmed actions directed at precisely selected categories of stakeholders are of key importance, as are the necessary investments.

Summary

The objectives and tasks of the Social Climate Fund are undoubtedly aligned with the principles of a just transition. The idea behind the Fund is based on the belief that those who have contributed least to climate change should not bear the brunt of the transition, even though they will be affected by its costs the most.

The Fund aims to ensure that the energy and climate transition is fair, and that social groups, especially those affected by or at risk of energy or transport poverty, are not marginalised. Extending the ETS to the buildings and road transport sectors will increase the cost of living, particularly for lower-income households, by imposing additional CO_2-related charges on fuels.

Therefore, a key element of the Fund's activities is to mitigate the risk of energy poverty, which includes providing direct income support. This provides immediate protection for the most vulnerable households against rising energy and fuel prices. Investments financed by the SCF in the thermal modernisation of buildings, replacement of inefficient heating systems and support for sustainable public transport are also intended to reduce household bills and increase resilience to fluctuations in energy and fuel prices. In this sense, the Fund aims to mitigate the effects of the transition and ensure that less affluent households benefit from it. This will help to realise the idea of justice, which assumes equal access to clean energy and new technologies.

However, certain conditions must be met for the objectives and assumptions of the Social Climate Fund adopted in EU law to materialise. Firstly, the Fund's budget must be supplemented with additional funds, as it is already evident that the scale of needs in even the largest beneficiary countries far exceeds the available funds. Extending the period for spending the funds will positively impact the rational management of scarce resources, ensure a more thorough selection of projects and enable reliable monitoring of results. The limited availability of funds means they must be spent quickly. In the context of fund management, this shifts the focus to increasing the efficiency of the system for managing these funds. Efficient management of the Fund's resources requires an institutional apparatus organised into several levels (strategic, operational and local) that operates on the basis of simple, transparent procedures.

It is also important to design support instruments tailored to specific needs (investment, protective measures, advisory support, etc.) to ensure high absorption of funds. At the same time, the limited amount of funds should encourage decision-makers to focus on solutions that will have a lasting impact. The transformational dimension of the SFK is crucial. In order to effectively achieve the objectives of a just transition, the Fund resources must be used primarily as a "transformative leverage" and therefore must be allocated to financing investments that

permanently reduce fuel consumption, thus supporting the energy and transport transformation. Properly managing these funds can, in practice, strengthen the resilience of the most vulnerable households to energy poverty and the risk of transport exclusion.

Regardless of the comments presented, the SCF can be considered a tool for a just transition, on the one hand, by mitigating the negative effects of the implementation of ETS2, and on the other hand, by accelerating the energy transition, especially in low-income households. The effectiveness of this tool will largely depend on ETS2 and whether appropriate changes are introduced in this mechanism. The most important of these is slowing down the implementation schedule for this mechanism and providing effective tools to counteract increases in allowance prices. No constructive decisions have yet been made on this issue.

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12 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 of 9 July 2021, p. 1).

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CBAM 2.0. The future of the mechanism after the changes introduced by the Omnibus package

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CBAM 2.0. The future of the mechanism after the changes introduced by the Omnibus package

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Summary

The article presents the current state and directions of development of the EU Carbon Border Adjustment Mechanism (CBAM), in the context of significant legislative changes introduced by the Omnibus package. The authors analyze how the new regulations are aimed at simplifying procedures, increasing the efficiency of the system and better adapting it to economic realities.

The article discusses, among other things, the introduction of a new de minimis threshold, which exempts a significant part of importers from the obligations under the mechanism, as well as a derogation from the requirement to obtain the status of an authorised CBAM declarant. In addition, the article presents information on the revised deadlines for submitting CBAM declarations, the rules for the purchase and repurchase of CBAM certificates, the verification of embedded emissions by accredited organizations and the possibility of entrusting the obligation to submit CBAM declarations to other entities.

The article outlines the measures introduced to simplify the calculation of embedded emissions and highlights new obligations that, following the introduction of these simplifications, fall only on the European Commission but also on the national authorities responsible for implementing the CBAM. The simplifications represent a step towards a more realistic and workable system that supports the European Union's climate objectives without placing an excessive burden on businesses. At the same time, it was noted that although the Omnibus I package solves many problems, it does not eliminate the challenges related to the implementation of the CBAM mechanism.

Introduction

At the end of 2025, the transitional period of the CBAM (Carbon Border Adjustment Mechanism) will come to an end. This EU mechanism concerns the import of certain categories of goods into the European Union from third countries and aims to equalise the cost of emissions. The functioning of the CBAM, in its so-called transition phase, began on 1 October 2023. The first year of the mechanism has shown that the system is not ideal and its complex rules may be difficult to implement. Following numerous comments from Member States and importers, the European Commission has decided that mechanism requires improvements and clarified before the start of the definitive period, which begins on 1 January 2026.

At the outset, however, it is necessary to present what the CBAM is and for what purposes it was established. This mechanism was introduced by Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism[1] as part of the European Green Deal. This mechanism responds to challenges related to the competitiveness of global trade and climate policy. The main objectives of the mechanism are to prevent carbon leakage – that is the relocation of carbon-intensive production to countries with less stringent environmental regulations, as well as to protect European producers from unequal competition from producers of imported goods from third countries where costs related to CO_2 emissions are often disregarded or significantly lower.

The scope of the mechanism covered the import of certain goods into the territory of the European Union. CBAM goods belong to sectors such as: cement, electricity, fertilisers, iron and steel, aluminium and hydrogen. The import of goods covered by the mechanism during the definitive period, i.e. from 2026 onwards, will result in the pricing of carbon dioxide emissions, so-called embedded emissions, based on the costs borne by European producers under the EU ETS, i.e. EU Emission Trading System. The CBAM affects not only importers of goods, but above all producers (operators of installations) operating in third countries. Its aim is to encourage them to modernise their production processes towards decarbonisation so that they can maintain their competitiveness on the EU market. Through its design, CBAM links trade policy with climate policy, using customs instruments as a tool to support greenhouse gas emission reduction objectives.

To the rescue - omnibus package

The rules of the CBAM transitional period mainly consist in the obligation for importers or indirect customs representatives to submit quarterly reports on goods imported into the European Union. This is the period during which the mechanism passed the first general test, which demonstrated its legal complexity as well as its scope of impact. This obligation is based on the value of consignments of imported goods. The original low entry threshold - EUR 150 per consignment (as referred to in Article 23 of Council Regulation (EC) No 1186/2009[2]) meant that

1 Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism (OJ L 130, 16.5.2023, p. 52-104).

2 Council Regulation (EC) No 1186/2009 of 16 November 2009 setting up a Community system of reliefs from customs duty (OJ L 324, 10.12.2009, p. 23).

even small-scale imports subject to these rules, which in turn forced many producers from third countries to face the challenge of complying with EU regulations. The first months of the mechanism's operation revealed a number of difficulties, including a high volume of consignments with negligible CO_2 emissions. At the same time, the scope of the reporting obligations imposed on importers, together with the tasks of administering authorities in the Member States, exposed inefficiencies in light of the considerable complexity of the CBAM, creating the need for swift adjustments. The challenge in this case was not only the difficult use of the CBAM registry, through which the reports are submitted, but also the ad hoc modifications introduced by its administrator (the European Commission) leading to numerous mistakes and irregularities. In addition, the complexity of the mechanism, prolonged legislative processes for implementing acts and the adoption of 'last minute' legal regulations have resulted in difficulties for EU Member States in preparing teams of qualified staff capable of explaining the functioning of the mechanism to interested parties and supporting them in fulfilling the obligations arising from these rules. It should also be noted that a significant factor contributing to these problems was the reluctance of installation operators in third countries to cooperate in determining the embedded emissions of goods and in providing importers with the actual data necessary for submitting the CBAM report.[3]

The first months of the mechanism's operation revealed a number of difficulties, including a high volume of consignments with negligible CO_2 emissions. At the same time, the scope of the reporting obligations imposed on importers, together with the tasks of administering authorities in the Member States, exposed inefficiencies in light of the considerable complexity of the CBAM, creating the need for swift adjustments.

These factors, combined with the rapidly evolving nature of global trade policy, made it necessary to modify the original design of the mechanism. The aim of these changes is to facilitate its implementation by reducing the administrative burden while preserving environmental integrity. The revision of the rules on the functioning of the CBAM is combined with an ambitious quantitative target set by the European Commission to reduce administrative burdens by: at least 25% for all enterprises and at least 35% for small and medium-sized enterprises[4]. Mario Draghi in his report titled 'The future of European competitiveness, Part A, A competitiveness strategy for Europe'[5], points out that Europe needs a more transparent and conducive regulatory system that does not stand in the way but supports economic development. Regulations should be designed to strengthen the competitiveness of European companies on global markets and increase the resilience of the economy to changes and crises. Therefore, the European Commission, building on the new objective and roadmaps, after analysing the quarterly reports and exchanging infor-

3 P. Lipka, Kryłowicz, M. Nowakowska, What do we know about the Carbon Border Adjustment Mechanism (CBAM) after one year of operation?, in *'GO2'50 Klimat. Society Economy', No 05/2024*, pp. 17-27.

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5 "The future of European competitiveness, Part A, A competitiveness strategy for Europe", M. Draghi et al., 2024.

mation with stakeholders, including in the CBAM Expert Group, has identified areas where simplification will achieve the objective of environmental integration while strengthening the CBAM mechanism. These amendments were proposed on 26 February 2025 as part of the so-called Omnibus I simplification package, which included a comprehensive set of legislative proposals combining all the above objectives. This package initiated the process of implementing changes to key European Union legislation concerning sustainability reporting (CSRD[6]), due diligence (CSDDD[7]) and imports of goods from third countries, i.e. trade (CBAM). As the European Commission points out, the need to simplify CABM has been actively raised by all stakeholders both inside and outside the EU, including public authorities and businesses. The main objective of the European Commission was a package of solutions containing a set of mutually reinforcing changes that will facilitate the smooth implementation of the CBAM, including streamlining and reducing administrative burdens. Final wording of the draft regulation amending Regulation (EU) 2023/956 was developed during the Polish Presidency of the Council of the European Union in the first half of 2025. It is worth emphasizing that this was a challenge implemented under time pressure, as the adoption of the Omnibus package was urgent and resulted from the need to enter into force before the CBAM definitive period of 1 January 2026. The lack of timely adoption of the package could lead to administrative and legal chaos, which would certainly translate into a loss of political credibility. The Regulation amending the CBAM[8] mechanism was published in the Official Journal of the European Union on 17 October 2025 and entered into force on the third day following its publication.

> *As the European Commission points out, the need to simplify CABM has been actively raised by all stakeholders both inside and outside the EU, including public authorities and businesses.*

Cbam in its revised form – what will change?

a) De minimis thresholds

The proposed changes to the CBAM rules have reshaped the mechanism. The key change that has the greatest impact on its functioning is the introduction of a new single mass-based threshold - 50 tonnes per year. The threshold applies to CBAM goods from four sectors of iron and steel, aluminium, fertiliser and cement. If the total net mass of CBAM goods from the above-mentioned sectors imported by an importer in a given calendar year does not exceed this threshold, that importer will be exempt from the obligations arising under the CBAM rules. This is a significant facilitation for importers, which translates into greater predictability and simplicity of import processes for operators with a small scale of activity. The 50-ton threshold set by the European Commission is not arbitrary; its determination was

6 Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (OJ L 322, 16.12.2022, p. 15–80).

7 Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence and amending Directive (EU) 2019/1937 and Regulation (OJ L, 2024/1760, 5.7.2024).

8 Regulation (EU) 2025/2083 of the European Parliament and of the Council of 8 October 2025 amending Regulation (EU) 2023/956 as regards simplifying and strengthening the carbon border adjustment mechanism (OJ L, 2025/2083, 17.10.2025).

preceded by detailed analyses. Customs data on imports of CBAM goods from the first year of the CBAM transitional period (Q4 2023 – Q3 2024) show that around 80% of importers accounted for only 0.1% of all embedded emissions associated with imported CBAM goods, while just the top 10% of importers were responsible for more than 99% of emissions. To determine the threshold, various mass levels ranging from 10 to 500 tons were assessed. The choice of a 50 tonnes annual treshold per importer covers those importers responsible for more than 99% of imported emissions. From the data provided by the European Commission, this threshold will release approximately 182 thousand importers from CBAM obligations (91% of the total number of importers), which account for less than 1% of the total embedded emissions from imports in the four CBAM sectors concerned.[9] Importers that do not reach this threshold will be exempted from the obligation to obtain the status of authorised CBAM declarant, to submit annual CBAM declarations and from the obligation to purchase and surrender CBAM certificates. However, in order to avoid circumvention, importers will be required to monitor the threshold of 50 tonnes per year. Exceeding the threshold results in the obligation to obtain the status of authorised declarant, and importer will not be able to carry out imports. Moreover, it should be noted that this threshold may be adjusted, as the European Commission is required to monitor and revise it so that it continues to cover the embedded emissions of all CBAM-covered goods imported from third countries at a level exceeding 99%. The Commission shall analyse the level of the threshold on the basis of a methodology using customs data on the quantities and types of imported goods and on the basis of the default values of embedded emissions that it makes available. Once every 12 months (by 30 April of each calendar year), the European Commission will assess whether there has been a significant change in the average embedded emission intensity of goods or in the pattern of trade in goods. In the event that the value of the threshold it calculates deviates from the applicable de minimis threshold by more than 15 tonnes, the threshold will be amended by a delegated act and its application will apply from the beginning of the following calendar year. Therefore, should this threshold change to 35 tonnes, importers not covered by the CBAM mechanism will have eight months to prepare for the new obligations, i.e. primarily to obtain the status of authorised CBAM declarant. It should also be noted that the threshold expressed in weight of imported goods is intended to make it easier for importers to monitor. Expressing a threshold in monetary terms per consignment (as is the case during the transitional period) does not reflect environmental aspects only the cost of purchasing the goods, whereas a threshold determined on the basis of parameters relating to imported embedded CO_2 emissions would be too complex for importers to monitor. In turn, the threshold expressed in embedded emissions would force the importer to perform calculations consisting in multiplying the weight of CBAM goods for each of the imported goods by CN codes and the default values of the emission factor of these codes set by the European Commission. The proposed weight-based threshold ensures both the achievement of the overall emission target and facilitates its implementation, as importers can independently monitor compliance with the threshold in its entirety on the basis of customs data – this obligation is

9 Commission Staff Working Document, Accompanying the document Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2023/956 as regards simplifying and strengthening the carbon border adjustment mechanism.

therefore limited to the aggregation of the tonnage of CBAM imported goods. Regardless of the above the above, it should be noted that imports of electricity and hydrogen are not covered by the de minimis exemption.

> *The choice of a 50 tonnes annual treshold per importer covers those importers responsible for more than 99% of imported emissions. From the data provided by the European Commission, this threshold will release approximately 182 thousand importers from CBAM obligations (91% of the total number of importers), which account for less than 1% of the total embedded emissions from imports in the four CBAM sectors concerned[9].*

b) Status of authorised CBAM declarant

Another important facilitation of the mechanism, important not only for importers but also for national CBAM authorities, is a temporary derogation from having the status of authorised CBAM declarant in 2026. As indicated by Regulation 2023/956, goods can only be imported into the customs territory of the EU by an authorised CBAM declarant. To facilitate the application of the above-mentioned regulation after the expiry of the transitional provisions and to avoid potential disruptions in the import of goods, the European Commission has allowed the continued importation of goods after the unified mass threshold has been exceeded, pending the decision on granting the relevant status. To benefit from this facilitation, an importer must submit an application for authorisation (in accordance with Article 5 of Regulation 2023/956) by 31 March 2026. This solution will not only help prevent administrative overload for national CBAM authorities, which expect a high volume of applications at the turn of 2025 and 2026, but will also enable importers to better plan their operational activities and avoid interruptions in imports. It should be noted that the granting of this status is conditional upon meeting the relevant criteria, which means that the authority may refuse to grant CBAM authorised declarant status. Importers who do not hold CBAM authorised declarant status and who import CBAM goods into the Union while exceeding the 50-ton threshold are subject to administrative fines (Article 17(7a) of Regulation 2023/956). This serves as a safeguard against attempts to circumvent the rules and ensures equal treatment of all entities importing CBAM goods.

c) Deadlines and repurchase of CBAM certificates

The Omnibus package also provides solutions to simplify CBAM reporting requirements. One of the key facilitations in this regard is to change the deadline for submitting annual CBAM declarations and surrendering an appropriate number of CBAM certificates. This deadline has been postponed from 31 May to 30 September each year (for the first time importers will submit an annual declaration in 2027 for 2026). This deadline coincides with the deadline for CO_2 emissions reporting by EU installations under the EU ETS. This solution provides importers with additional time to prepare their declarations and purchase CBAM certificates. It also extends the period during which operators of installations outside the European Union can prepare their emissions reports and have them verified. The change in the deadlines for submitting declarations and surrendering certificates also results in a revised deadline for importers

to request the repurchase of certificates (31 October) and for the European Commission to cancel certificates (1 November). It should be noted that the methodology regarding the number of excess CBAM certificates that an EU Member State will be able to buy back from an authorised CBAM declarant has been changed. Under the original rules governing the functioning of the CBAM, a Member State could only buy back excess CBAM certificates from an importer in a number corresponding to one third of the total number of certificates purchased in the previous calendar year. Following legislative changes, a Member State may repurchase the number of CBAM certificates that an authorised declarant will be required to purchase in the year of import in order to comply with the quarterly obligation laid down in Article 22 (2) of Regulation 2023/956 (currently the 50% rule, which is described later in the article). This change not only reduces costs and administrative burdens but also helps mitigate the risk of excessive purchasing of CBAM certificates.

d) Delegating the CBAM Reporting Obligation

One of the changes, which is also a considerable facilitation for importers, is the possibility of giving a third party access and the right to submit a CBAM declaration. This is addressed to declarants who do not have qualifications or operational capacity or intend to entrust the implementation of these obligations to external entities. These entities may be e.g. environmental or international trade consultants or experts who need to meet certain criteria in order to access the CBAM registry (e.g. have an economic operator registration and identification number, i.e. an EORI number established in a Member State by a customs authority). However, CBAM authorised declarants will remain responsible for all CBAM obligations, including the purchase and surrender of the correct number of CBAM certificates.

e) Verification of embedded emissions

Another change that will make it easier for importers to submit CBAM declarations is to dispense with the need to verify embedded emissions calculated on the basis of default values provided by the European Commission. Requiring verification of all embedded emissions, even if they are based on default values, would create operational difficulties and generate additional costs. For this reason, the European Commission has decided to simplify the declaration procedure by eliminating this formality. In addition, declarants will be free to choose which embedded emissions they wish to use in the preparation of the annual CBAM declaration – whether they will use actual values to calculate embedded emissions or default values which will include an additional 'mark-up' (the level of this mark-up will be specified in an implementing act). Where actual emissions cannot be determined, the importer will no longer be required to provide evidence of this (which could potentially involve third-country producers), and neither the European Commission nor the competent national CBAM authorities will be required to assess such evidence.

f) Special rules for 2026 and the sale of CBAM certificates

When discussing changes to the CBAM mechanism, the delay in the start of the sale of CBAM certificates cannot be overlooked. As a general rule, CBAM certificates should be sold from 2026 onwards, but due to delays, the Omnibus legislative package introduced a derogation from this rule. U Member States will sell certificates to authorised

declarants on a dedicated common central platform (CCP) as of 1 February 2027.

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What does this mean for importers? This means that they will not be able to purchase certificates 'on an ongoing basis' to cover the embedded emissions of imported goods in 2026. It is worth mentioning the so-called 50% rule, which, thanks to the Omnibus package, replaced the 80% rule (i.e. the quarterly obligation set out in Article 22 (2) of Regulation 2023/956). The CBAM Regulation requires authorised CBAM declarants to hold a certain number of certificates in their account in the CBAM registry, which should correspond, at the end of each quarter, to at least 50% of the embedded emissions of goods imported from 1 January of a given year. The change in the percentage from 80% to 50% aims to reduce the burden on operators covered by the mechanism, while maintaining the effectiveness of the control and safeguard measure against the risk of non-compliance. Therefore, due to these changes, the 50% rule will not apply in 2026. As a consequence, in 2027 importers will be burdened with the purchase of certificates to account for the embedded emissions in goods imported in 2026, as well as with the ongoing purchase of certificates for 2027. These changes have also been reflected in a special rule for determining the prices of those certificates for 2026. The general principle is that the European Commission will calculate the price of CBAM certificates as the average settlement price of EU ETS allowance auctions on the auction platform, in accordance with the procedures laid down in Delegated Regulation (EU) 2023/2830[10], for each calendar week (the so-called weekly prices, pursuant to Article 21(1) of Regulation 2023/956). For goods imported in 2026, however, this rule is based on so-called quarterly prices. The European Commission will calculate this price on the basis of the quarterly average closing price of EU ETS allowances on the auction platform. As a result, the price of CBAM certificates purchased in 2027 will reflect the level of EU ETS allowance prices applicable in 2026. This means that, in the case of imports of goods covered by the CBAM into the customs territory of the European Union in the second quarter of 2026, the importer will be required to purchase CBAM certificates in 2027 at a price determined on the basis of the average closing prices of EU ETS auctions from the second quarter of 2026.

> *The general principle is that the European Commission will calculate the price of CBAM certificates as the average settlement price of EU ETS allowance auctions on the auction platform, in accordance with the procedures laid down in Delegated Regulation (EU) 2023/2830[10], for each calendar week (the so-called weekly prices, pursuant to Article 21(1) of Regulation 2023/956).*

10 Commission Delegated Regulation (EU) 2023/2830 of 17 October 2023 supplementing Directive 2003/87/EC of the European Parliament and of the Council by laying down rules on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances (OJ L, 2023/2830, 20.12.2023).

Simplified methods for calculating embedded emissions

The European Commission, pursuant to Article 7 of Regulation 2023/956, is working on a delegated regulation that will set out a detailed methodology for calculating embedded emissions. At the same time, the experience gathered during the transition period has enabled the European Commission to identify simplifications, which have already been incorporated at the stage of developing the Omnibus package. This concerns, for example, the exemption from the obligation to account for embedded emissions of precursors (CBAM goods used as input materials in the production of the final CBAM good) produced within the European Union. During the transition period, precursors produced in the EU that are used in the production of CBAM goods in third countries must be taken into account when determining embedded emissions. For example, under the transitional period, a third country producer producing mixed fertilizers and using input materials (ammonia and urea) from an EU-based installation covered by the EU ETS is required to obtain information on the embedded emissions of ammonia and urea to add them to the calculation of the embedded emissions of its mixed fertilizers. Subsequently, the relevant carbon price under the EU ETS that has already been paid to the Union producer shall be fully deducted from its CBAM financial commitment in order to avoid double counting[11]. Such an approach increases the administrative burden associated not only with the process of calculating embedded emissions but also with reporting obligations. Under the approach adopted in the Omnibus package, precursors produced in the EU (or in countries or territories excluded from the CBAM pursuant to Annex III to the CBAM Regulation), which are covered by the EU ETS and for which the greenhouse gas emission cost has been paid, are assigned zero embedded emissions when calculating the individual embedded emissions of CBAM goods. The quantity and origin of these precursors will only be monitored and reported during the verification process.

An important element of the new regulations on calculating embedded emissions is the exclusion of certain production processes associated with the final stage of manufacturing. The embedded emissions of some aluminium and steel products currently covered by the CBAM depend primarily on the embedded emissions of input materials; that is, most embedded emissions arise from the production of their precursors, while the share of emissions generated at the final stages of production is typically low. These final production stages include finishing processes carried out by separate installations not covered by the EU Emissions Trading System (EU ETS), except for integrated installations. One example of this issue is the production of CN codes falling under HS code 7318 (screws, nuts, etc.). The input materials for these products (e.g., wire rod) undergo production processes to manufacture the final goods. In the EU, such processes (e.g., cutting, forging) are typically performed by installations not covered by the EU ETS and generally account for a relatively small share of total embedded emissions[12]. Therefore, in order to ensure consistency with EU ETS rules and to simplify the application of CBAM

11 Commission Staff Working Document, Accompanying the document Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2023/956 as regards simplifying and strengthening the carbon border adjustment mechanism.

12 Commission Staff Working Document, Accompanying the document Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2023/956 as regards simplifying and strengthening the carbon border adjustment mechanism.

requirements for operators in third countries, embedded emissions associated with these production processes have been excluded from the emission-calculation boundaries. This exclusion further focuses the CBAM methodology and its scope on high-emission processes.

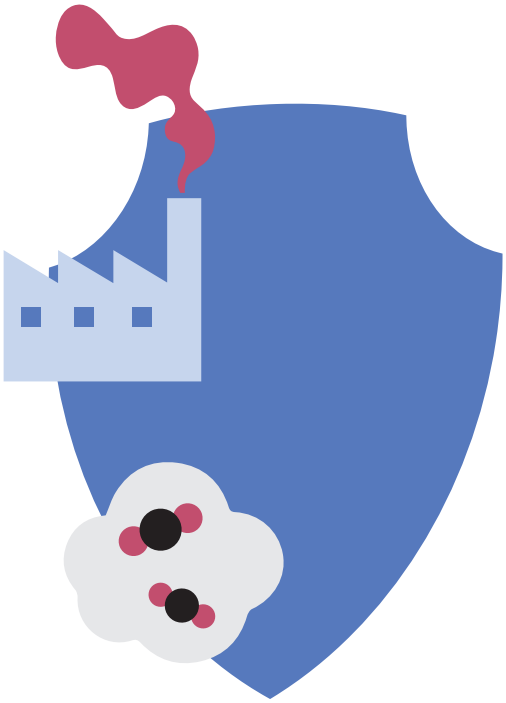
In the revised version of the regulation, additional changes have been introduced, such as the exclusion of non-calcined kaolin clay from the scope of the CBAM and the inclusion of electricity as a good in Annex II to Regulation 2023/956, which lists goods for which only direct emissions are to be taken into account when calculating embedded emissions. Although these changes are of a clarifying nature, they play an important role in the practical application of CBAM rules. Non-calcined clays are not highly emission-intensive and therefore pose a lower risk of carbon leakage; moreover, they are one of the main raw materials used in ceramic production—a sector that is currently not covered by the CBAM. A precise definition of the scope of goods subject to the mechanism, as well as of the types of emissions to be included, is essential for the proper fulfilment of reporting obligations by obligated entities and for ensuring compliance with regulatory requirements.

Reduced formalities, enhanced responsibility

The proposed changes introduced under the Omnibus package bring a number of significant simplifications for importers, which will undoubtedly result in substantial administrative and operational relief. However, this does not imply that obligations have been reduced across the board. Several of the proposed solutions introduce new responsibilities for both national CBAM authorities and the European Commission. One such responsibility is the monitoring of the 50-ton threshold by both entities, aimed at identifying potential attempts to circumvent the applicable regulations. The European Commission and national CBAM authorities will monitor the unified mass threshold from the beginning of 2026 on the basis of customs data obtained through the Surveillance system, which facilitates communication between the customs authorities of the Member States and the Commission for customs-supervision purposes. If an importer who does not hold the status of an authorised CBAM declarant exceeds the single mass-based threshold, this information - once verified by the national authority - will be transmitted to the customs authorities. Consequently, the customs authorities will prohibit further imports of goods by that importer until the end of the calendar year or until the importer obtains authorised CBAM declarant status. Moreover, such importers are subject to an administrative monetary penalty pursuant to Article 26(2a) of Regulation 2023/956.

A completely new obligation for national CBAM authorities is the registration of accredited verifiers in the CBAM registry, which will entail a range of additional organisational and supervisory tasks. It will be necessary to ensure that verifiers applying for access to the registry meet the required qualitative and formal criteria. Furthermore, the legal provisions specify the conditions under which they may be removed from the registry. Consequently, continuous management of the registry and its regular updating will be required on the part of CBAM authorities in the EU Member States. This process will, however, facilitate the reporting obligations of declarants, as it will enhance the quality and reliability of data on embedded emissions.

It is also worth noting that it will simplify the review of verification reports for the European Commission and the competent national authorities, since the integrity and authenticity of the data will no longer require manual checks but will instead rely on a system-based approach, thereby improving data comparability.



Under the new regulations, an additional obligation has been imposed on the European Commission to develop and publish a list of greenhouse gas emission charges for individual third countries, based on the actual emission fee paid and averaged over the year (expressed in EUR/tCO_2). These values are necessary for deducting such charges from the obligations of an importer who has brought a CBAM good into the European Union – i.e., for reducing the number of certificates required for surrender. This mechanism prevents double charging for CO_2 emissions and thereby promotes the application of greenhouse gas emission fees in third countries. In determining these values, the Commission will rely on the best available data derived from credible, publicly accessible sources as well as information provided by third countries. Consequently, the emission-fee values will be subject to periodic review. However, the deduction of the emission fee determined by the Commission will be possible only when the declarant calculates embedded emissions in the CBAM declaration on the basis of default values. This represents a significant simplification for importers who are unable to use actual embedded-emission values in their CBAM declarations. Evidence gathered during the transitional period indicates that declarants subject to reporting obligations face difficulties in obtaining the required information on the emission fee actually paid in the third country. This approach therefore provides both producers and declarants with additional flexibility, while simultaneously enabling the European Commission to develop a practical method for deducting greenhouse gas emission charges.

Cbam - the future full of challenges

Despite the numerous simplifications introduced through the Omnibus package, the future of the mechanism continues to present a range of challenges that will require further work and action. Pursuant to Article 30(2) and (3) of Regulation 2023/956, the European Commission is required to present a review report on the CBAM by the end of 2025. This document will include, among other elements, an assessment of the transitional period, an analysis of the mechanism's impact on third countries and on international cooperation, as well as planned actions for 2026–2027, including the extension of the CBAM to downstream goods and the development of an approach to preventing circumvention. The report will also consider the potential expansion of the CBAM after 2027 to cover indirect emissions, transport-related emissions, and the gradual inclusion of goods from additional sectors.

Preliminary conclusions are likewise expected regarding the effectiveness of the mechanism, both in terms of its technical functionality and its ability to achieve its core objectives - namely, preventing carbon leakage and supporting the competitiveness of EU producers. This report will certainly set a new course of action to address the weaknesses of the mechanism and strengthen anti-abuse rules.

> *Pursuant to Article 30(2) and (3) of Regulation 2023/956, the European Commission is required to present a review report on the CBAM by the end of 2025. This document will include, among other elements, an assessment of the transitional period, an analysis of the mechanism's impact on third countries and on international cooperation, as well as planned actions for 2026–2027, including the extension of the CBAM to downstream goods and the development of an approach to preventing circumvention.*

Particular attention should be paid to the issue of exports to third countries of goods related to CBAM produced in the European Union. The European Steel and Metal Action Plan[13] highlights the potential risk of carbon leakage in relation to metals produced in the EU, which are subject to carbon pricing under the EU ETS and exported to third countries, thereby losing competitiveness compared with producers based in jurisdictions with lower climate ambitions. This risk of carbon leakage may also shift to downstream goods, for example through minor modifications to basic CBAM products. In addition, companies manufacturing or processing CBAM-related goods in the EU may relocate their activities to third countries. In its strategy, the European Commission has announced that it will propose measures to address the identified risks in this area, including legislative amendments. Given the urgent need for clarity, the Commission is considering work on expanding and strengthening the CBAM. It must be emphasised, however, that any proposed solutions must comply with the rules of the World Trade Organization (WTO).

> *The European Steel and Metal Action Plan[13] highlights the potential risk of carbon leakage in relation to metals produced in the EU, which are subject to carbon pricing under the EU ETS and exported to third countries, thereby losing competitiveness compared with producers based in jurisdictions with lower climate ambitions.*

Even after the simplifications introduced, the CBAM remains a mechanism that is not yet fully developed. Although its fundamental legal framework has been established, it continues to evolve dynamically. The European Commission is required to adopt a series of delegated and implementing acts that will specify key aspects of the mechanism's operation. These acts will concern, among other matters, the calculation of embedded emissions, the accreditation of verifiers and verification rules, the conditions for the sale and repurchase of CBAM certificates, CBAM declarations, and the treatment of greenhouse gas emission charges.

13 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - A European Steel and Metals Action Plan, COM(2025)125 final.

Summary

The simplifications to the CBAM mechanism introduced under the Omnibus package are crucial for ensuring its efficient operation. They represent a significant step toward a more robust and effective mechanism that achieves climate objectives without imposing excessive burdens on businesses. The way in which the mechanism is ultimately shaped will be of great importance for its future functioning and for supporting EU industry in its decarbonisation efforts by preventing carbon leakage and maintaining industrial competitiveness. The consequences of the newly introduced measures will become apparent in the coming years, and only then will it be possible to assess their effectiveness. However, the challenges already emerging today require the mechanism to be continuously adapted to evolving circumstances, which is why the consistent improvement of its functioning remains essential.

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Accreditation and verification issues in CBAM

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Accreditation and verification issues in CBAM[1]

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Summary

Annual embedded emissions released during the production of CBAM goods from 2026 onwards should be verified by an independent, accredited verifier, if they have been calculated using actual values. A non-EU entity with legal personality may become a CBAM verifier after successfully completing accreditation by a National Accreditation Body[2] (NAB) located in the European Union (EU). Accreditation activities and supervision of verifiers are to be carried out in relation to groups of activities, in accordance with aggregate categories of goods, with separate types of activities being electricity imported into the customs territory of the European Union and indirect emissions. A verifier who obtains an accreditation certificate will be able to verify annual emissions generated during the production of CBAM goods at an installation located in a third country, in accordance with its scope of accreditation. The basis for the verification process is a monitoring plan drawn up by the installation operator. However, this plan will not be subject to approval by the competent authority but will be checked by the verifier for compliance with the requirements of the CBAM methodology. Regulations have also been introduced that will allow the verifier to outsource certain verification activities to subcontractors. After conducting an audit at an installation, the verifier will issue a verification report on the operator's annual emissions report, indicating whether the report is free from misstatements and non-compliance. The verification report should be issued in the CBAM registry, in English, and will be one of the elements of the CBAM declaration submitted by authorised declarants. For the purposes of CBAM, mechanisms for peer evaluation of NABs and mutual recognition of verifiers are also envisaged. In addition, close coordination between the competent authorities and the European Commission is necessary for the review of CBAM declarations, as well as regular exchange of information between the competent authorities and national accreditation bodies regarding accreditations issued, as part of the supervision of verifiers.

Reliable verification of reported data plays a fundamental role in ensuring the credibility of the CBAM system. Since each emission unit is assigned a certain market value (price) and each tonne of emissions generates financial consequences for the company covered by the mechanism, it is necessary to confirm the accuracy and correctness of the emission volumes reported by authorised declarants. This gives market participants the certainty that 1 ton of CO_2 emissions in one country is exactly equal to 1 ton of CO_2 emissions reported in another, which in turn translates into the credibility of allowance and certificate prices.

Regulation 2025/2083[3] amended Regulation 2023/956[4], removing the requirement to verify emissions calculated using default values during the definitive period. This change will reduce the annual number of required verifications, consequently reducing the demand for verifiers and the number of necessary accreditations. In December 2025, two legal acts were published in the Official Journal of the European Union, which established binding rules for accreditation and verification in CBAM:

- Commission Delegated Regulation (EU) 2025/2551 of 20 November 2025 supplementing Regulation (EU) 2023/956 of the European Parliament and of the Council by specifying the conditions for granting accreditation to verifiers, for the control and oversight of accredited verifiers, for the withdrawal of accreditation and for mutual recognition and peer evaluation of accreditation bodies[5] (hereinafter referred to as Regulation 2025/2551)

and

- Commission Implementing Regulation (EU) 2025/2546 of 10 December 2025 on the application of the principles for verification of declared embedded emissions pursuant to Regulation (EU) 2023/956 of the European Parliament and of the Council[6] (hereinafter referred to as Regulation 2025/2546).

The paper provides an overview of the requirements set out in these regulations.

Authorized CBAM declarants may calculate the annual amount of embedded emissions released during the production of CBAM goods based on actual values or default values. With regard to embedded emissions associated with goods imported into the customs territory of the Union, from January 1, 2026, where actual values are used, emission reports should be verified by independent verifiers accredited by the national accreditation bodies of the Member States of the European Union.

1 CBAM – Carbon Border Adjustment Mechanism.

2 Pursuant to the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93 (OJ L 218 z 13.8.2008, p. 30, as amended).

3 Regulation (EU) 2025/2083 of the European Parliament and of the Council of 8 October 2025 amending Regulation (EU) 2023/956 as regards simplifying and strengthening the carbon border adjustment mechanism (OJ L, 2025/2083, 17.10.2025).

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6 Commission Implementing Regulation (EU) 2025/2546 of 10 December 2025 on the application of the principles for verification of declared embedded emissions pursuant to Regulation (EU) 2023/956 of the European Parliament and of the Council (OJ L 2025/2546, 22.12.2025).

With regard to embedded emissions associated with goods imported into the customs territory of the Union, from January 1, 2026, where actual values are used, emission reports should be verified by independent verifiers accredited by the national accreditation bodies of the Member States of the European Union."

The CBAM declaration, submitted by an authorised CBAM declarant to the CBAM registry[7], must then be accompanied by an emissions report for the installation concerned and a verification report. An accredited verifier will verify the emissions report at the request of the operator of the installation in a third country and issue a verification report on that report. Each CBAM verifier, after obtaining accreditation, is required to submit an application for registration in the CBAM registry, and in the event of loss of accreditation, they will be deregistered.

"Each CBAM verifier, after obtaining accreditation, is required to submit an application for registration in the CBAM registry, and in the event of loss of accreditation, they will be deregistered."

The CBAM registry will also record all verification reports issued by accredited verifiers, which will be subject to checks and controls by both the competent authority of the Member State, determined according to the location of the authorised CBAM declarant, and the European Commission.

On December 22, 2025, the European Commission published delegated and implementing regulations relating to accreditation and verification in the CBAM. The delegated regulation specifies the conditions for national accreditation bodies to issue accreditation for CBAM purposes, introduces rules for the control and supervision of accredited verifiers, as well as regulates the mutual recognition and peer evaluation of accreditation bodies. On the other hand, the implementing regulation lays down rules for the verification of emissions, the qualification of verifiers, and format for the verification report of the CBAM emissions report. Where applicable, both acts have implemented the rules set out in Regulation (EU) 2018/2067[8] (hereinafter: Regulation 2018/2067), taking into account the differences between CBAM and EU ETS, which include:

- verification is carried out at the level of an installation located outside the jurisdiction of the European Union, in relation to emissions embedded in goods covered by CBAM, produced in that installation;
- responsibility for submitting a correct declaration lies with authorised declarants and not with installation operators;
- the report may appear in multiple declarations submitted in different countries, so its revision may be subject to action by competent authorities from different Member States;
- the verification activities differ from those currently in force in the European Union Emissions Trading System (EU ETS);
- the rules for calculating embedded emissions differ from those in force in the EU ETS.

7 Commission Implementing Regulation (EU) 2024/3210 of 18 December 2024 laying down rules for the application of Regulation (EU) 2023/956 of the European Parliament and of the Council as regards the CBAM registry (OJ L, 2024/3210, 30.12.2024), as amended.

8 Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council (OJ L 334, 31.12.2018, pp. 94–134).

Scope of CBAM accreditation and activity groups

The purpose of accreditation and ongoing supervision of verifiers is to confirm the competence, impartiality and independence of verifiers and to ensure that the verifier complies with legal requirements[9]. Current CBAM regulations do not allow accreditation to be issued by accreditation bodies from third countries, nor is there a requirement for verifiers to be based in the European Union, and only entities with legal personality may become verifiers. Accreditation obtained for a given type of activity under the EU ETS cannot be automatically extended to the accreditation of CBAM verifiers.

> *Accreditation obtained for a given type of activity under the EU ETS cannot be automatically extended to the accreditation of CBAM verifiers.*

Under the EU ETS, national accreditation bodies carry out accreditation and supervision activities separately for each activity group specified in Annex I to the EU ETS Directive[10]. The certificate, issued after successful accreditation, contains a list of the activity groups for which the verifier may carry out verification activities. With regard to CBAM, the solution is to accredit groups of activities in line with the aggregate categories of goods.

> *With regard to CBAM, the solution is to accredit groups of activities in line with the aggregate categories of goods.*

Aggregated categories of goods were originally specified in the annex to Regulation 2023/1773[11]. In addition, separate activity groups (scopes of accreditation) will be required for the verification of electricity as a CBAM commodity and indirect emissions. Activity No. 98 concerns the verification of data on the allocation of free emission allowances and is required in CBAM for the verification of the adjustment reflecting the free allocation in the EU ETS (Table 1).

9 World Bank.(2019). Designing accreditation and verification systems. A guide to ensuring credibility for carbon pricing instruments (https://documents1.worldbank.org/curated/en/256881550773558761/pdf/134801-WP-PUBLIC-21-2-2019-11-52-9-PMRReportPagesOnlineCompressed.pdf; accessed: 15.01.2026).

10 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC (OJ L 275, 25.10.2023, p. 32), consolidated version of 1 March 2024.

11 Commission Implementing Regulation (EU) 2023/1773 of 17 August 2023 laying down the 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 during the transitional period (OJ L 228, 15.9.2023, p. 94).

Table 1. Aggregate categories of CBAM goods and corresponding types of EU ETS activities.

CBAM activity group No	Scope of accreditation	Activity groups pursuant to Annex I to Implementing Regulation (EU) 2018/2067
Aggregated goods category		
I	Calcined clay	1a, 1b, 6, 98
	Cement clinker	
	Cement	
	Aluminous cement	
II	Hydrogen	1a, 1b, 8, 98
	Ammonia	
III	Nitric acid	1a, 1b, 9, 98
IV	Urea	1a, 1b, 98
	Mixed fertilisers	
V	Sintered Ore	1a, 1b, 3, 98
	Pig Iron	
	DRI (direct reduced iron)	
	Crude Steel	
VI	Ferro alloys (FeMn, FeCr, FeNi)	1a, 1b, 4, 98
VII	Unwrought aluminium	1a, 1b, 4, 5, 98
VIII	Iron or steel products	1a, 1b, 4, 98
	Aluminium products	
Other activities		
L	Carbon capture, utilisation and storage (CCUS)	10, 11
LI	Electricity imported into the custom territory of the Union	n/a
LII	Indirect emissions	n/a

Source: Annex I to Regulation 2025/2551.

The identification of accreditation scopes for each type of CBAM activity (aggregate category of goods) serves another important function. Each activity group corresponds to a specific type of production process, a different commodity, and different monitoring boundaries. The national accreditation body assesses (and confirms) whether the verifier actually has the competencies required for its scope of accreditation.

An entity accredited for a given group of activities in the EU ETS will be able to apply for an extension of its accreditation to a specific group of activities in CBAM or apply for a new accreditation for CBAM purposes only. In the case of an application for extension of accreditation, the national accreditation body must take into account accreditations issued under the EU ETS when assessing the qualifications of the CBAM verifier.

> *In the case of an application for extension of accreditation, the national accreditation body must take into account accreditations issued under the EU ETS when assessing the qualifications of the CBAM verifier.*

After a positive assessment of the candidate for a verifier, NAB issues a decision to grant (renew, extend the scope of) accreditation to the applicant. The decision will be confirmed by a certificate containing the following information:

- the identity of the national accreditation body,
- the name and unique accreditation identification of the verifier,
- the scope of accreditation and groups of activities,
- the country of establishment of the NAB and of the verifier,
- the effective date of accreditation and its expiration date,
- a reference to the normative documents used for the assessment.

A candidate verifier based in a third country seeking accreditation for CBAM purposes may submit an application to any national accreditation body located in an EU Member State[12].

> *A candidate verifier based in a third country seeking accreditation for CBAM purposes may submit an application to any national accreditation body located in an EU Member State[12].*

This solution will potentially increase the number of verifiers on the market, reduce administrative costs, and may also lower verification costs. However, it will place a burden on national accreditation bodies, which are required to conduct annual audits as part of their mandatory supervision of verifiers and, in the event of non-compliance with the requirements, may limit the scope of the verifier's accreditation, suspend it, or withdraw it. However, if for some reason the NAB is unable to consider an application, it should provide the entity with a list of other national accreditation bodies that can carry out this procedure.

Outsourcing verification activities to subcontractors

Under the EU ETS, subcontractors may be used, but only in accordance with the rules set out in the standards (ISO 14065:2020, ISO 17029:2019) and Regulation 2018/2067. Similar rules have been introduced in the CBAM. If an accredited verifier does not have the full set of competences or resources (auditors) to carry out a given assignment, they will be able to include an external expert in the verification team or transfer part of the work to another verifier, e.g., a local branch operating in the country where the installation is located. The first solution does not change the fact that the accredited verifier remains the only legal entity accountable to the national accreditation body in the EU, while in the second solution, the basic contract still links the verifier to the installation, although the installation operator must consent to the use of the services of an external entity. This model of working in CBAM will reduce travel and translation costs and make use of knowledge of national practices, but it will be subject to restrictions because the independent review and preparation of the verification report cannot be delegated and must be performed by an accredited CBAM verifier, who is responsible for the verification carried out and for the content of the verification report. The conditions for outsourcing are the conclusion of a legally binding agreement with a local entity, the consent of the installation operator, and the collection of objective evidence that the local verifier operates in accordance with EN ISO/IEC 17029: 2019, has the appropriate competence, maintains impartiality and independence, and knows and applies the relevant CBAM methodological principles. National accreditation bodies have also been authorized to supervise those

12 It concerns national accreditation bodies that carry out accreditation within the scope of CBAM.

bodies that have been commissioned to carry out verification work. The assessment of verifiers will therefore be possible both when granting accreditation and during annual supervision or special assessments. As a result, the openness to outsourcing verification activities to subcontractors is meant to go hand in hand with maintaining the responsibility and transparency of the verification process.

Verification and verification report

Verification in CBAM will be based on rules similar to those applicable in the EU ETS. The basis for monitoring, reporting, and verification (MRV) is a monitoring plan describing the methodology for collecting data, as specified in the regulations, for the purpose of calculating annual emissions. Likewise, in CBAM, the installation operator will be required to develop a monitoring plan in accordance with the CBAM methodology in order to assign emissions to CBAM goods. However, the monitoring plan will not be approved by the competent authorities and will not be part of the CBAM declaration. It is the accredited verifier who, as part of the annual verification activities, will analyse the latest version of the plan for compliance with the CBAM methodology and, if any irregularities are identified, will ask the installation operator to update the document. It is the job of the accredited verifier to act in the public interest, independently and with professional scepticism. A summary of the verification findings, including the verifier's opinion on whether the emissions report prepared by the installation operator is free from material misstatements and non-compliance, will be included in the verification report. Starting January 1, 2027, an accredited verifier will be required to issue a verification report in the CBAM registry, in English.

Starting January 1, 2027, an accredited verifier will be required to issue a verification report in the CBAM registry, in English.

The content of this document is to be visible to authorised declarants responsible for submitting declarations and available for review by the European Commission and competent authorities.

As in the case with the EU ETS, for the purposes of issuing a verification opinion in CBAM, a "materiality level" will apply, i.e., a threshold according to which the verifier assesses whether the combined impact of misstatements and non-conformities in the report is "material," meaning that it could influence the conclusions of the user of the emissions report. If the impact is not material, after correcting any errors in the emissions report, a satisfactory opinion on the installation operator's emissions report may be issued. The conclusions of the verification described in Table 2 remain applicable to the verifier.

Due to the specific nature of the mechanism, Regulation 2025/2546 sets materiality thresholds at the level of CBAM goods. When assessing irregularities in the declared data, the verifier should apply materiality levels to each ton of goods identified by CN code, with a materiality threshold of 5 % for both total specific embedded emissions and the allocation of free allowances for total specific embedded emissions.

Table 2. Conclusions from the CBAM report verification.

Verification status	Description
Satisfactory	Operator's emissions report is free from material misstatements
Unsatisfactory	Operator's emissions report contains material misstatements or non-conformities that were not corrected before issuing the verification report
	The scope of verification is too limited and the verifier could not obtain sufficient evidence to issue a verification opinion with reasonable assurance that the report is free from material misstatements
	Non-conformities, individually or combined with other non-conformities, provide insufficient clarity and prevent the verifier from stating with reasonable assurance that the operator's emissions report is free from material misstatements

Source: Author's own work based on Annex II to Regulation 2025/2551

In the event of misstatements, non-compliance, or failure to comply with the regulations, the verifier will ask the installation operator to correct them and will record these cases in the internal verification documentation. A similar process will apply to identified areas for improvement, both in terms of data flow and control activities, and in terms of emissions monitoring and reporting. If the verifier identifies areas for possible improvement in the operator's activities, they will include recommendations for improvement in the verification report and, during the verification carried out the following year, will check whether and how the operator has implemented these recommendations. The issuance of the verification report in the CBAM registry completes the verification process of the installation operator's report.

Mutual recognition of verifiers and peer evaluation of national accreditation bodies

The basis for mutual recognition of accreditation certificates throughout the EU is trust in national accreditation bodies, built through compliance with the requirements of Regulation 765/2008[13] in terms of independence, impartiality, and competence, as well as a system of peer evaluations coordinated by the European cooperation for Accreditation (EA). For the purposes of CBAM, it is assumed that the mechanisms for peer evaluation of NABs and mutual recognition of verifiers, as known from the EU ETS, will be transferred. Where a national accreditation body has not undergone a full peer evaluation process, Member States should accept accreditation certificates and verification reports from verifiers accredited by that national accreditation body only if the peer evaluation has already started or the NAB has successfully undergone peer evaluation before 2026 and demonstrates compliance with Regulation 2025/2551.

Where a national accreditation body has not undergone a full peer evaluation process, Member States should accept accreditation certificates and verification reports from verifiers accredited by that national accreditation body only if the peerevaluation has already started or the NAB has successfully undergone peer evaluation before 2026 and demonstrates compliance with Regulation 2025/2551.

However, the assessment of whether the conditions for this exemption are met remains the responsibility of the EA and requires the submission of an appropriate application. The exemption is to apply for a period of up to 4 years and, in the case

13 Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93 (OJ L 218, 13.8.2008, p. 30), as amended.

of NABs that have successfully undergone peer evaluation in accordance with Regulation 2018/2067, will be granted automatically.

Site visits

In the EU ETS, the rule is that the verifier conducts a physical audit of the installation as part of the verification activities. As part of the audit, the auditor checks the operation of measuring equipment, monitoring systems, installation boundaries, production processes, feedstock streams, emission sources, technical connections, etc., and the installation operator is required to provide access to the relevant locations. The auditor also interviews employees and checks how the data used for emission calculations is collected and processed. This allows them to confirm with sufficient certainty that the emissions report is free from material misstatements. For this reason, virtual visits to the site and cancellations of visits can only take place after strict conditions have been met. The CBAM verifier may conduct a virtual visit to the installation only if a physical visit took place in the previous year, there have been no significant changes to the monitoring plan, the auditor is familiar with the installations, and all necessary information can be obtained and assessed remotely.

The CBAM verifier may conduct a virtual visit to the installation only if a physical visit took place in the previous year, there have been no significant changes to the monitoring plan, the auditor is familiar with the installations, and all necessary information can be obtained and assessed remotely.

Simplified verification, where a visit to the installation (virtual or physical) is omitted entirely, requires the consent of the competent national authority in the EU ETS. In the case of CBAM, the rules are to be more flexible, but the decision not to organize a physical visit to the facility must be justified and recorded in the internal verification documentation.

Exchange of information between competent authorities and the European Commission

The European Commission and the competent national authorities will jointly review CBAM declarations and the accompanying verification reports. Since a single declaration may cover multiple installation emission reports and a single report may be used in multiple declarations, close coordination between the parties will be necessary. The verifier itself creates extensive internal documentation (strategic and risk analysis, verification plan, results of procedures, evidence collected before and during the site visit), but only the operator's emissions report and the verification report, with a brief description of the monitoring plan and precursors used, will be included in the declaration - the plan as such or reports on precursors or other evidence are not attached. The authorities reviewing the declarations may request access to additional materials from the verifier's internal documentation.

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In such a case, the verifier will be required to provide the requested documents via the CBAM registry within 30 calendar days of the request being made.

Exchange of information between the national accreditation body and the competent authority

Following the example of the EU ETS, there will also be a regular exchange of information between the national accreditation body and the national competent authority regarding the accreditation work program for the following year, with a description of the planned activities for each verifier and management reports summarizing the results of supervision and reassessment, complaints considered and any changes in accreditations. What is also expected is that the national competent authorities will share with each other and with the EC information from the above-mentioned documents and data on the initiation and results of the review of specific verification reports. The exchange of documentation is to take place via the CBAM registry. The national accreditation body will forward to the competent authority in which it is established any decision to grant, extend, or renew CBAM accreditation, together with the scope of accreditation, decisions to suspend, withdraw, or restrict the scope of accreditation and information on any lifting of the suspension of accreditation.

The national accreditation body will forward to the competent authority in which it is established any decision to grant, extend, or renew CBAM accreditation, together with the scope of accreditation, decisions to suspend, withdraw, or restrict the scope of accreditation and information on any lifting of the suspension of accreditation.

The rules for accrediting verifiers and verifying reports on emission volumes in CBAM are based on the achievements of the EU ETS, including proven MRV solutions, which, however, had to be adapted to the actual conditions and specific nature and structure of the new Carbon Border Adjustment Mechanism. As a result, from January 1, 2026, CBAM comes equipped with a set of binding rules, set out in Regulations 2025/2551 and 2025/2546, which, on the one hand, ensure the reliability of reported data and, on the other, improve the quality of monitoring and reporting of emissions by operators of installations located in third countries.

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The Role of Financing Mechanisms in the Development of CDR Projects in Europe and Poland in the Context of the CRCF Framework Implementation

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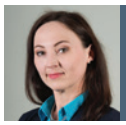

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Keywords: CRCF, carbon sink certification, carbon sinks, QU.A.L.ITY criteria, CDR, DACCS, BioCCS technologies, biochar, carbon farming, financing and funds, financial mechanisms, voluntary carbon market (VCM), carbon removals, carbon credits, climate neutrality.

Abstract

The aim of this article is to present the role of the EU Carbon Dioxide Removal Certification Framework (CRCF) as a tool supporting climate finance and an opportunity for the development of Carbon Dioxide Removal (CDR) projects in Europe and Poland.

The first part of the article presents the new logic for supporting climate action stemming from the CRCF Regulation, which introduces an EU certification system for CO_2 removal technologies and practices. It discusses key quality criteria (QU.A.L.ITY), monitoring and verification mechanisms, and potential technologies such as DACCS, BioCCS, biochar, and carbon farming. The importance of the CRCF for increasing the transparency of the CDR market and reducing the risk of greenwashing is emphasised.

The second part of the article analyses the impact of the CRCF on the development of the CDR market in Poland, identifying both opportunities and challenges. It highlights the potential of regenerative agriculture, the potential for offsetting emissions in energy-intensive industries, the development of climate start-ups, and innovation in construction. Existing barriers, such as the high cost of technology, and low public awareness, are discussed, along with ways to overcome them through certification and education.

The third part presents financing sources for CDR projects, including EU funds (Horizon Europe, LIFE, Innovation Fund), national climate funds and programs (KPO, FEnIKS, NFOŚiGW), and market mechanisms. The emerging EU programme for the purchase of permanent removal units plays a particularly important role, as it is intended to ensure stable demand for certified technologies and accelerate their commercialisation. Supported by these instruments, the CRCF could become the foundation for the development of an innovative low-carbon economy in Poland.

In summary, the analyses presented in the article show that the CRCF is not merely a technical regulation, but a strategic tool supporting climate transformation and the development of innovation. Implementing uniform EU certification standards and financing mechanisms could create the foundation

for a new market for ecosystem services and CO_2 sequestration technologies. In this context, the Polish perspective is crucial – national success in this area depends on ensuring stable sources of financing, and broad public education.

A new logic for supporting pro-climate actions

The current approach to financing climate action has focused mainly on reducing or avoiding CO_2 emissions, i.e. mitigation. However, in recent years, the growing need to achieve climate neutrality has brought CO_2 removal into the spotlight. Implementing effective tools and solutions to support the development of removal initiatives and technologies is becoming indispensable. In this context, in 2024, Regulation (EU) 2024/3012 of the European Parliament and of the Council was adopted, establishing an EU certification framework for sustainable carbon dioxide removal, carbon-intensive techniques, and carbon storage in products (the so-called CRCF Regulation). The CRCF (Carbon Removal and Carbon Farming Certification Framework)[1] introduces a new logic: rewarding the active removal of CO_2 from the atmosphere rather than merely avoiding its emission into the atmosphere. This represents a significant paradigm shift that could trigger entirely new funding streams—both public and private.

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Thanks to the CRCF:

- CDR (Carbon Dioxide Removal)[2] projects finally gain measurable market value;
- there is now a real possibility to generate CO_2 removal units[3] that can be sold or used on the market;
- investors receive transparent frameworks for assessing risk and return on investment in climate projects;
- carbon farming practices[4], i.e., sustainable soil and forest management, can be certified as activities that remove CO_2 or reduce emissions, opening up access to additional funding sources for farmers and foresters.

1 The CRCF is a voluntary EU regulatory framework for the certification of activities related to the removal of carbon dioxide from the atmosphere. It is part of the EU's strategy to achieve climate neutrality by 2050. It was established by Regulation (EU) 2024/3012 of the European Parliament and of the Council of 27 November 2024 on the establishment of a Union framework for the certification of sustainable carbon dioxide removal, carbon-intensive techniques and carbon storage in products (the CRCF Regulation).

2 CDR is a set of technologies and practices that actively remove CO2 from the atmosphere and permanently store it – in soil, vegetation, products or geological structures, i.e. DACCS (direct air capture), BioCCS (bioenergy with CO2 capture and storage), biochar (BCR), afforestation/reforestation, regenerative agriculture (carbon farming), enhanced rock weathering (ERW), marine techniques (ocean alkalization, wetland management).

3 For the purposes of this article, the terms "CO2 removal units", "offsets" and "carbon credits" are treated used interchangeably, each representing one metric tonne of CO2 equivalent.

4 Carbon farming (also known as regenerative agriculture) refers to a set of agricultural and forestry practices aimed at removing CO2 from the atmosphere (R) and reducing greenhouse gas emissions (M). These practices include actions that increase carbon sequestration in soil, plants, and trees, improve soil structure and fertility, and reduce methane and nitrous oxide emissions from agriculture. Examples of such practices include no-till farming (M), the use of cover crops and catch crops (R/M), afforestation and agroforestry (R), manure and fertilizer management (M), and rotational grazing (R/M).

CRCF as a driver for innovation

The CRCF not only certifies – it motivates concrete actions targeted at removing CO_2 from the atmosphere. The CRCF aims to create credible, uniform certification standards in the EU that can be used in the Voluntary Carbon Market (VCM)[5]. This will make European carbon credits more transparent and resistant to greenwashing[6]. The introduction of clear quality criteria (QU.A.L.ITY) means that entities (companies) must invest in technologies that comply with the following principles[7]:

- **Qu**antification – CO_2 removal must be measured accurately, conservatively, and transparently;
- **A**dditionality – actions must go beyond standard practices and legal requirements;
- **L**ong-term Storage – it must be demonstrated that carbon is stored permanently or for an extended period, with appropriate monitoring and accountability mechanisms;
- Sustainabil**ity** – actions must not cause significant harm to the environment (DNSH principle – Do No Significant Harm) and should generate additional benefits for sustainable development goals;
- and Traceability – it is necessary to ensure the ability to track and verify data and certificates;
- Integrity – actions must comply with applicable regulations and ethical standards.

> *The CRCF aims to create credible, uniform certification standards in the EU that can be used in the Voluntary Carbon Market (VCM)[5]. This will make European carbon credits more transparent and resistant to greenwashing[6].*

As a result, the CRCF may stimulate the development of technologies and techniques such as:

- DACCS (Direct Air Capture and Storage) – economic, research, and industrial activities related to capturing carbon dioxide (using chemical sorbents or solvents) directly from the atmosphere and then permanently storing it in geological formations;
- Bioenergy with CO_2 Capture and Storage (BioCCS) – an area of economy and technology focused on producing bioenergy combined with the capture and permanent storage of carbon dioxide in deep geological formations, which can support the decarbonization of hard-to-abate sectors such as heavy industry, aviation, and road transport;
- Biochar – a practice involving the processing of biomass (e.g., plant residues, wood, manure) under limited oxygen conditions (pyrolysis) to create a stable form of organic carbon. This process transforms organic matter into a durable carbon material that can be used mainly in agriculture and environmental protection, supporting the circular economy and CO_2 sequestration;

5 The VCM market, or Voluntary Carbon Market, is a dynamically developing space where companies, organizations, and individuals can offset their greenhouse gas emissions by purchasing so-called carbon credits.

6 Greenwashing (often referred to in Polish as "ekościema" or "zielone mydlenie oczu") is a practice in which a company, organization, or institution presents its actions as environmentally friendly, while in reality they do not meet the appropriate environmental standards.

7 Quality criteria set out in Articles 4 – 7 (Chapter 2) of Regulation (EU) 2024/3012.

- Regenerative agriculture (carbon farming) and agroforestry – the practice of integrating trees and shrubs with crop cultivation or livestock farming on the same land, e.g., planting trees among crop fields, hedgerows as natural fences and wildlife shelters, or pastures with trees providing shade and improving the microclimate;

- Production of CO_2 - absorbing building materials (conditionally) – innovative solutions that not only reduce emissions, but actively remove carbon dioxide from the atmosphere during use or production, such as bio-cement with cyanobacteria, concrete with biochar additives, or cement produced via electrolysis[8].

An important, yet still missing element of the CRCF are methodologies for specific types of activities aimed at removing CO_2 from the atmosphere, which are gradually being developed by the European Commission (hereinafter: EC), in co-operation with the EU Expert Group on carbon removals (CREG).

It should be emphasized that the infrastructure for the EU carbon removal certification system is still taking shape. By the end of 2026, the plans to:

- finalize methodologies for selected types of CDR activities (see Table 1);
- establish an accreditation system for certification bodies;
- launch a registry for certificates and carbon credits.

It should be emphasized that the infrastructure for the EU carbon removal certification system is still taking shape.

Table 1. Current status of CRCF methodologies development (as of August 2025).

Type of activity	Status of work on the methodology
DACCS (Direct Air Capture and Storage) **BioCCS (Bioenergy + CCS)** **Biochar (BCR)**	• Draft methodology (delegated act on permanent sinks) published by the EC; • By 22 September 2025 – public consultations; • October 2025 – CREG meeting; • November 2025 – adoption by the EC; • December 2025 – Q1 2026 – scrutiny period by the EP and the Council of the EU; • Q1-Q2 2026 – publication in the Official Journal of the EU.
Regenerative agriculture (carbon farming)	• preliminary proposals in consultations with experts; • October 2025 – CREG meeting on the draft act; • Autumn 2025 – public consultations; • Q1 2026 – adoption by the EC; • Q1 2026 – scrutiny period by the EP and the Council of the EU; • Q2 2026 – publication in the Official Journal of the EU.
Afforestation / agroforestry*	Lack of full methodology
Carbon storage in products*	Waiting for detailed guidelines
Enhanced rock weathering (ERW)*	No methodology – in development and consultation phase

** These activities are not currently technically considered CDR due to the lack of durability and risk of storage reversibility, lack of clear process control, and issues with verification and certification (MRV).*

Source: Own study based on EC data.

8 Building materials can only be certified in the CRCF conditionally, as they require detailed verification of removal durability, additionality and compliance with sustainability principles.

In parallel with the development of methodologies for specific types of activities within the CRCF, intensive preparations are underway at the EU level to implement a third-party project verification system. This is one of the key pillars of CRCF implementation, intended to ensure the credibility, transparency, and quality of certified CO_2 removal activities.

> *A third-party project verification system is one of the key pillars of CRCF implementation, intended to ensure the credibility, transparency, and quality of certified CO_2 removal activities.*

The EC-approved certification system will be required to submit regular annual reports on its activities. Furthermore, it will verify whether the information submitted by entities applying for certification for CO_2 removal activities has been properly verified. The certification system will also be responsible for publishing, at least annually, a list of certification bodies, along with information about the body that approved them. The certification systems will monitor the activity of these entities and maintain a public register of CO_2 removal units[9]. Detailed guidelines for the systems will be specified in EC implementing regulations.

According to the EC's plans, the EU Registry – a central database that will collect certificates of compliance[10] and CO_2 removal units – is scheduled to launch in 2026, in parallel with the full implementation of the CRCF certification rules. Until then, work is expected to continue on the registry's technical structure, establishing interoperability standards, and consulting with stakeholders – companies, environmental NGOs, and Member States.

The above EC timelines confirm that 2026 will be a key year for the practical implementation of the CRCF – only then will eligible projects be able to be certified in accordance with the full rules. Full implementation of the CRCF should:

- create favourable conditions for the development of new business models, i.e. the sale of a new (innovative) product in the form of CO_2 removal units;
- launch an incentive system for companies to invest in research and development in order to meet the stringent QU.A.L.ITY criteria, which should drive the development of innovative clean technologies (Research + Development + Innovation, R+D+I);
- improve access to financing for investors engaging in green technologies by expanding the portfolio of products that allow them to

9 Carbon sequestration or soil emission reduction units, generated under the EU CRCF certification scheme, are equal to one metric tonne of CO2 equivalent and fall into four categories:

10 Permanent Removal Units (PRUs) – awarded for activities resulting in long-term (≥100 years) CO2 storage. This primarily applies to technologies such as geological CO2 storage (e.g., in salt or basalt formations), carbon mineralization (e.g., carbonation), and permanent CO2 sequestration in degradation-resistant materials;

11 Carbon Removal Units (CRUs) – awarded for biological CO2 removal through improved agricultural land management (e.g., carbon-intensive crops, agroforestry), peatland restoration, and increasing soil organic carbon;

12 Storage Removal Units (SRUs) – awarded for the permanent trapping of CO2 in materials with a long life cycle (≥35 years), such as structural timber, bio-based composites, and biocarbonate-containing building materials;

13 Emission Reduction Units (ERUs) – awarded for actions that reduce CO2, CH4, and N2O emissions from agricultural systems, such as optimizing nitrogen fertilization, limiting cultivation on organic soils, and managing soil moisture and structure.

14 A certificate of compliance is a statement of conformity issued by a certification body confirming that a given activity meets the requirements of the CRCF Regulation.

enter new markets, as well as enabling the real implementation of ESG[11] and CSR[12] strategies.

Furthermore, it should be noted that the inclusion of carbon removal units in the emissions accounting by installations covered by the EU ETS, currently under consideration as part of the EU ETS revision[13] and negotiations on the EU's 2040 target[14], will additionally stimulate the development of the CDR market by ensuring adequate demand for such units.

CRCF as an opportunity and a challenge for Poland

For Poland, the CRCF is not only a regulatory challenge but also a major opportunity. Poland can leverage its agricultural and technological potential to generate domestic carbon credits while supporting local economies.

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Regenerative agriculture (carbon farming)

Polish agriculture can become an important player in the newly emerging market for ecosystem services – for example, Polish regenerative agriculture (carbon farming), which involves implementing practices that increase the organic carbon content of soils. Poland has significant soil and agricultural potential to become one of the main beneficiaries of the transformation towards regenerative agriculture in Europe. Growing interest in this agricultural production model may attract investment, innovation, and public support. According to experts from the Terra Nostra Foundation[15], regenerative agriculture can reduce production costs by as much as 500-800 PLN/ha and increase the competitiveness of Polish farms. By allowing these activities to be certified as CO_2 removals and/or greenhouse gas emission reductions, farmers will gain the opportunity to generate carbon credits that can be sold to companies offsetting their emissions, creating an additional source of income for farmers in return for providing ecosystem services. These initiatives could also help Polish farmers improve access to financing from public funds (e.g., the CAP) and private funds (e.g., partnerships with food companies).

15 ESG (Environmental, Social, Governance) are the three pillars by which companies' responsibility and sustainability are assessed – not only financially but also ethically and ecologically. The EU's CSRD directive, despite simplifications introduced under the Omnibus I package, still requires many companies to report on ESG.

16 CSR (Corporate Social Responsibility) is a concept according to which companies should consider their social and environmental impacts in their business activities and take responsibility for them.

17 EU emissions trading system for maritime, aviation and stationary installations and market stability reserve – review, public consultations (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14549-EU-emissions-trading-system-for-maritime-aviation-and-stationary-installations-and-market-stability-reserve-review_en; accessed: 15/09/2025), including the position of KOBiZE presenting the Polish perspective in this respect: Feedback on EU emissions trading system for maritime, aviation and stationary installations, and market stability reserve – review (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14549-EU-emissions-trading-system-for-maritime-aviation-and-stationary-installations-and-market-stability-reserve-review/F3571523_en; accessed: 15/09/2025)

18 European Commission, EU Climate Law sets new targets for 2040, press release (https://ec.europa.eu/commission/presscorner/detail/pl/ip_25_1687; accessed: 15/09/2025)

19 K. Mirończuk, Regenerative agriculture is the future. How to implement change and achieve higher profits? (https://www.money.pl/gospodarka/rolnictwo-regeneratywne-to-przyszlosc-jak-przeprowadzc-zmiane-i-miec-wyzsze-zyski-6940755250489984a.html; accessed: 26/08/2025)

New opportunities for offsetting emissions and collaborating with the carbon dioxide removal market in energy-intensive industries.

As part of preparations for the revision of the EU ETS Directive, the European Commission is considering the possibility of including certified permanent CO_2 removal units (PRUs) as a recognized accounting element within the emissions trading system. This means that, in the future, entities covered by the EU ETS – particularly energy-intensive industries – will likely be able to use PRUs to offset emissions, especially those that are technologically unavoidable. This should significantly increase the market and operational value of these units.

This will be particularly important for industrial processes where CO_2 emissions are technologically unavoidable (e.g., limestone calcination in cement production). Other companies in energy-intensive sectors, such as steel, cement, or chemical production, will be able to reduce costs associated with CO_2 emissions. Moreover, mechanisms such as CBAM (Carbon Border Adjustment Mechanism)[16] and ESG reporting obligations will contribute to increasing the need to reduce the carbon footprint. Purchasing certified carbon credits is a real opportunity to transform Polish industry toward climate neutrality, especially in a situation where the still high share of fossil fuels in Poland's energy mix[17] makes emission offsetting a necessity rather than a choice. CRCF can help balance emissions during the transition period before the energy transformation reaches full scale.

Emerging sources of competitive advantage for climate start-ups.

Recently, the VCM market has been steadily growing, and CRCF certification could further accelerate this trend. Innovative climate start-ups can attract investors through certified CDR projects. With the implementation of CRCF, start-ups will be able to develop new business models by generating certified CO_2 removal units, selling them to companies offsetting emissions, and offering digital platforms for monitoring and trading credits. This will enable the creation of scalable, replicable business models. CRCF could not only increase their investment appeal but also allow for scaling activities across Europe.

A new paradigm in construction: buildings as climate assets.

The construction sector, once certain conditions are met, can play a significant role in promoting low-emission building and improving the energy efficiency of buildings (in line with the requirements of the EPBD Directive[18]) by implementing materials capable of absorbing CO_2, while taking into account the use of local components[19] and technologies (local content). The possibility

20 CBAM, or the Carbon Border Adjustment Mechanism, is a key instrument of the EU's climate policy aimed at preventing "carbon leakage," which occurs when high-emission production is relocated outside the territory of the Union.

21 According to the Forum Energii report titled Energy Transition in Poland. 2025 Edition, in 2024, 85% of Poland's primary energy came from fossil fuels (41% from coal, 27% from oil, and 17% from gas). Poland remains one of the most emission-intensive countries in the world in terms of the carbon intensity of primary energy consumption. In 2023, only Kuwait, South Africa, Kazakhstan, and China had more emission-intensive economies.

22 The Energy Performance of Buildings Directive – EPBD (2024/1275) requires new buildings to be zero-emission from 2030, and public buildings from 2028.

23 Local materials can be more easily monitored and certified according to CRCF principles, which facilitates meeting the QU.A.L.ITY criteria (measurement accuracy, additionality, durability and sustainability), and also reduces the carbon footprint of their transportation, which positively affects the GWP (Global Warming Potential) balance over the entire life cycle of the building.

of obtaining certified carbon credits for using CRCF-compliant materials could strengthen the position of Polish construction companies within the Voluntary Carbon Market (VCM).

However, challenges remain:

High implementation costs.

CO_2 removal technologies, particularly DACCS and BioCCS, remain highly capital-intensive and require further investments in infrastructure (e.g., installations, geological storage facilities for captured CO_2), financing of operational costs (energy, transport, monitoring), as well as research and development (R&D). Many of these technologies are still in the pre-commercial phase (e.g., DACCS), and their future costs and deployment timelines remain uncertain.

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For DAC technology[20], current estimates indicate that first-of-a-kind installation costs are €200-900/tCO_2 for L-DAC[21] (Liquid Direct Air Capture) and €600-2400 tCO_2 for S-DAC[22] (Solid Direct Air Capture), with significant reductions expected through R&D, economies of scale, and policy support. Future installations could see costs drop to €100-600/tCO_2 (L-DAC) and €100-1200/tCO_2 (S-DAC), with medians of €210-330/tCO_2 and €360/tCO_2, respectively. A significant cost factor in DAC technology is the need for solvents and sorbents, and the process itself indirectly relies on critical materials necessary for scaling up renewable energy.

Analyses from the CDR.fyi platform[23], which monitors the market for sustainable carbon dioxide removal, also confirm that the costs of sustainable CO_2 removal using BioCCS and DACCS will remain very high in 2030 – the average break-even point (BEP)[24] could reach \$212/tCO_2 and \$341/tCO_2, respectively, while some DACCS suppliers currently indicate over \$600/tCO_2. Even the cheapest CDR method – biochar, whose break-even point can drop to \$50/tCO_2 – is associated with significant investment costs, especially since most suppliers quote prices in the range of \$100-200/tCO_2 (see Fig. 1).

24 DAC (Direct Air Capture) is a technology for directly capturing carbon dioxide from the atmosphere, which does not involve a further stage of permanent storage.

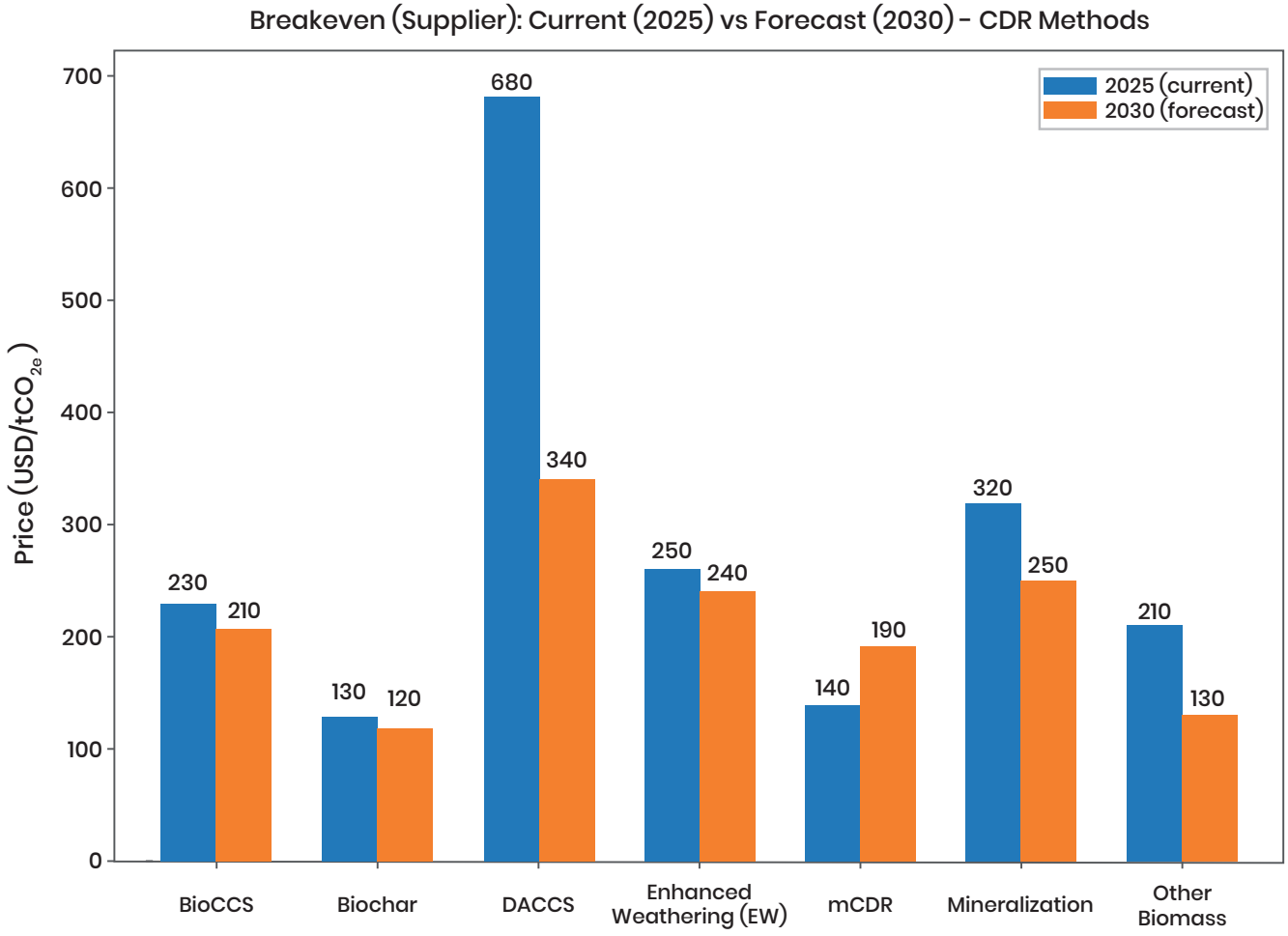
25 L-DAC is one of the variants of DAC technology that uses chemical liquids (e.g., KOH) to absorb CO2 from the air. Its advantages include scalability and proven processes, while its drawbacks are high energy and water consumption.

26 S-DAC is the second variant of DAC technology, which uses solid materials (sorbents) to absorb CO2 from the air. Its advantages include lower operating temperatures and modularity, while its drawbacks are limited industrial experience.

27 Bridging the Gap: Durable CDR Market Pricing Survey, CDR.fyi (https://www.cdr.fyi/reports/pricing-survey-jan-2025.pdf; accessed: 04/11/2025)

28 The breakeven cost (BEP) in the context of CDR technologies refers to the minimum price per tonne of CO2 at which the provider can cover all production, operational, and investment costs without incurring a loss. It is not a market price, but rather the profitability threshold below which a given project becomes unviable.

Figure. 1. Current and projected break-even points (BEPs) for CDR methods



Source: Bridging the Gap: Durable CDR Market Pricing Survey, CDR.fyi (https://www.cdr.fyi/reports/pricing-survey-jan-2025.pdf; accessed: 04/11/2025)

The need for public education

CDR is a relatively new topic and often misunderstood by the broader public. Challenges in this area include, among others, a low level of awareness (many people do not distinguish CDR from traditional carbon offsetting), a lack of trust in the information provided – resulting in widespread concerns about "technological greenwashing" and manipulation of facts – as well as insufficient communication, manifested by the absence of information campaigns that would explain the role of CDR in achieving climate neutrality. Therefore, broader education – inclusive in nature and involving, among others, public media – should cover not only society at large but also local governments, the construction sector, farmers, and entrepreneurs, who may become key participants in the emerging CDR market.

Despite numerous challenges, the implementation of CRCF can significantly facilitate project execution by providing a stable legal framework and available forms of financial support. In the context of Poland, where CDR projects are still at an early stage of development, CRCF can play a key role in overcoming institutional, financial, and technological barriers. CRCF can help address specific obstacles that have been detailed in Table 2.

Table 2. The potential of CRCF to remove major obstacles to the development of CDR projects in Poland.

Barrier to CDR development in Poland	How CRCF can help?
Lack of standards and definitions • Lack of unified terminology (e.g., interchangeable use of "CO_2 absorption, "CO_2 removal, "carbon sequestration") makes consistent planning and reporting difficult; • Lack of national MRV standards; • Lack of national methodologies for CO_2 removal; • Fragmented legal regulations.	**Standardization of certification rules** • In accordance with the CRCF Regulation (EU 2024/3012), every activity subject to certification must meet four QU.A.L.ITY criteria; • Certification is based on methodologies developed by the European Commission, which define, among other things, standard baseline levels, calculation rules, and documentation requirements; • Verification is carried out by independent, accredited certification bodies that assess the project's compliance with the methodology and quality criteria; • The European Commission will adopt delegated acts that specify monitoring, reporting, and verification (MRV) rules for different types of CDR activities; • The possibility of using established, recognized procedures and methodologies instead of developing new ones from scratch can accelerate the implementation of CDR projects; • Progressive standardization resulting from harmonized rules across the EU can facilitate certificate trading and comparability of CDR projects.
Low awareness within the sector • Limited knowledge of CDR technologies; • Lack of understanding of EU regulations; • Insufficient awareness of financing opportunities; • Low presence of the topic in public debate.	**Promotion and education as part of CRCF implementation** • Promotion and education are essential for the effective functioning of the system; • Dissemination of knowledge about CDR certification opportunities among businesses and public institutions through integrating CRCF into local climate strategies and training programs for certifiers, climate advisors, and local government representatives; • Education for farmers, foresters, and representatives of the energy sector on practices that can generate certified CO_2 removal units, including creating knowledge platforms and digital tools that provide access to methodologies, emission calculators, and examples of best practices; • Building public trust in certification mechanisms and their impact on climate and the economy by supporting educational and research institutions in developing curricula on CDR and sustainable development, media campaigns, and dialogue with local stakeholders.
Difficulties in financing CDR projects • Insufficient public support mechanisms; • Lack of dedicated financing instruments; • High investment and operational costs; • Regulatory uncertainty – the unregulated legal status regarding support for CDR development creates significant uncertainty, making planning and investment in this area difficult.	**Carbon credits as a new source of income** • They can provide a new source of income for farmers, foresters, and industrial enterprises implementing practices such as agroforestry, regenerative agriculture, afforestation, or technologies like BioCCS, DACCS, and biochar. Selling certified CO_2 removal units can create an additional revenue stream alongside energy, biomaterials, or agricultural products, improving investment profitability and shortening payback periods. Projects generating carbon credits can attract capital from climate funds, ESG investors, and financial institutions seeking green assets; • Additionally, the EU purchasing program offers opportunities for companies, farms, and research institutions to monetize climate-positive actions, especially in countries like Poland, which have significant soil and agricultural potential.

Source: Own elaboration

As a result, CRCF can not only support the development of domestic CDR projects but also strengthen Poland's position in European climate policy, enabling its active participation in cross-border mechanisms for emission reduction and carbon dioxide sequestration.

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Sources of financing for CDR projects

Activities covered by CRCF can be financed from various sources, both public and private – since the main objective of the regulation is to promote and implement CDR technologies and practices. The main financing options are as follows:

Public financing:

- **EU funds** – projects certified under CRCF may apply for support from the following EU programs:
    - **Horizon Europe** - the largest EU research and innovation program (with a budget of €95.5 billion for 2021-2027), supporting projects that develop new CO_2 removal technologies (e.g., DAC, CCS, bio-sequestration), create monitoring and verification systems for carbon removal, and integrate environmental actions with digital and energy transition. CDR projects can be implemented as part of international research consortia, particularly under the "Global Challenges and European Industrial Competitiveness" cluster. The EIC Transition program, a financial instrument of the European Innovation Council (EIC) under Horizon Europe, supports the transition from basic research to technology validation and commercialization readiness. It enables the development of technologies from TRL 3/4 to TRL 5/6[25] and is intended for projects based on results of previous EU initiatives such as EIC Pathfinder[26] , FET[27], and ERC PoC[28];
    - **The LIFE programme**, an EU financial instrument dedicated to the protection of the environment, nature, and climate (with a budget of €3.488 billion for the "Environment" and €1.944 billion for "Climate Action" areas for the years 2021-2027), supports activities related to regenerative (carbon) agriculture, projects that enhance the durability of CO_2 absorption by ecosystems, and the implementation of innovative solutions in land management and green infrastructure. LIFE is particularly attractive

29 The TRL scale (Technology Readiness Level), which defines the levels of technological maturity, indicates the degree of advancement of research, work, or a product – from concept to commercialization – and measures the ability to bring a solution to market. This method allows for comparing the development stages of technologies across completely different scientific fields. The TRL scale consists of 9 levels.

30 EIC Pathfinder is a research and innovation funding program managed by the European Innovation Council (EIC) under the Horizon Europe framework. Its goal is to support breakthrough, visionary research projects that can lead to the creation of radically new technologies.

31 The FET program (Future and Emerging Technologies) is an EU initiative that supports groundbreaking scientific research and the development of technologies with the potential to change paradigms in science, the economy, and society. FET funds highly promising, high-risk research projects that may lead to the creation of radically new technologies. Its goal is to go beyond established patterns and discover entirely new development paths.

32 ERC PoC (ERC Proof of Concept) is a special grant from the European Research Council that helps researchers transform research results into practical applications – both commercial and societal.

for plantation owners, local authorities, and NGOs implementing local initiatives in line with CRCF principles;

- **The Innovation Fund,** one of the world's largest programs supporting breakthrough climate technologies (with an estimated budget of €50 billion for the years 2021-2027), finances the development and deployment of CO_2 capture and storage technologies, installations using renewable energy sources, as well as projects aimed at improving energy efficiency and reducing greenhouse gas emissions. The Innovation Fund is particularly relevant for large-scale projects (DACCS, BioCCS) that can demonstrate measurable and lasting impacts in line with QU.A.L.ITY principles;

- **The European Agricultural Guarantee Fund** (**EAGF,** Pillar I of the Common Agricultural Policy (CAP)) is a financial support mechanism for the agricultural sector, offering, among other things, incentives for adopting climate-friendly farming practices through direct payments or eco-schemes. EAGF resources come from the EU budget, although their implementation operates under a shared management system, with Member States participating in administration and control;

- **The European Agricultural Fund for Rural Development** (**EAFRD**) is an EU fund operating in the agriculture and rural development sector, financed from the EU budget under Pillar II of the CAP. It supports, among other things, the implementation of innovative technologies for permanent CO_2 removal (e.g., through funding investments, training, and innovative projects), such as enhanced rock weathering (ERW) or agroforestry (including agrosilvopastoral systems and environmental premiums). Similar to the EAGF, implementation takes place under a shared management system – Member States co-finance part of the projects (national contribution), but the primary source is the EU budget.

- **National climate funds and programs** – Member States can support local projects through (using Poland as an example):

- **The National Recovery Plan (KPO)** is Poland's program of reforms and investments, forming part of the EU's Recovery and Resilience Facility (RRF) under the NextGenerationEU package. Within this framework, it is possible to finance pilot CDR projects as part of the energy and climate transition;

- **European Funds for Infrastructure, Climate and Environment (FEnIKS)** is a national program financed from European sources—mainly the Cohesion Fund and the European Regional Development Fund (ERDF) under the EU cohesion policy for 2021-2027. It supports investments in technologies that reduce emissions and increase CO_2 absorption, for example through green area reclamation, biochar development, implementation of DAC technologies, and enhancing soil carbon retention;

- **Tax incentives for innovation** are mechanisms within tax law that can support companies investing in Poland in projects and initiatives related to CDR (Carbon Dioxide Removal) and CCS (Carbon Capture and Storage) technologies, aligned with ESG (Environmental, Social, Governance)

objectives. These projects may include, among others, developing new CO_2 capture and storage technologies, testing installation or process prototypes, and developing innovative certification methods. The most important incentives include: prototype relief, robotics relief, relief for hiring innovative employees, the possibility of combining R&D relief[29] and IP Box relief[30], and an extended R&D relief[31];

- **The National Fund for Environmental Protection and Water Management (NFOŚiGW)** offers preferential loans that can be partially forgiven upon achieving specific environmental outcomes, such as low-interest loans for projects related to CO_2 sequestration, afforestation and ecosystem restoration, and the implementation of DAC and CCS technologies. In 2025, NFOŚiGW programs include "Adaptation to Climate Change and Biodiversity Protection", "Low-Emission Transformation and Emission Reduction", "Modernization Fund/National Recovery Plan", as well as initiatives for biomass and biogas (BioCCS);

- **Bank Gospodarstwa Krajowego (BGK)** offers instruments such as the Green Loan (FENG), Biznesmax guarantee, and liquidity guarantees. These preferential loans and credit guarantees reduce investment risk and can attract private capital;

- **European Investment Bank – EIB Venture Debt** is a special quasi-equity debt financing instrument offered by the European Investment Bank (EIB), targeted at fast-growing, innovative companies in Europe (including SMEs and mid-caps[32]) that have typically already completed venture capital funding rounds and seek to accelerate growth without significantly diluting founders' equity.

Private ESG financing:

- **ESG investments and carbon credits** are based on the premise that CDR projects certified under the CRCF framework can attract investors interested in sustainable development and green technologies, such as ESG and green bond funds, corporate entities, financial institutions and banks, private investors, and venture capital (VC)[33] funds seeking future-oriented technologies like enhanced rock weathering (ERW), biochar, or DACCS;

- **Partnerships with corporations** where large companies can co-finance CRCF projects as part of their climate neutrality strategies and corporate social responsibility (CSR). Generating carbon credits compliant with EU CRCF standards, which can be used by corporations for voluntary offsets or ESG reporting, helps increase access to innovative solutions and partnerships with the scientific sector, start-ups, and local communities,

33 The R&D relief covers costs incurred in connection with scientific research and development work, such as employee salaries for R&D activities or expert analyses.

34 The IP Box relief provides preferential taxation of income derived from legally protected intellectual property rights (such as patents or copyright on computer programs) that have been created, developed, or improved as part of the taxpayer's R&D activities.

35 The extended R&D relief allows for the deduction of costs related to innovation and technology development.

36 Mid-caps, or "medium-capitalization companies", is a category of enterprises defined in EU documents and financial programs as positioned between SMEs (micro, small, and medium-sized enterprises) and large companies.

37 Venture capital (VC), also known as high-risk or private equity financing, is a form of funding in which investors – typically specialized funds-invest in young, innovative companies with high growth potential in exchange for equity in those companies.

while simultaneously strengthening their brand image as responsible and committed to combating climate change.

Other sources:

- **Green crowdfunding**, which involves raising funds from citizens, organizations, and local communities for specific – mainly local – environmental initiatives. In the context of CDR, this may include afforestation and green area restoration, biochar production from organic waste, regenerative agricultural practices (carbon farming), or the construction of local DACCS installations or CO_2 storage in products;

- **Green bonds**, a special type of debt instrument issued by financial institutions, municipalities, governments, or companies to finance or refinance environmental projects (so far mainly in areas such as renewable energy, energy efficiency, sustainable transport, water and waste management, and biodiversity protection) – including sovereign issues[34], municipal bonds, corporate bonds, and investment funds with a green component. They are attractive to investors – by allowing them to invest capital in a manner consistent with ESG principles while simultaneously obtaining a financial return; to issuers – by providing access to a new group of investors, the opportunity to improve their image, and often more favourable financing terms; and to the environment – by providing real support for projects. They can become a key financing tool for projects that permanently remove CO_2 from the atmosphere – both locally and globally;

- **Breakthrough Energy Catalyst (BEC)**, a global platform for financing climate projects initiated by Bill Gates and supported by partners, i.e., the EIB and the EC. Its goal is to accelerate the implementation of breakthrough climate technologies – primarily DAC/DACCS, BioCCS, mCDR – which have the potential to significantly reduce GHG emissions but are but remain too costly to compete with fossil fuel-based technologies.

EU CDR Procurement Program

The EC is currently working on the first program for purchasing permanent carbon removal units (EU Purchasing Programme for Permanent Carbon Removals)[35], which aims to support the development of technologies and the CDR market, generate public and private demand for high-quality permanent removals (DACCS, BioCCS, ERW), and ensure efficient and cost-effective public management of CDR through the direct purchase of certified CO_2 removal units. As part of this work, the EC is

38 Poland was the first country in the world to issue sovereign green bonds in 2016, amounting to € 750 million. In June 2025, the Ministry of Finance issued 12-year green bonds worth € 1.25 billion under the EMTN program.

39 European Commission: Directorate-General for Climate Action, Ecologic Institute, McDonald, H., Gardiner, J., Görlach, B. et al., An EU purchasing programme for permanent carbon removals – Assessment of policy options and recommendations for short-term policy design, Publications Office of the European Union, 2025, https://data.europa.eu/doi/10.2834/8212975; accessed: 25/08/2025.

considering seven policy options for the EU purchasing program, which could form the basis for implementing a support mechanism for CDR technologies in the years 2025-2030:

- **EU coordinated Buyers' Club** – a public program implementing a mechanism to aggregate private demand for the purchase of permanent CDR, financed by private companies and financially supported (operational costs, seed funding) by the EC;
- **EU Removals Fund** – a publicly managed initiative for the strategic purchase of CO_2 removal technologies, modelled on the Innovation Fund and Denmark's NECCS;
- **Centralised Procurement Agency** – an EU institution coordinating CO_2 removal purchases through auctions, minimizing transaction costs;
- **Investment vehicle** – a public, independent investment fund combining public and private capital and risk-reduction instruments to build the CO_2 removal market;
- **Independent foundation** – a privately managed non-profit organization supporting the CO_2 removal market using mixed public-private financing, operating outside typical public sector constraints;
- **Carbon Central Bank (CCB)** – a new and complex, politically independent public institution with a broad mandate to shape the carbon removal market, functioning similarly to the European Central Bank (ECB);
- **Rule-based mechanism** – a limited mechanism operated by an EU agency to stabilize CO_2 removal prices in removal markets and/or the EU ETS, inspired by the Market Stability Reserve (MSR).

It is worth emphasizing that the CCB concept aligns with the idea of the European Carbon Central Bank (ECCB)[36] proposed by CAKE/KOBiZE experts. This model envisions the establishment of an independent public institution with a broad mandate to stabilize prices and reduce risk, which would manage the future EU emissions market and ensure its stability through 2050. Ensuring stability and predictability of emission allowance (EUA) prices, along with implementing new mechanisms such as ETS2, CBAM, and CO_2 capture technologies, would create favourable conditions for the development and scaling of CDR technologies in the EU. The ECCB would aim to stabilize the EU carbon market by balancing EUA supply with certified removal units (CDR) and high-quality offsets. A dedicated reserve would gradually release units to prevent price shocks, while coordination with the Market Stability Reserve (MSR) would allow flexible responses to market conditions. The system could include units from voluntary carbon markets (VCM) and global ETS systems (USA, China), provided strict integrity criteria are met, transitioning from passive adjustment to active management of prices and market credibility.

Each of the options proposed by the EC for the EU CDR purchasing program has been assessed in terms of its strengths and weaknesses, as presented below in Table 3.

40 R. Jeszke, S. Lizak, M. Rosłaniec, M. Pyrka, European Central Carbon Bank (ECCB): Introducing the ECCB as the new institution to manage the future EU carbon market (https://climatecake.ios.edu.pl/wp-content/uploads/2025/06/KOBiZE_ECCB_Policy-Brief_final_26062025; accessed: 04/11/2025)

Table 3. Qualitative assessment of CDR purchasing program policy options in light of current climate policy assumptions

Evaluation Criteria	Sub-criteria	Indicator / Question	Buyer's Club coordinated by the EU	EU Carbon Removal Fund	Central Public Procurement Agency	Investment Instrument	Independent Foundation	Central Carbon Bank (CCB)	Rules-based Mechanism
Effectiveness	Support for CDR technology development and innovation	Ability to support development of multiple technologies / removal types	++	++	0	++	++	+	−−
		Ability to handle large facilities (>1 $MtCO_{2-e}$)	+	+	0	+	+	+	−
	Market development for CDR	Ability to attract private financing (outside ETS/RTS)	+	0	0	+	+	0	−
		Capacity to develop the market (e.g., coordination, standardization)	+	+	0	+	+	++	−−
	Market demand for CDR: short-/medium-/long-term	Ability to generate stable short-term market demand for CDR	++	++	+	0	0	−−	−
		Ability to generate stable medium- and long-term market demand for CDR	+	+	0	0	+	+	0
	Public governance	Public oversight	+	++	++	0	−	+	0
Efficiency	Administrative costs	Low administrative costs for the EU and stakeholders (Member States)	0	−	0	−	0	−−	+
	Administrative burden	Low compliance costs for the business community, including SMEs	+	+	+	0	0	+	−
	Dynamic efficiency	Incentives for cheaper removals over time	++	++	+	+	++	++	−−
Coherence	Avoiding major policy changes	Requirement for significant adaptation of regulatory framework	+	++	+	0	−	−−	−

Source: European Commission: Directorate-General for Climate Action, Ecologic Institute, McDonald, H., Gardiner, J., Görlach, B. et al., An EU purchasing programme for permanent carbon removals – Assessment of policy options and recommendations for short-term policy design, Publications Office of the European Union, 2025, https://data.europa.eu/doi/10.2834/8212975

Considering the options under review and their characteristics, in the short-term perspective (2025-2030) the EC is examining a purchasing program based on the EU Carbon Removal Fund combined with an EU Buyers' Club and a Central Public Procurement Agency.

Summary and assessment of financing possibilities for CDR technologies in the EU

The current system for financing CDR technologies in the EU is characterized by significant fragmentation and a lack of a unified approach. Support mechanisms are dispersed across various

programs, funds, and financial instruments, and their availability and conditions largely depend on the type of technology used and the sector in which it is implemented. Despite the financial tools available, the development of CDR in Europe still faces a number of systemic barriers that require comprehensive reforms. For example, the low level of utilization of tools such as EIC Pathfinder or EIB Venture Debt indicates the need for better alignment of instruments with market needs. There is also a lack of solutions enabling the development of durable and scalable CDR projects, particularly at early stages of development (TRL 1-6).

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Financing CDR projects poses a significant challenge, particularly due to the early stage of technology development and high initial costs. Current EU programs (e.g., Horizon Europe, EIC Transition) mainly support research and development (TRL 1-6), while commercialization (TRL 7-9) relies primarily on limited access to the Innovation Fund. Public support is usually granted in the form of competitive grants, which restricts the number of beneficiaries and favours large entities with an established market position. Meanwhile, technology start-ups and SMEs often depend on private investments, which tend to favour projects with low capital requirements. Unfortunately, the complexity of procedures and low success rates may discourage many companies from applying for public funding. Therefore, it is justified to seek alternative forms of support for the development of CDR projects that can complement current financing mechanisms, such as:

- preferential loans and credit guarantees, which would reduce investment risk and could attract private capital;
- grants for industrial clusters, supporting collaboration, innovation, and infrastructure development;
- other support mechanisms that could stimulate the development of new CDR technologies and reward verified CO_2 removal outcomes, such as contracts for difference, performance-based premiums, or guaranteed purchase prices for carbon credits.

> *A well-designed integration of CRCF regulations with carbon credit purchasing programs can attract additional public and private capital, supporting the development of CO_2 removal technologies as well as their scaling at the European level.*

A well-designed integration of CRCF regulations with carbon credit purchasing programs can attract additional public and private capital, supporting the development of CO_2 removal technologies as well as their scaling at the European level.

Proposal for Integrated financing framework for the development of CDR in Poland

The development of carbon dioxide removal (CDR) technologies in Poland requires not only the creation of appropriate regulatory frameworks, but above all a stable, multi-level financing system.

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The financing system for the development of CDR projects could be based on a set of complementary financial and implementation instruments, including, among others:

Dedicated Grant Programs and Preferential Loans

- Targeted grant support and preferential loans for CDR projects can enable them to progress from basic research through prototyping to commercial deployment. Existing public institutions and specialized programs supporting climate innovation can play a key role in this process;

- CDR projects may be financed by national institutions, such as:

    - **National Fund for Environmental Protection and Water Management (NFOŚiGW)** – through grants and preferential loans for pro-environmental projects, including CO_2 removal, modernization of industrial installations, and carbon sequestration projects in soils and forests, as well as launching a dedicated priority program to support CDR investments;

    - **National Centre for Research and Development (NCBR)** – by funding R&D projects focused on new CDR methods (e.g., DACCS, biochar, ERW) and their real-world demonstrations, within programs such as European Funds for a Modern Economy (FENG)[37], GOSPOSTRATEG[38], or SMART Path[39];

    - **Polish Agency for Enterprise Development (PARP)** – by providing financial support for SMEs and start-ups to implement innovations (including funding for equipment purchases, pilot tests, and market entry abroad), particularly investments in environmental technologies and the circular economy.

CDR green bonds

- Bonds issued by the state, local government units (LGUs), or – in specific cases – public institutions and municipal companies, dedicated to the development of CDR infrastructure (e.g., DACCS, biochar, ERW);

- Proceeds from bond issuance could finance, among other things: DACCS installations, production and application of biochar as a form of permanent carbon sequestration in soil, accelerated rock weathering (ERW) in agriculture, agroforestry and afforestation combined with CO_2 removal monitoring systems, development of logistics and storage

41 European Funds for a Modern Economy 2021-2027 (FENG) is an operational program that continues the previous programs – Innovative Economy 2007-2013 (POIG) and Smart Growth 2014-2020 (POIR). FENG aims to help entrepreneurs finance the entire R&D&I process, support companies at every stage of development, enable the development of research and development infrastructure, finance high-risk projects, and promote the "green" and digital transformation of enterprises. The FENG budget amounts to approximately PLN 42.9 billion.

42 GOSPOSTRATEG is a program financed by the National Centre for Research and Development (NCBR), aimed at increasing the use of socio-economic research results in shaping development policies. The total planned budget for the program, under which projects involving scientific research, development work, and implementation activities are carried out, amounts to PLN 500 million.

43 SMART Path is the flagship support instrument under the FENG 2021-2027 program, primarily targeted at micro, small, and medium-sized enterprises, but also available to large companies and consortia. Its goal is to provide comprehensive support for innovative projects that contribute to the development of a modern, green, and digital economy in Poland. The total program budget amounts to approximately PLN 35 billion.

infrastructure for captured CO_2 (e.g., pipelines, storage hubs);

- Possibility of co-financing, providing credit guarantees, or blended finance[40] arrangements by the European Investment Bank (EIB) under its green transition and climate innovation support policy, or by the European Bank for Reconstruction and Development (EBRD), particularly for regional projects involving industrial modernization and low-emission infrastructure.

Carbon contracts for difference (CCfD) – temporary subsidies

- The state (or another designated public institution) can set a "reference price" (strike price), representing the minimum amount an investor will receive for removing one tonne of CO_2, guaranteed by the government;
- If the market price of carbon credits falls below this level, the state is obliged to pay the difference to the investor; conversely, if the market price exceeds the set level, the investor must return the surplus to the state budget, preventing excessive profits and increasing public acceptance of the mechanism;
- This mechanism can serve as an incentive for investors to build large DACCS or BioCCS installations without exposure to price risk.

Dedicated pathways for climate start-ups and technical universities

- **Climate accelerators** focused on developing programs that accelerate the growth of young companies, offering mentoring, access to laboratories, support in attracting investors, and opportunities to test solutions in real-world environments (living labs[41]);
- **Academic pathways** that, through grants and competitions for research teams from technical universities, would enable the commercialization of research results, creation of spin-offs[42], and collaboration with industry;
- **International programs** that, as part of participation in EU initiatives such as EIT Climate-KIC, Horizon Europe, or the Innovation Fund, would provide both funding and access to networks of technology partners across Europe.

44 Blended finance is a model in which public capital (e.g., government funds, EU funds, development grants) is combined with private capital (e.g., investments from companies, venture capital funds, commercial banks) within a single project. The goal is to mobilize a larger scale of investment in projects of significant social, environmental, or developmental importance, which might otherwise be too risky or insufficiently profitable for the private sector.

45 Living labs are innovative environments where users, scientists, companies, public institutions and local communities co-create, test and develop new solutions – often in real-world conditions, not just in the laboratory.

46 Spin-offs are companies or ventures separated from a larger organization – usually a university, research institute, or corporation – with the aim of commercializing innovative ideas, technologies, or research results. They help accelerate technology transfer from science to industry, strengthen regional innovation and competitiveness, create jobs in high-tech sectors, and enable the acquisition of investors and grants (e.g., from Horizon Europe). Examples of Polish spin-offs include Warsaw Genomics (University of Warsaw), PolTREG (Medical University of Gdańsk), UAVS Poland (AGH University of Science and Technology in Kraków), and Advanced Graphene Products (Lodz University of Technology).

The role of the CRCF in the financing system for CDR projects in Poland will be significant, as it will pave the way for the development of new business opportunities across various sectors of the economy. Acting as a bridge between science, business, finance, and climate policy, the CRCF will ultimately provide market value to CO_2 removal activities and enable their integration with financial mechanisms. Thanks to the CRCF, which ensures uniform certification and transparency, it will be possible to accurately account for climate impacts, increase investor and financial institution confidence, and create a market for high-quality CO_2 removal credits.

The role of the CRCF in the financing system for CDR projects in Poland will be significant, as it will pave the way for the development of new business opportunities across various sectors of the economy. Acting as a bridge between science, business, finance, and climate policy, the CRCF will ultimately provide market value to CO_2 removal activities and enable their integration with financial mechanisms.

Conclusions: CRCF as a system of change

It is important to emphasize that CRCF is a key technical framework for the EU's climate and regulatory transformation. It is a comprehensive system that has the potential to:

- establish the first EU-wide standard and market for CDR projects;
- provide a clear and robust price signal, facilitating accurate market valuation and commercialization of CDR initiatives;
- transform the voluntary carbon removal market into a credible mechanism, progressively aligned with the regulated compliance market;
- enable citizens and enterprises to make a meaningful contribution toward achieving climate neutrality.

CRCF is a key technical framework for the EU's climate and regulatory transformation.

For CDR technologies to make their rightful contribution to achieving climate neutrality at the EU level by 2050, it is essential to establish a stable, predictable, and long-term support system that covers all stages of project development – from research and demonstration phases to commercial deployment. The CRCF must serve as the qualitative foundation of this system, ensuring uniform EU-wide certification standards for various CDR methods – ranging from carbon farming and CO_2 storage in products to permanent CO_2 removal in industrial installations.

However, certification alone is not enough. In order to enable the stable development of CDR technology in the EU, it is necessary to implement consistent financial and regulatory instruments which, based on CRCF quality and certification standards, will ensure predictability and investment security. Strategic areas include:

- evolution of the CDR market, meaning a gradual transition from the current Voluntary Carbon Market (VCM) to a regulated market where CRCF-compliant certified CDR units could be integrated into the EU ETS or

national compliance mechanisms. In parallel, national CO_2 purchasing programs based on long-term contracts should be developed to guarantee demand for certified CO_2 removals;

- political and budgetary stability, as ensuring continuity of funding for research, pilot projects, and CDR deployment amid shifting geopolitical and economic priorities will be critical. Support should encompass both EU and national resources, with guarantees of a multi-year investment horizon, enabling CRCF-certified CDR projects to plan effectively over decades;

- integration with EU climate objectives, based on the principle that CRCF-certified CDR technologies should be recognized as one of the pillars of the European Green Deal. Their development must support the EU's climate transition, accelerate decarbonization of hard-to-abate sectors, and stimulate technological innovation across the European economy.

When we look at the CRCF not through the perspective of EU legal regulation, but as an impulse to build a modern, low-carbon economy, we can pave the way for both improving the climate and strengthening the EU's position in the global transition towards sustainable development. However, this requires maintaining a strategic approach.

It is equally crucial to create a stable and ambitious financing framework, without which the development of CDR technologies will remain limited to niche pilot projects. If Poland intends to leverage the CRCF as a driver of its competitiveness, it needs a financial system as modern as the technologies themselves – one that fosters innovation, supports solution exports, and enables the construction of a sustainable economy within the EU market and globally.

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The Paris Agreement Crediting Mechanism is gaining momentum

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The Paris Agreement Crediting Mechanism is gaining momentum

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Keywords: PACM, Paris Agreement, offsets, Article 6

Summary

Following the landmark decisions taken at COP29 in Baku, the Paris Agreement Crediting Mechanism (PACM)—the new global framework for generating carbon credits under Article 6.4 of the Paris Agreement—has entered its implementation stage. The Supervisory Body of the Mechanism (SBM) is now tasked with operationalizing this framework. While the political design elements were agreed in Baku, the technical architecture—especially the standards governing baseline setting, additionality, leakage, and non-permanence—is being finalized. As the PACM transitions from rule-making to implementation, its trajectory will likely determine the credibility of international carbon cooperation under the Paris Agreement. If certain conditions are met, the PACM could emerge as a global benchmark of integrity, setting the tone for both compliance and voluntary markets. Its evolution will not only define the credibility of carbon markets but also test the Paris Agreement's capacity to deliver cooperative, scalable, and equitable climate action.

The PACM enters the implementation phase

Following the landmark decisions taken at COP29 in Baku[1] (2024), the *Paris Agreement Crediting Mechanism (PACM)* — the new global framework for generating carbon credits under Article 6.4 of the Paris Agreement — has entered its implementation stage. The expectations surrounding this mechanism are high: many see it as the legitimate successor to the *Clean Development Mechanism (CDM)* of the Kyoto era, but also as a qualitative leap toward a new generation of "baseline-and-credit" systems that combine environmental integrity with Paris alignment.

> *Following the landmark decisions taken at COP29 in Baku[1] (2024), the Paris Agreement Crediting Mechanism (PACM) - the new global framework for generating carbon credits under Article 6.4 of the Paris Agreement - has entered its implementation stage.*

The Supervisory Body of the Mechanism (SBM) is now tasked with operationalizing this framework. While the political design elements were agreed in Baku, the technical architecture—especially the standards governing baseline setting, additionality, leakage, and non-permanence—is being finalized. These standards are the foundation of the mechanism's credibility and will determine whether it can deliver *real, additional, and verifiable* mitigation outcomes aligned with the temperature goals of the Paris Agreement.

Two milestones in early 2025 have significantly advanced this agenda. The Standard on Baseline Setting introduced a conservative, dynamic approach ensuring that reference levels reflect progressively stronger ambition. It enshrines the concept of downward adjustment, requiring that baselines tighten by at least 1% per year, preventing stagnation and supporting alignment with the long-term Paris temperature goal[2]. Proposals to exempt low-economic-potential projects were rejected, maintaining the principle of methodological consistency and environmental integrity.

The Standard on Additionality complements this framework by ensuring that mitigation activities go beyond both regulatory requirements and common practice. The standard introduces periodic reassessment—at minimum upon renewal of the crediting period—to confirm continued additionality in changing national policy contexts[3]. Together, these standards form the methodological core of PACM integrity and signal a shift toward stricter oversight compared to past offset systems.

A third key instrument, the Standard on Leakage, adopted in May 2025, defines principles for identifying and accounting for emissions occurring outside project boundaries. By applying conservative assumptions and transparent monitoring requirements, it ensures that net climate benefits are not overstated[4].

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Defining rules for removals

The 18th meeting of the Supervisory Body (SBM), held in October of 2025, marked a turning point in the regulation of removal activities under the PACM. The main focus was the adoption of the Standard on Addressing Non-Permanence and Reversals—the so-called Reversal Standard—a key text defining how projects that store carbon (e.g. afforestation, biochar, soil carbon) must manage reversal risks[5].

After months of consultation and more than 10 000 pages of stakeholder input, the SBM adopted the standard along with an accompanying concept note introducing additional design elements. The final outcome reflects a pragmatic compromise:

- Post-crediting monitoring (PCM) period – Instead of defining a single mandatory duration, the SBM decided that the PCM period will be methodology-specific, justified by proponents and subject to review by the Methodological Expert Panel (MEP) and SBM approval. This flexibility acknowledges the diversity of removal pathways.

- Negligible reversal threshold – The definition of "negligible risk" is also methodology-dependent, guided by the upcoming Reversal Risk Assessment Tool, currently being developed by the MEP.

- Financial assurance – The SBM added a new condition under which activity participants may terminate PCM obligations early: by demonstrating sufficient insurance coverage or equivalent guarantees, including third-party guarantees, subject to SBM approval.

The new decisions have elicited mixed reactions from the carbon market community:

- Supportive voices — such as The Nature Conservancy (TNC) and the International Emissions Trading Association (IETA)[6] — welcomed the revised text as a "significant improvement" that balances environmental integrity with practical implementation.

- Critical voices, including Carbon Market Watch (CMW)[7], expressed concern that market actors exerted disproportionate influence, weakening science-based permanence rules and "politicizing" the SBM's deliberations.

The element of the post-crediting monitoring was likely the most contentious issue leading up to the final discussion of the matter by the SBM. Earlier drafts from the Methodological Expert Panel (MEP) had proposed indefinite post-crediting monitoring, a measure widely opposed by nature-based solutions (NbS) proponents.

It should be observed, that in a lot of the science based literature on the matter of reversals, many actually advocated[8] that in order to align with the best practice for land-based carbon storage activities, the monitoring period should be determined at the level of at least 100 years. At a certain

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stage of the meeting of the SBM members were considering a range of 60-100 years, but no consensus was reached.

> *The element of the post-crediting monitoring was likely the most contentious issue leading up to the final discussion of the matter by the SBM. Earlier drafts from the Methodological Expert Panel (MEP) had proposed indefinite post-crediting monitoring, a measure widely opposed by nature-based solutions (NbS) proponents.*

The final decision abandons indefinite monitoring, without setting a specific duration, and defers the determination of post-crediting monitoring periods and negligible reversal thresholds to the methodology level. This approach allows project-specific tailoring but raises concerns about potential inconsistency and reduced rigor across methodologies.

The SBM plans to review the reversal standard once experience is gained from early methodologies, with the option to later set unified guidance on monitoring duration and negligible-risk thresholds.

In parallel, the SBM adopted the Common Practice Analysis Tool, completing the additionality framework. This tool allows differentiated treatment for Least Developed Countries (LDCs) and Small Island Developing States (SIDS), reflecting equity principles embedded in Article 6.4 decisions[9].

Transitioning CDM projects – Integrity and controversy

The transition of legacy Clean Development Mechanism (CDM) projects to the PACM remains one of the most controversial elements of the mechanism's rollout. Although politically mandated by the Parties at COP26 in Glasgow (2021)[10], the process has drawn criticism from observers who argue that many CDM projects suffered from inflated baselines and limited additionality.

The SBM has acknowledged these integrity concerns but emphasized that it operates within the political guidance of the COP decisions. Still, recent discussions—particularly concerning clean cooking (cookstove) projects—show that the Supervisory Body is willing to take a firmer stance.

The SBM addressed the issue of fraction of non-renewable biomass (fNRB) values used in clean cooking methodologies. High fNRB values can inflate credited emission reductions by assuming greater environmental harm from traditional biomass use. To counter concerns of over-crediting, the SBM agreed that such projects must update emission factors to reflect current data, preventing excessive credit issuance and setting a precedent for more conservative treatment of legacy activities.

Formally, transitioned projects will be subject to strict temporal limits. Those using existing CDM methodologies may continue to issue credits only for emission reductions occurring until 31 December 2025. Thereafter, they must adopt new

9 UNFCCC (2025). A6.4-SBM018-A15: Common Practice Analysis Tool. (https://unfccc.int/sites/default/files/resource/A6.4-SBM018-A15.pdf; accessed: 24.10.2025 r.)

10 UNFCCC (2021). Decision 3/CMA.3, Guidance on the Mechanisms under Article 6 of the Paris Agreement (Glasgow) (https://unfccc.int/sites/default/files/resource/cma2021_10a01E.pdf#pag_29; accessed: 24.10.2025 r.)

PACM-approved methodologies in line with the latest standards on baselines and additionality.

It should also be noted, that the SBM at its 18th meeting revised the CDM Transition Standard and Procedure, extending the deadline for projects with host country approval to 31 December 2026 to submit additional information required for transition[11]. Many projects who already have the green light from the hosts to transition called for more time to supplement the necessary information, including with reference to aspects such as sustainable development benefits of transitioning projects.

Financing challenges and institutional sustainability

Another critical dimension discussed by the SBM this year concerns the financial sustainability of the mechanism. While the PACM has ambitious implementation goals, it currently lacks stable self-financing and was facing a potential budget shortfall by early 2026.

The Supervisory Body approved a two-year financial plan[12] covering essential operational and implementation costs, even though not all funding sources have been secured at the time of approval. To address the gap, options included reallocating residual funds from the CDM Trust Fund and mobilizing voluntary contributions from Parties. The decision to proceed with an implementation budget underlines both the urgency of maintaining the mechanism's momentum and the continued dependence on interim financial arrangements.

However, until the mechanism becomes fully self financed, it's financial fate very much depends on decisions by the Parties taken at the yearly summits, where formally any resources from other UN-ran systems (such as the outgoing mechanism of CDM), could be earmarked for the implementation of PACM. A similar decision was already taken at COP in Glasgow, were a significant portion of CDM finances was earmarked for implementation of Article 6. In the same vein, the most recent climate summit COP 30 in Belem passed a decision which again relocated CDM funds in the amount of almost 27 million USD towards further implementation of PACM.

Outlook – Integration with global and regional policies

Looking ahead, the PACM is expected to reach full operationalization within the next two years. The first top-down methodologies could be approved even in 2025, followed by bottom-up submissions from project developers and the first issuances of Article 6.4 credits by end of 2026. This timeline would mark the formal beginning of the Paris-aligned global carbon market.

At the same time, broader policy debates are emerging in major jurisdictions—especially within the European Union—on whether and how to integrate high-integrity international credits into their future climate policy frameworks. The forthcom-

11 UNFCCC (2025). A6.4-SBM018-A12: Revised CDM Transition Standard and Procedure (https://unfccc.int/sites/default/files/resource/A6.4-SBM018-A12.pdf; accessed: 24.10.2025 r.)

12 UNFCCC (2025). A6.4-SBM017-A01: Two-Year Financial Plan of the Supervisory Body (https://unfccc.int/sites/default/files/resource/A6.4-SBM017-A01.pdf; accessed 24.10.2025 r.)

13 European Commission (2024). Communication on the 2040 Climate Target and Climate Architecture Beyond 2030. (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52024DC0063; accessed: 24.10.2025 r.)

ing EU 2040 climate target architecture may open limited avenues for such flexibility mechanisms[13].

> *At the same time, broader policy debates are emerging in major jurisdictions—especially within the European Union—on whether and how to integrate high-integrity international credits into their future climate policy frameworks. The forthcoming EU 2040 climate target architecture may open limited avenues for such flexibility mechanisms[13].*

Several Member States, including Poland, have proposed expanding the scope of international credit use to enhance cost-effectiveness, support industrial competitiveness, and stabilize carbon market dynamics. Suggested options include increasing the quantitative limit for credit use from 3% to 10% and allowing credits from mechanisms such as the PACM to enter the EU ETS as early as 2031, under strict governance and quality criteria.

In view of stakeholders arguing for extending the flexibility, integrating PACM credits could:

- help smooth price volatility in the EU ETS,
- relieve hard-to-abate sectors such as steel and cement,
- and provide flexibility to manage uncertainties in land-use sinks under the LULUCF Regulation.

Beyond these practical benefits, incorporating PACM credits would reinforce global cooperation, directing finance toward credible mitigation efforts in developing countries. If implemented with integrity safeguards, the PACM could become a cornerstone of a Paris-aligned international carbon architecture, bridging voluntary and compliance markets while supporting the achievement of both national and global climate goals.

Some also suggest that with the deliberations of the EU's 2040 architecture, the focus should primarily be on the removal credits[14]. Through that the EU could consider setting up its own framework for international CDR credits in addition to what is currently implemented under the Carbon Removal Certification Framework. A potential public bidding program for such credits could be set up, and the EU could suggest that it is willing to pay a meaningful minimum price for those credits. The proceeds of such credits would come in addition to the New Collective Quantified Goal (NCQG) on climate finance. This type of EU policy would lead to the creation of a de facto 'premium' sub-group of credits as part of PACM: Paris-aligned, high-quality, carbon dioxide removal credits.

Toward a global benchmark for integrity

As the PACM transitions from rule-making to implementation, its trajectory will likely determine the credibility of international carbon cooperation under the Paris Agreement. Unlike the Kyoto-era CDM, which operated under a more uniform global framework, the PACM is designed for plurality and differentiation—recognizing national circumstances while imposing universal integrity principles.

As the PACM transitions from rule-making to implementation, its trajectory will likely determine

14 BENCINI, Jacopo, DELBEKE, Jos, DOMBROWICKI, Piotr Mikolaj, Creating EU demand for Paris-aligned carbon dioxide removal credits, EUI, STG, Policy Brief, 2025/07 (https://hdl.handle.net/1814/92617; accessed: 24.10.2025 r.)

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Its success will hinge on three factors: (1) whether methodology developers can operationalize complex standards on permanence, additionality, and baselines without prohibitive transaction costs; (2) whether host countries can integrate the mechanism into their national accounting systems without risking double counting; and (3) whether buyers, including compliance systems like the EU ETS, accept PACM credits as credible mitigation units.

If these conditions are met, the PACM could emerge as a global benchmark of integrity, setting the tone for both compliance and voluntary markets. Its evolution will not only define the credibility of carbon markets but also test the Paris Agreement's capacity to deliver cooperative, scalable, and equitable climate action.

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LIFE ENSPIRE "Climate integration: opportunities and limitations of candidate countries (Balkans, Ukraine, Moldova, Türkiye) in adapting to EU policy"

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Keywords: climate policy of the EU and candidate countries, NDC, NECP, energy mix, emissions trading system (EU ETS), carbon pricing, long term strategy (LTS), MRV

List of abbreviations:
CAKE - Centre for Climate and Energy Analyses at KOBIZE/IOŚ-PIB
CBAM - Carbon Border Adjustment Mechanism
EU ETS – European Union Emissions Trading System
ETS – Emissions Trading System
GHG – greenhouse gases
IMF – International Monetary Fund
INDC – Intended Nationally Determined Contribution
IPA – Instrument for Pre-accession Assistance
EC – European Commission
NECP – National Energy and Climate Plan
LIFE ENSPIRE – project entitled Exploring New Scenarios for the Progressive Integration of Neighbouring States into the EU ETS beyond 2050 (co-financed by EU funds from the LIFE programme and national funds from the National Fund for Environmental Protection and Water Management)
LTS – Long Term Strategy
LULUCF – land use, land use change and forestry
IEA – International Energy Agency
MRV – monitoring, reporting and verification
NDC – Nationally Determined Contribution
NFOŚiGW – National Fund for Environmental Protection and Water Management
RES – renewable energy sources
GDP – gross domestic product
TR ETS – Turkish Emission Trading System
EU – European Union
UNFCCC – United Nations Framework Convention on Climate Change

Abstract

This article is based on research conducted as part of the LIFE ENSPIRE project (101155901–LIFE23–GIC–PL–LIFE ENSPIRE)[1] carried out by the Institute of Environmental Protection – National Research Institute and co-financed by the European Commission from the LIFE programme and by the National Fund for Environmental Protection and Water Management.

The article presents an analysis of the preparations of selected candidate countries for European Union membership – Albania, Bosnia and Herzegovina, Montenegro, Kosovo, North Macedonia, Serbia, Türkiye, Ukraine and Moldova – for the implementation of the EU's climate policy. Based on a review of the literature, the state of the accession process, the economic situation (GDP), greenhouse gas emissions, the energy mix structure, the reduction targets set out in strategic documents (NDC, LTS, NECP) and the status of planned emissions trading schemes (ETS) were analysed. All the countries analysed consider climate policy to be one of the key elements of EU integration, but the pace and scope of its implementation vary significantly from country to country. Türkiye, Ukraine, Moldova and Montenegro are the most advanced in terms of implementing emissions trading systems, while Serbia and Albania are approaching the implementation stage and the remaining countries are at an early stage of preparation. The article reviews the current situation in this area and identifies the main challenges and opportunities for further integration of the region into the EU's climate policy.

Political and economic situation (GDP, accession)

The LIFE ENSPIRE project analyses the economic situation in the context of climate and energy policy in selected regions and countries that are candidates for EU membership.

The LIFE ENSPIRE project analyses the economic situation in the context of climate and energy policy in selected regions and countries that are candidates for EU membership, i.e. the Balkan countries (Albania, Bosnia and Herzegovina, Montenegro, Kosovo, North Macedonia, Serbia), Türkiye, Ukraine and Moldova. These countries were selected due to their possible accession to the EU and the resulting extension of climate policy legislation, including the emissions trading system. Furthermore, trade, electricity transmission and political cooperation mean that, in the EC's analysis, i.e. by 2050, these countries may be part of the European Union, hence obtaining input data and including them in more detail in economic and sectoral modelling will be crucial for the analysis of potential climate policy development strategies. In this context, it is particularly important to refer to Poland, whose energy mix and geopolitical situation 20-30 years ago resembles the current situation of most EU candidate countries, and whose proximity to borders, including with Ukraine, means that the impact of changes in climate and energy policy will be significant for our country.

1 More on the LIFE ENSPIRE project you can find at: https://climatecake.ios.edu.pl/life-enspire-project/?lang=en

Table 1. GDP of EU candidate countries and Poland.

Country	Nominal GDP (USD billion, 2023)	GDP per capita (USD thousand, 2023)
Albania	23,2	8,6
Bosnia and Herzegovina	27,6	8,0
Montenergo	7,65	12,3
Kosovo	10,47	6,5
Moldova	16,7	6,7
North Macedonia	15,8	8,6
Serbia	81,3	12,3
Türkiye	1 150,0	13,5
Ukraine	182,0	5,3
Poland	813,0	22,1

** Green indicates high values, red indicates low values, and intermediate shades represent the remaining range of values between them.*

Source: CAKE/KOBiZE based on IMF data, 2025

> *Analysis of data from the last two decades shows significant GDP growth in the Balkans, Ukraine, Moldova and Türkiye.*

Analysis of data from the last two decades shows significant GDP growth in the Balkans, Ukraine, Moldova and Türkiye. These indicators point to dynamic economic development in these countries, despite the challenges associated with European integration and the need for structural reforms. The largest nominal economies are Serbia, Ukraine and Türkiye, with GDP exceeding USD 80 billion (Table 1). Türkiye's nominal GDP even exceeds that of Poland. The highest GDP per capita values were recorded in Türkiye, Montenegro and Serbia, exceeding USD 12,000. They are followed closely by Albania and North Macedonia. The lowest GDP per capita is found in Ukraine, Moldova and Kosovo, where values do not exceed USD 7,000.

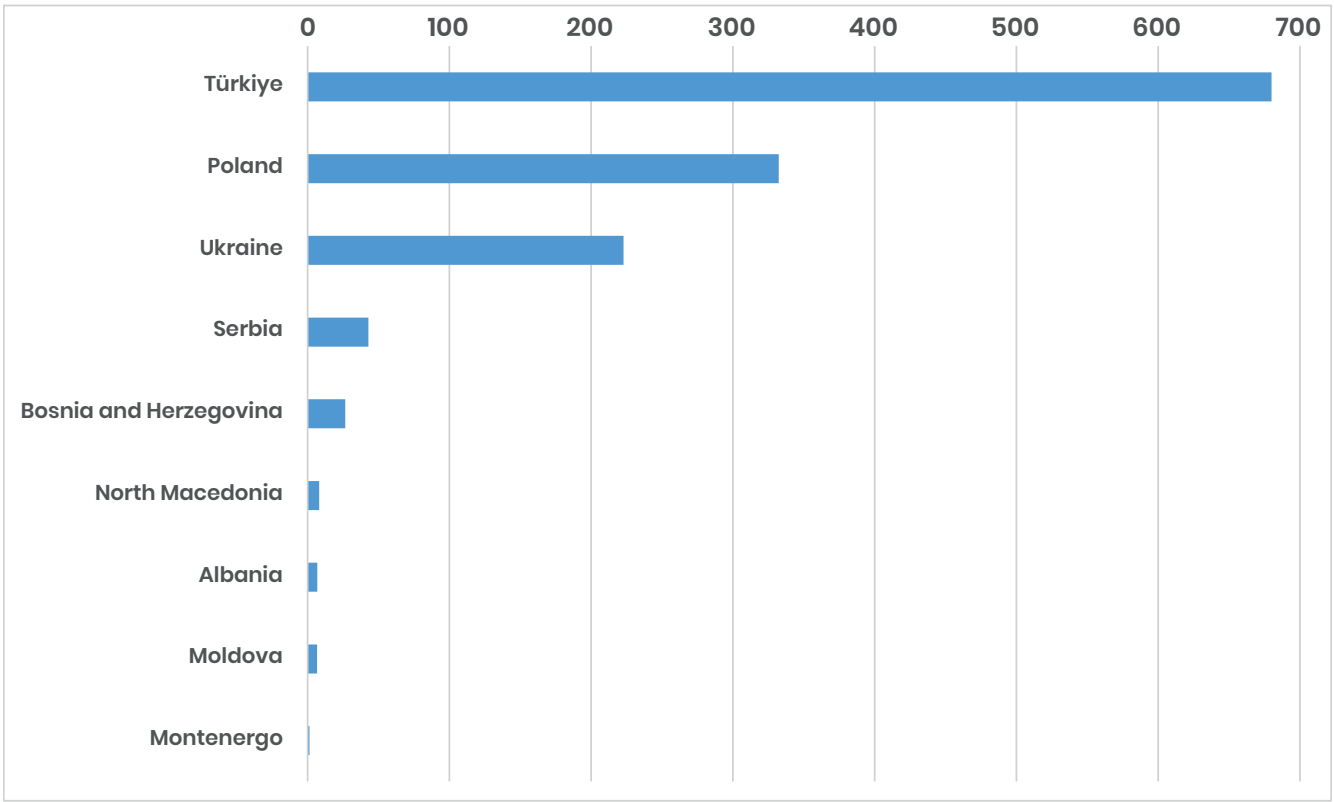
> *The countries most advanced in the accession process are Montenegro and Albania.*

The countries most advanced in the accession process are Montenegro and Albania. Montenegro obtained EU candidate status in 2010, and currently all 33 negotiation chapters have been screened and opened, i.e. checked for compliance with EU legislation, and in addition, 7 chapters have already been provisionally closed, i.e. finalised. Montenegro has an ambitious political plan to join the EU in 2028. In the case of Albania, the target date is 2030. Albania began the

accession process much later, with the first talks only starting in July 2022. As part of the process, further clusters are being opened and reviewed, including cluster 4, 'green agenda & sustainable connectivity'. In addition, due to the specific geopolitical situation and the threat from Russia, procedures are being carried out at a rapid pace for Ukraine and Moldova, which officially applied for membership in 2022. In September 2025, Ukraine[2] and Moldova[3] announced the completion of the screening process. In the case of the other Balkan countries, despite obtaining candidate status, the process is likely to be lengthy due to political problems, the need for reforms and significant delays. Of all the countries analysed, Türkiye has been applying for EU membership for the longest time (since 2005). Due to the suspension of negotiations and political deadlock, Türkiye is not actively participating in negotiation clusters (nor in opening new chapters). The last important meeting between Turkish Foreign Minister Hakan Fidan and Commissioner Marty Kos took place in July 2025 in Brussels. It resulted only in a joint declaration of willingness to engage in dialogue and cooperation on accession issues[4].

Baseline – emissions, per capita emissions and energy mix

Figure 1. Greenhouse gas emissions, 2024, CO_2 mln tonnes.



Source: ourworlddata.org

2 Ukraine successfully completes its screening proces, European Commission, 30.09.2025, (https://enlargement.ec.europa.eu/news/ukraine-successfully-completes-its-screening-process-2025-09-30_en, accessed: 5.12.2025).

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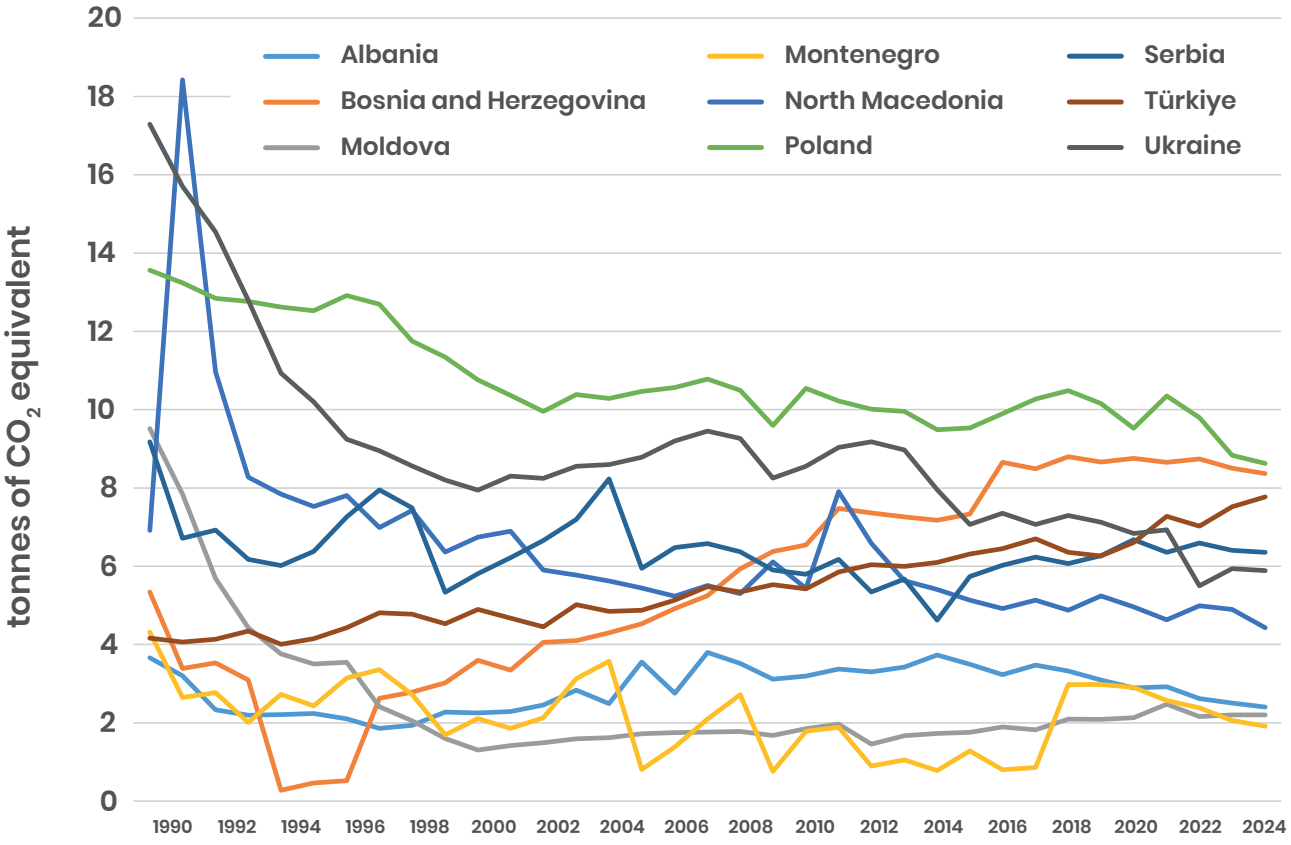
Figure 2. Greenhouse gas emissions per capita, 1990–2023, tonnes of CO_2 equivalent



Source: ourworlddata.org

An analysis of greenhouse gas (GHG) emissions data in selected candidate countries in 2024 shows clear differences in both total emissions and per capita emissions. The highest total emissions (Figure 1) were recorded in Türkiye and Ukraine, approximately 680 million tonnes of CO_2 equivalent and 220 million tonnes of CO_2 equivalent, respectively, mainly due to the large scale of the economy and the intensive use of fossil fuels.

The highest total emissions (Figure 1) were recorded in Türkiye and Ukraine, approximately 680 million tonnes of CO_2 equivalent and 220 million tonnes of CO_2 equivalent.

By comparison, Poland emitted approximately 330 million tonnes of CO_2 equivalent that year. Serbia, although much smaller in terms of population than Türkiye or Poland, also has high total emissions of approximately 45 million tonnes of CO_2 equivalent, with coal dominating its energy mix, the highest share in Europe.

Poland emitted approximately 330 million tonnes of CO_2 equivalent that year.

In terms of per capita emissions (Figure 2), the highest values in 2024 were recorded in Bosnia and Herzegovina (approx. 8 tonnes of CO_2 equivalent/person), indicating higher energy consumption per capita and intensive emissions from the industrial and energy sectors.

> *In terms of per capita emissions (Figure 2), the highest values in 2024 were recorded in Bosnia and Herzegovina (approx. 8 tonnes of CO_2 equivalent/person)*

The lowest per capita emissions, approximately tonnes of CO_2 equivalent/person, are found in Albania, Montenegro and Moldova, where the energy structure is based on energy imports (Moldova) and hydropower (Albania, Montenegro), which limits emissions from fossil fuels. Poland tops the list, with a value of approximately 9 tonnes of CO_2 equivalent/person. This high value is due to several factors, including an energy mix based on coal and greater economic development and consumption than in the other countries analysed.

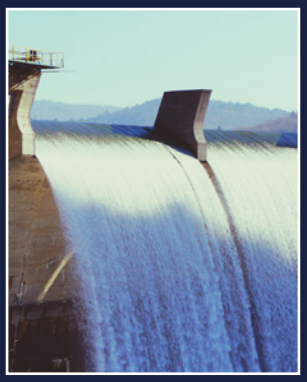
Graph. 1. Dominant energy sources in selected countries.

Bosnia and Herzegovina

Kosovo

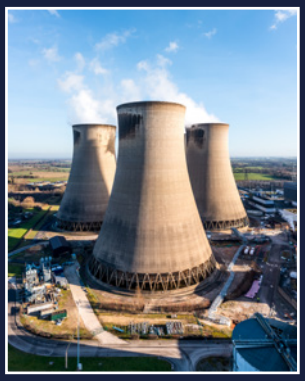
North Macedonia

Serbia



Albania

Montenegro



Ukraine

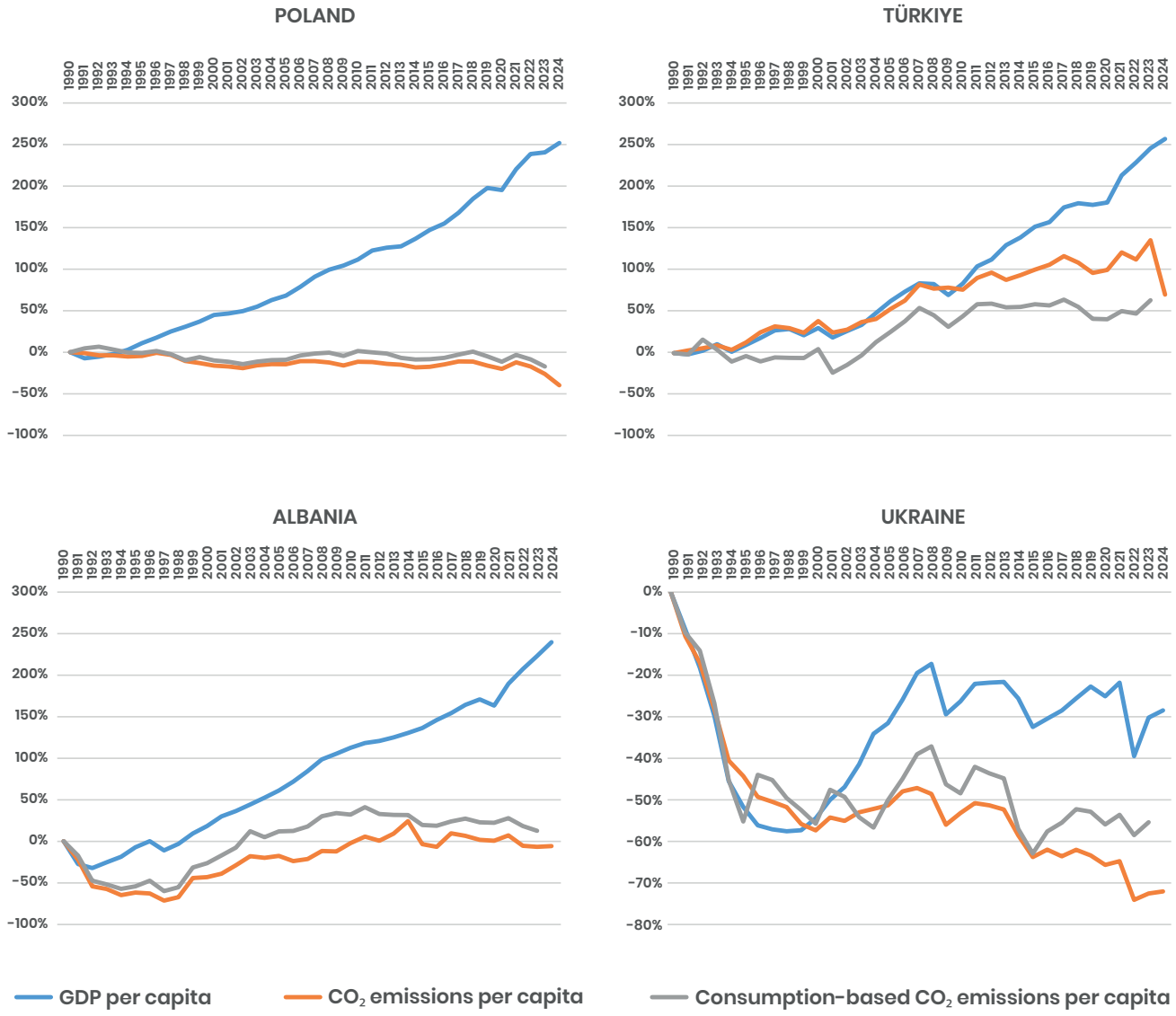
Moldova

Türkiye

Source: CAKE/ KOBIZE based on IEA

The dominant energy sources in the region (Graph. 1) largely determine the level of emissions. Countries such as Albania and Montenegro mainly use hydropower, which results in low emissions, while Serbia, Bosnia and Herzegovina, Kosovo and North Macedonia rely heavily on coal, which translates into higher greenhouse gas emissions. Albania is one of the countries that obtains 100% of its electricity from RES[5]. Türkiye has a balanced energy mix comprising coal, gas and renewable energy sources (RES), while Moldova and Ukraine rely heavily on imported energy and gas or nuclear energy.

Figure 3. Change in CO_2 emissions per capita and GDP per capita, 1990–2024, %



Source: ourworlddata.org

In several countries selected for analysis, including Poland, Albania, Ukraine and Türkiye, different paths of dependence between economic growth and per capita CO_2 emissions are visible, which allows for an assessment of the degree of so-called 'decoupling', i.e. the separation of economic growth from emissions.

5 This small country has achieved something that Europe can only dream of, Farmer.pl, 30 November 2025, (https://www.farmer.pl/energia/oze/ten-maly-kraj-osiagnal-cos-o-czym-europa-dopiero-marzy,168916.html, accessed: 5.12.2025).

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Poland is a clear example of this process – since 1990, Poland's GDP per capita has more than tripled, while CO_2 emissions per capita have not increased and total emissions have fallen by several dozen per cent. This means that Poland has managed to continue its economic development while reducing emissions, mainly through industrial modernisation, improved energy efficiency and a gradual transition to renewable energy sources.

Albania has also seen GDP growth with moderate emissions growth, indicating low dependence of the economy on fossil fuels. The energy mix, based largely on hydropower, means that economic growth does not lead to a proportional increase in emissions.

Ukraine, on the other hand, stands out with a decline in both GDP and emissions, which is the result of the economic transformation after 1990 and the loss of part of its heavy industry, as well as the continuing high poverty rate among its population. In its case, lower emissions are more a result of economic stagnation than deliberate decarbonisation. The current situation is also unique due to the war that has been ongoing since 2022.

Unlike the other countries, Türkiye is characterised by simultaneous growth in GDP and CO_2 emissions, which indicates that these processes are not fully decoupled. Although the rate of economic growth exceeds the growth in per capita emissions, there is still a long way to go before these processes are decoupled due to the fossil fuel-based energy mix.

A comparison of the situation in these four countries shows that achieving sustainable decoupling requires a profound energy transition and a consistent climate policy – where these measures have been systematic and long-term (as in Poland), the effects are more pronounced.

Long-term and short-term reduction targets (NDC, NECP, net zero strategies)

The Paris Agreement obliges parties to submit national contributions, i.e. commitments to take action to reduce greenhouse gas emissions, to the United Nations Framework Convention on Climate Change every five years, with each subsequent contribution expressing a higher level of ambition in terms of emission reductions, and, optionally, adaptation measures.

Overview of actions and commitments reported by countries (NDCs) Türkiye

Türkiye

Türkiye submitted its first intended nationally determined contribution to the UNFCCC Secretariat in September 2015, where it reported a target of reducing greenhouse gas emissions by up to 21% by 2030 compared to the reference scenario. On 13 April 2023, Türkiye submitted its first updated NDC, committing to reduce greenhouse gas emissions by 41% by 2030 compared to the reference scenario, which corresponds to 695 million tonnes of CO_2 equivalent by 2030. Subsequently, on 21 March 2024, the Climate Change Mitigation Strategy and Action

Plan (2024–2030) and the Climate Change Adaptation Strategy and Action Plan (2024–2030) were published, which were developed as tools for implementing the updated NDC[6].

> *Türkiye's climate policy is based on the long-term goal of achieving net-zero greenhouse gas emissions by 2053 (...)*

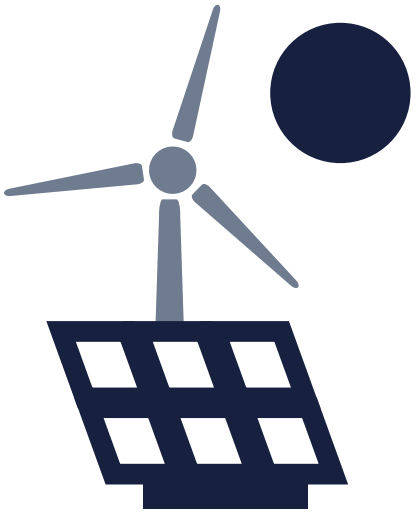
Türkiye's climate policy is based on the long-term goal of achieving net-zero greenhouse gas emissions by 2053, which was announced in 2021 and formalised in the Long-Term Climate Strategy of November 2024. This document provides the main foundation for sectoral climate strategies and emission reduction measures, setting out 89 strategic objectives in 18 sectors. The Environmental Protection Act, which includes the 'polluter pays' principle, is of key importance. Türkiye plans to peak its emissions by 2038 at the latest, which is a key milestone on the road to climate neutrality. Türkiye's National Energy Plan (2023) sets out energy supply and demand projections to 2035 in line with the commitment to achieve net-zero by 2053, including detailed targets for renewable energy capacity, nuclear energy and battery storage, as well as energy efficiency and green hydrogen policies.

Ukraine

The initial GHG emission reduction target for 2030 set out in Ukraine's intended nationally determined contribution was to remain below 60% of 1990 levels. In the updated NDC submitted to the UNFCCC in 2021 to the UNFCCC, a more ambitious greenhouse gas emission reduction target was set - 65% by 2030 compared to 1990 levels, covering emissions from the energy sector, industrial processes, agriculture, LULUCF and waste[7]. In November 2025, the Ukrainian government approved NDC 3.0 under the Paris Agreement, which provides for a reduction in greenhouse gas emissions of more than 65% compared to 1990 levels by 2035[8].

> *Ukraine is committed to achieving climate neutrality by 2060[8].*

Ukraine is committed to achieving climate neutrality by 2060. The National Energy and Climate Plan (NECP) was approved on 25 June 2024 and developed in accordance with EU Regulation 2018/1999, integrating the best practices of EU Member States, within the framework of Ukraine's commitments as a party to the Energy Community Convention and in the context of its aspirations for EU membership.



6 Türkiye 2053 Long Term Climate Strategy, (https://unfccc.int/sites/default/files/resource/Turkiye_Long_Term_Climate_Strategy.pdf, accessed: 05.11.2025).

7 Updated Nationally Determined Contribution of Ukraine to the Paris Agreement, 2020, (https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf, accessed: 05.11.2025).

8 Albania Revised NDC, (Albania Revised NDC.pdf; accessed: 10.12.2025).

Moldova

The Republic of Moldova has committed to reducing greenhouse gas emissions across the economy by 71% by 2030 compared to 1990 levels in its latest NDC 3.0 submission. This represents an increase in ambition compared to the previous 1% reduction target set out in NDC 2.0, where the target was 70%. Moldova has set an absolute target for 2035 to reduce net GHG emissions by 75% below 1990 levels. In the long term, in accordance with Law No. 74 of 11 April 2024 on climate action, the country aims to achieve climate neutrality by 2050, with emissions that cannot be reduced being offset by absorption in the LULUCF sector[9].

> *The Republic of Moldova has committed to reducing greenhouse gas emissions across the economy by 71% by 2030 compared to 1990 levels in its latest NDC 3.0 submission.*

The main sectoral document is the Low-Carbon Development Programme to 2030, approved in 2023, which sets legally binding emission reduction targets in seven sectors, including energy, transport, buildings, agriculture and land use, and identifies implementation priorities such as renewable energy, modernisation (i.e. improving energy efficiency), sustainable mobility and low-carbon agriculture, as well as MRV and a financing plan implemented through the 2024-2026 Action Plan.

Albania

The Republic of Albania submitted its first NDC in November 2015, committing to reduce CO_2 emissions by 11.5% compared to the baseline scenario for the period 2016-2030, which corresponds to a reduction of 708 kilotonnes of CO_2 by 2030. Albania submitted its next NDC in 2021, setting a target of reducing emissions by 20.9% by 2030. Albania has not submitted a new NDC for 2025[10,11].

> *Albania (...) setting a target of reducing emissions by 20.9% by 2030.*

In 2014, Albania established an Interministerial Working Group on Climate Change, which coordinates all institutions involved in climate change activities and facilitates the integration of climate issues into new and existing policies, programmes and actions. In July 2019, Albania approved its National Climate Change Strategy and corresponding national mitigation and adaptation plans. The country has implemented several projects and studies on climate change mitigation and adaptation.

Bosnia and Herzegowina

Bosnia and Herzegovina submitted its first INDC in October 2015. In March/April 2021, it adopted and submitted to the UNFCCC an update of its commitment, i.e. the NDC 2020-2030. The unconditional GHG emission reduction target for Bosnia and Herzegovina for 2030 is 33.2%

9 Government of Moldova, NAtionally Determined Contribution 3.0, (https://unfccc.int/sites/default/files/2025-05/MD_NDC_3.pdf, accessed: 05.11.2025).

10 Albania Revised NDC, (Albania Revised NDC.pdf; accessed: 10.12.2025).

11 Albania First NDC (Updated submission), 12.10.2021, (https://unfccc.int/documents/497221, accessed: 05.11.2025).

compared to 1990. The conditional target (dependent on more intensive international assistance, in particular for the just transition of mining areas) assumes a 36.8% reduction in emissions compared to 1990. In the longer term, by 2050, the country assumed a 61.7% reduction in emissions (without support) and a 65.6% reduction (conditionally) compared to 1990.

The NECP draft was sent to the Energy Community Secretariat on 30 June 2023, and the revised descriptive part and summary of the Secretariat's recommendations were submitted on 28 June 2024. The full version, including the analytical part, has not yet been adopted and is a requirement for completing the NECP approval process.

Serbia

In its first submitted emission reduction commitment, the so-called INDC of 2015, Serbia committed to reducing GHG emissions by 9.8% by 2030 compared to 1990. In its next updated commitment submitted by Serbia in 2022, NDC 2.0. (2022), Serbia set a target of reducing emissions by 33.3% by 2030 compared to 1990. Serbia continues to increase its ambition and in 2025 Serbia submitted a new NDC 3.0 target for the period up to 2035, which was adopted on 4 September 2025. This document sets a target of reducing GHG emissions by 40.1% by 2035 compared to 1990 levels (excluding LULUCF emissions). This target represents a fourfold increase in ambition compared to the original 2015 NDC, as well as a further increase in ambition compared to the 2022 NDC 2.0[12].

> *Serbia (...) aims to reduce GHG emissions by 40.1% by 2035 compared to 1990 levels (excluding LULUCF emissions).*

Serbia has developed a Low Carbon Development Strategy 2023-2030 with projections to 2050, which provides a long-term roadmap for reducing emissions and forms the basis for the updated NDC. The Integrated NECP for 2021-2030 (projections to 2050) defines specific sectoral targets for decarbonisation, energy efficiency and RES development.

Montenegro

Montenegro submitted its first NDC in 2017, committing to a 30% reduction in emissions by 2030 (excluding LULUCF) compared to 1990. Subsequently, in its updated NDC 2.0 submitted in 2021, the 2030 target was set at a 35% reduction in emissions (excluding LULUCF), meaning that the new target represents a significant increase in climate ambition. Montenegro updated its NDC 3.0 in 2025, committing to reduce emissions by at least 55% by 2030 and 60% by 2035 compared to 1990 levels.[13] NDC 3.0 additionally takes into account the LULUCF sector and expanded climate change mitigation measures in the agriculture, industry, transport, infrastructure and waste management sectors[14].

Core strategic documents include the National Climate Change Strategy until 2030 (2015) and the draft NECP (2024), which integrates sectoral

12 Submission of the updated Nationally Determined Contribution of the Republic of Serbia for the period until 2035, 2025, (https://unfccc.int/sites/default/files/2025-09/Republic%20of%20Serbia%20NDC3.0%20Official%20Submission%20Letter.pdf; https://unfccc.int/sites/default/files/2025-09/NDC3%20of%20the%20Republic%20of%20Serbia.pdf, accessed: 10.12.2025).

13 Update of NDC Montenegro, February 2025, (https://unfccc.int/sites/default/files/2025-02/001_eng_NDC_Montenegro.pdf, accessed: 10.12.2025)

14 Ukraine successfully completes its screening proces, (https://unfccc.int/node/645826 ; https://climatepromise.undp.org/what-we-do/where-we-work/montenegro, accessed: 10.12.2025).

policies in five dimensions consistent with EU policy, including decarbonisation, energy efficiency and energy security, with emission projections for 2030 at 3.06 tonnes of CO_2 equivalent (based on current policies) and 2.40 tonnes of CO_2 equivalent (taking into account additional policies) and a share of RES in gross final energy consumption of 43-53%. No long-term strategy has been prepared yet.

> *Montenegro updated its NDC 3.0 in 2025, committing to reduce emissions by at least 55% by 2030 and 60% by 2035 compared to 1990 levels[13].*

North Macedonia

North Macedonia has committed to reducing greenhouse gas emissions by 51% compared to 1990 levels by 2030. Taking into account net emissions (i.e. after deducting LULUCF removals), the country plans to reduce emissions by 82% by 2030 compared to 1990. The updated NDC focuses mainly on climate change mitigation measures, with a view to including an adaptation component in subsequent versions of the NDC, once the relevant national strategic and planning documents have been prepared and adopted[15].

> *North Macedonia has committed to reducing greenhouse gas emissions by 51% compared to 1990 levels by 2030.*

North Macedonia prepared its Long-Term Strategy in 2021. In the case of North Macedonia, the update of the NECP requires full integration with the strategic environmental assessment process and the implementation of the relevant Directive into national law. Although the NECP was adopted in May 2022, the climate targets for 2030 have not yet been legally defined. Work on the National Plan is still ongoing.

Kosovo

Kosovo published its National Climate and Energy Strategy 2019-2028 and the Climate Change Act (January 2024). Both documents served as the basis for the preparation of the NECP and NDC. Although Kosovo is not a member of the UNFCCC Framework Convention, it voluntarily submitted its first NDC in 2025. The submitted NDC is linked to the NECP[16].

In line with the target set out in the NECP, regardless of access to international climate funds, Kosovo has set a target in its NDC to reduce annual GHG emissions by 16.3% by 2030 compared to 2016, which means a reduction in emissions to 8.95 tonnes of CO_2 equivalent in 2030[17].

> *Kosovo has set a target in its NDC to reduce annual GHG emissions by 16.3% by 2030 compared to 2016 (...)*

Kosovo has not informed the Energy Community

15 Enhanced Nationally Determined Contribution, Submission by the Republic of North Macedonia, 2021, (https://unfccc.int/sites/default/files/NDC/2022-06/Macedonian%20enhanced%20NDC%20%28002%29.pdf , accessed: 10.12.2025).

16 Kemi miratuar Kontributin e Përcaktuar Kombëtar (NDC), të parin në historinë e Kosovës, 22.03.2025, (https://mmphi.rks-gov.net/News/NewsArticle?ArticleID=2464, accessed: 10.12.2025).

17 Kosovo's first and voluntary Nationally Determined Contributions (NDC), 2025, (https://ammk-rks.net/assets/cms/uploads/files/DECISION%20GRK%20NO.%2020_253%20The%20Nationally%20Determined%20Contribution%20(NDC)%20of%20Kosovo.pdf, acccessed: 10.12.2025).

of the adoption of the NECP, exceeding the statutory deadline. It must also fully implement the provisions of the Environmental Impact Assessment Directive and the Environmental Liability Directive, and the strategic environmental assessment for the NECP project requires cross-border consultations.

In conclusion, it is clear that all the countries mentioned in the article are making efforts to commit to reducing emissions on an ongoing basis. However, their different baseline situations, differences in energy production methods, and the capabilities of individual countries must be taken into account. The most advanced countries submitted their NDCs in 2025 for 2030, such as Moldova and Serbia, but not all of them submitted updated NDCs in 2025. Earlier NDCs were also not submitted on time and by all parties to the Paris Agreement. When pointing to preparations for EU accession, the different levels of adaptation of countries to EU climate policy should be taken into account. Some are more advanced than others. However, in order to compare their targets, it is also necessary to cite their proposals submitted under the NECP – at least by those countries that have done so.

Table 2. Summary of emission reduction commitments based on NDCs submitted by countries.

Country	Commitment to the emission reduction target	Goal and pursuit of climate neutrality
Türkiye	41% by 2030	2053 r.
Ukraine	60% by 2030 / 65% by 2035	2060 r.
Moldova	71% by 2030 / 75% by 2035	2050 r.
Albania	20.9% by 2030	Aspirational target – 2050 (based on the Sofia Declaration)
Bosnia and Herzegovina	33.2% by 2030 compared to 1990	
Serbia	33.3% by 2030 and 40.1% by 2035 compared to 1990	
Montenegro	55% by 2030 and 60% by 2035 compared to 1990	
Macedonia	51% by 2030 compared to 1990	
Kosovo	16.3% by 2030 compared to 2016	

Source: CAKE/KOBiZE based on submitted NDCs and the Sofia Declaration, 2020.

Sofia Declaration on the Implementation of the Green Agenda for the Western Balkans

Six Western Balkan countries – Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia – signed a special "Sofia Declaration on the Green Agenda for Western Balkans"[18] in 2020, in which these countries committed themselves, among other things, to cooperating with the EU to achieve carbon neutrality on the continent by 2050 through the implementation of climate policy and reform of the energy and transport sectors. The Green Agenda for the Western Balkans covers five areas: climate, energy and mobility, circular economy, pollution prevention, and sustainable agriculture.

Furthermore, the countries committed to the following in the energy and climate area:

- Adapting to EU climate legislation after its implementation, which aims to achieve climate neutrality by 2050;
- Setting forward-looking energy and climate goals for 2030 in line with the Energy Community framework and EU legislation, as well as developing and implementing integrated energy and climate plans containing measures to reduce greenhouse gas emissions in the economies of the Western Balkans by incorporating climate actions into all relevant sectoral policies;
- Preparing and implementing a climate change adaptation strategy to increase resilience by safeguarding investments against the effects of climate change and ensuring greater integration of climate change adaptation measures with disaster risk reduction;
- Continued adjustment to the EU ETS system for the trading of emissions permits, as well as work to introduce other instruments for the carbon pricing to promote decarbonisation in the region;
- Increasing the capacity to implement nature-based solutions to mitigate and adapt to climate change;
- Increasing energy efficiency and the share of RES;
- Reducing and gradual phasing out subsidies for fossil fuels;
- Supporting plans for the renovation of buildings.

18 Sofia declaration on the Green Agenda for the Western Balkans, Regional Cooperation Council, (https://www.rcc.int/files/user/docs/196c92cf0534f629d43c460079809b20.pdf, accessed: 10.12.2025).

Supporting plans for the renovation of buildings (ETS, MRV)

The process of implementing climate policy mechanisms, such as carbon pricing, ETS and MRV (Monitoring, Reporting, Verification) in the countries of the Western Balkans, Türkiye, Ukraine and Moldova remains varied, but is consistently moving towards compliance with the EU ETS framework. In 2025, only Montenegro had a functioning ETS system, while Türkiye, Ukraine and Moldova are at an advanced stage of legislative and institutional preparation. The other countries in the region are developing national MRV systems to varying degrees or planning future implementation of emissions trading in response to the EU's CBAM mechanism.

The most advanced group – Montenegro, Türkiye, Ukraine, Moldova

The Emissions Trading System in Montenegro was introduced in February 2020 as a national mechanism for reducing CO_2 emissions, initially covering three installations: the Pljevlja power plant, the KAP aluminium plant and the Tosçelik steel plant. The operators of these installations had to surrender allowances to cover their emissions, with allocation taking place both through free allocations and auctions. In Montenegro, a linear reduction factor for the emission cap was set, decreasing by 1.5% per annum between 2020-2030, and the minimum reserve price at auctions is approximately EUR 24/tonne of CO_2.

In practice, the operation of the system has been disrupted by changes in government, delays in the adoption of allocation plans, and rising energy prices, which contributed to the closure of two of the three installations covered by the system in 2022. As a result, since 2025, the only installation actually operating under the system is the power plant in Pljevlja. The Montenegrin government is working on revising national legislation to better align the national emission system with the principles of the EU ETS.

In 2025, Türkiye adopted a breakthrough climate law (published on 9 July)[19], establishing the legal basis for Türkiye's national ETS (Turkish Emission Trading System, TR ETS). The law introduces the Carbon Market Board, which oversees the system, approves national allocation plans and sets out the rules for free allowances and offset limits. Auction revenues are to be allocated entirely to green transformation and climate action. The ETS is to be launched on a pilot basis in 2026-2027 and then move into the full implementation phase. The TR ETS system will cover installations in the energy and industrial sectors emitting more than 50,000 tonnes of CO_2 per year, with data to be obtained from the national monitoring, reporting and verification system in place since 2015 (approx. 770 installations). MRV is based on EU standards – annual reports are verified by accredited verifiers under the supervision of the Turkish Directorate for Climate Change.

Work on the Turkish TR ETS is supported by the World Bank as part of a project financing modelling, economic impact analysis and implementation of the national ETS. The pre-accession programme also plans to transpose EU ETS regulations.

In October 2024, Ukraine adopted a law on climate policy[20], establishing a framework for a national

19 https://www.resmigazete.gov.tr/eskiler/2025/07/20250709-1.htm, (accessed: 5.12.2025).

20 https://climate-laws.org/documents/https-zakon-rada-gov-ua-laws-show-3991-ix-text_e74b?id=law-no-3991-ix_aa5b, (accessed: 5.12.2025).

ETS. The system[21] will have an absolute emissions cap and be based on the cap-and-trade principle, with a pilot planned for 2028. Full operation will not take place until at least three years after the end of martial law. The MRV system, in force since 2021, became mandatory again in 2025 after a period of voluntariness caused by the war. The MRV system covers CO_2 and N_2O emissions from the energy, steel and chemical sectors, with annual reporting to the Ministry of Environmental Protection and verification by independent auditors. The law provides for integration with the EU ETS in the longer term, as part of the commitments under the EU-Ukraine Association Agreement.

Moldova continues to work on the introduction of a national ETS based on the Climate Action Act No. 74/2024[22], which largely implements the provisions of the EU ETS Directive on the emissions trading system. The Act introduces the obligation for stationary installations to hold a greenhouse gas emissions permit and specifies a list of activities subject to the obligation to monitor and report emissions. The Environmental Protection Agency has been designated as the competent authority for issuing permits and coordinating emission monitoring plans, and has developed internal procedures in this regard. Moldova has also implemented monitoring, reporting, verification and accreditation rules in line with EU regulations. An obligation to submit annual emissions reports verified by accredited verifiers has been introduced, and penalties for failure to submit a report have been specified. The National Accreditation Centre has been designated as the body responsible for accrediting greenhouse gas emissions verifiers.

Intermediate group – Serbia, Albania

Serbia has a fully operational MRV system, introduced by the Climate Change Act (2021)[23] and detailed in implementing acts issued in 2023-2024. A digital e-GHG platform is operating for reporting and verifying data. An ETS is planned but not yet implemented; its development is envisaged in the 2024 NECP.

Albania has not yet implemented the ETS into its legal system. At this stage, it has adopted the basic definitions from the ETS and is developing a national MRV system[24]. The basic definitions and terms from the EU ETS have been transposed into national law under the Climate Change Act[25]. A requirement to obtain an environmental permit covering greenhouse gas emissions has been introduced and a list of activities subject to emission monitoring and reporting has been defined. A system of financial penalties for operating without the required permit and for failure to monitor or report emissions has also been introduced. Currently, however, the implementation and enforcement of these provisions, including the identification of entities subject to the obligation, the creation of structures and procedures within the competent authority and the application of penalties, remains in the development phase.

21 https://icapcarbonaction.com/en/ets/ukraine, (accessed: 5.12.2025).

22 https://www.legis.md/cautare/getResults?doc_id=143228&lang=ro, (accessed: 5.12.2025).

23 http://www.parlament.gov.rs/upload/archive/files/cir/pdf/zakoni/2021/337-21.pdf, (accessed: 5.12.2025).

24 Serbia races Ahead on ETS preparations, as other Eastern neighbours stall, Carbon Pulse, 10.12.2025, (https://carbon-pulse.com/466412/, accessed: 5.12.2025).

25 https://climate-laws.org/documents/law-no-155-2020-on-climate-change_8c21?id=law-no-155-2020-on-climate-change_1817, (dostęp: 5.12.2025).

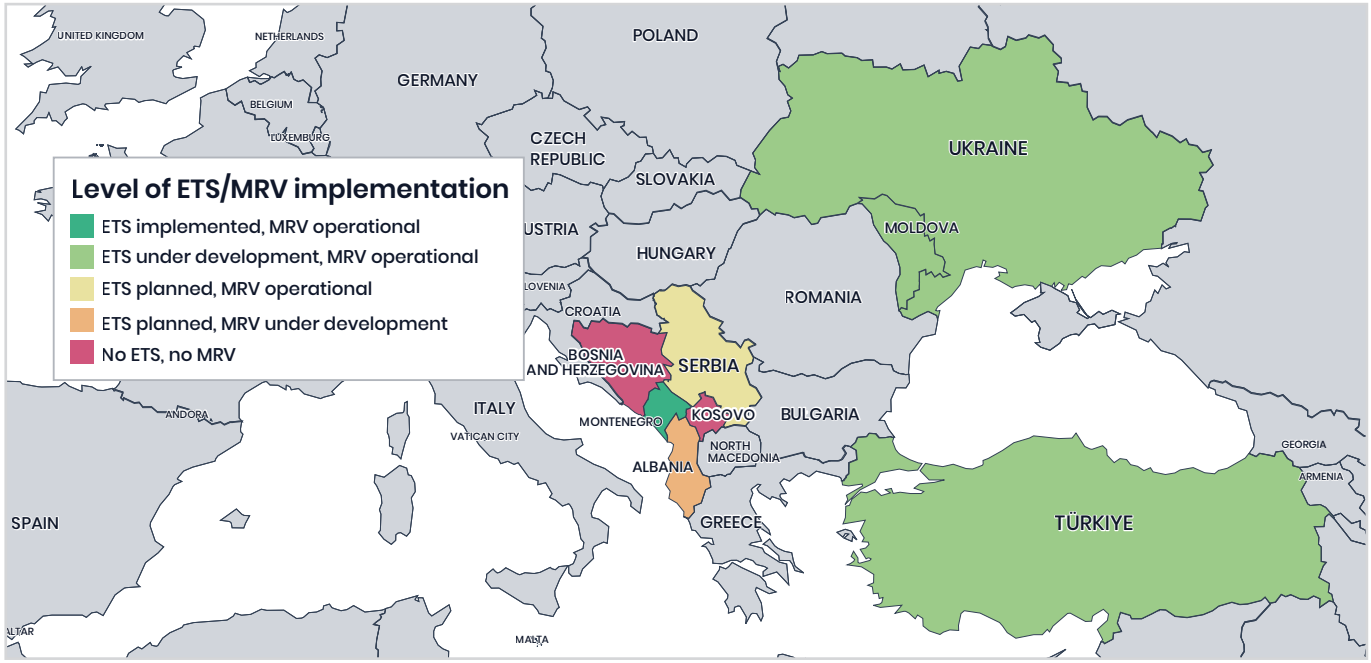
Initial stage – Bosnia and Herzegovina, Kosovo, North Macedonia

Bosnia and Herzegovina does not yet have an MRV system or a national GHG emissions inventory.

Kosovo is just beginning work on the legislative basis for MRV with the support of the Energy Community, and the lack of a legal framework and limited human resources are hampering progress.

North Macedonia is creating the legal basis for MRV and ETS with a view to integrating into the EU emissions market.

Graph 2. Level of ETS/MRV implementation in the analysed countries.



Source: CAKE/KOBiZE

Challenges and possible solutions

In order to accelerate decarbonisation, the foundation of an effective climate policy should be a combination of an efficient emissions monitoring system, a transparent regulatory framework, and stable financial and political support. All analysed countries recognise ETS and MRV as key elements of integration with EU climate policy, but show significant differences in the pace and scope of implementation of ETS systems and emission pricing mechanisms. The most advanced are Türkiye, Ukraine, Moldova and Montenegro, the first of which is implementing a comprehensive climate law, the second and third are preparing to pilot the ETS despite the ongoing war or conflict with Russia, and the latter has an ETS system in place. Serbia and Albania are approaching the implementation stage, while the other countries are at the beginning of this path. Across the region, the EU's carbon border adjustment mechanism (CBAM) is the main driver for the development of national pricing mechanisms.

> *The most advanced are Türkiye, Ukraine, Moldova and Montenegro, the first of which is implementing a comprehensive climate law, the second and third are preparing to pilot the ETS despite the ongoing war or conflict with Russia, and the latter has an ETS system in place. Serbia and Albania are approaching the implementation stage, while the other countries are at the beginning of this path.*

High dependence on fossil fuels, in particular lignite and hard coal, among countries such as Bosnia and Herzegovina, North Macedonia, Kosovo and Serbia, limits the possibilities for decarbonisation, and the lack of clearly defined deadlines for phasing out coal hinders long-term planning. Poor energy efficiency and ageing infrastructure are problems common to most countries in the region. In addition, high dependence on energy imports, e.g. in Moldova, increases fiscal risk and weakens energy security.

High dependence on fossil fuels, in particular lignite and hard coal, among countries such as Bosnia and Herzegovina, North Macedonia, Kosovo and Serbia, limits the possibilities for decarbonisation (...)

Weak institutional capacity, limited financial resources and fragmented climate policy management are another significant barrier. In many countries, responsibilities are spread between ministries and agencies (a problem particularly serious in Moldova, Bosnia and Herzegovina and Kosovo), which delays the prompt implementation of successive versions of the NECP/NDC and pricing mechanisms. Countries such as Albania and North Macedonia are struggling with limited public resources and insufficient administrative preparedness, which slows down the implementation of instruments such as national ETS systems or MRV mechanisms. In Ukraine, the war has further weakened administrative capacity. Other problems stem from low levels of private investment and investment uncertainty in the region.

In many countries, responsibilities are spread between ministries and agencies (a problem particularly serious in Moldova, Bosnia and Herzegovina and Kosovo), which delays the prompt implementation of successive versions of the NECP/NDC and pricing mechanisms.

First and foremost, it is necessary to develop and maintain transparent, reliable systems for reporting emissions. A transparent MRV system is the foundation for both national climate policies and integration with EU mechanisms, including the EU ETS and CBAM. The second strategic area of action is the swift implementation of national emissions trading systems. At the same time, the implementation of a just transition plan is crucial for mitigating the socio-economic effects in coal-dependent regions and for maintaining public support for climate policy. Another challenge is financing the energy transition. Countries in the region have limited fiscal resources, which hinders the modernisation of networks, the development of renewable energy sources and the improvement of energy efficiency. The introduction of environmental charges and the wider use of carbon taxes or emissions trading systems may not only increase pressure to reduce emissions, but also create an additional source of public revenue to finance the transition in agriculture, transport and industry.

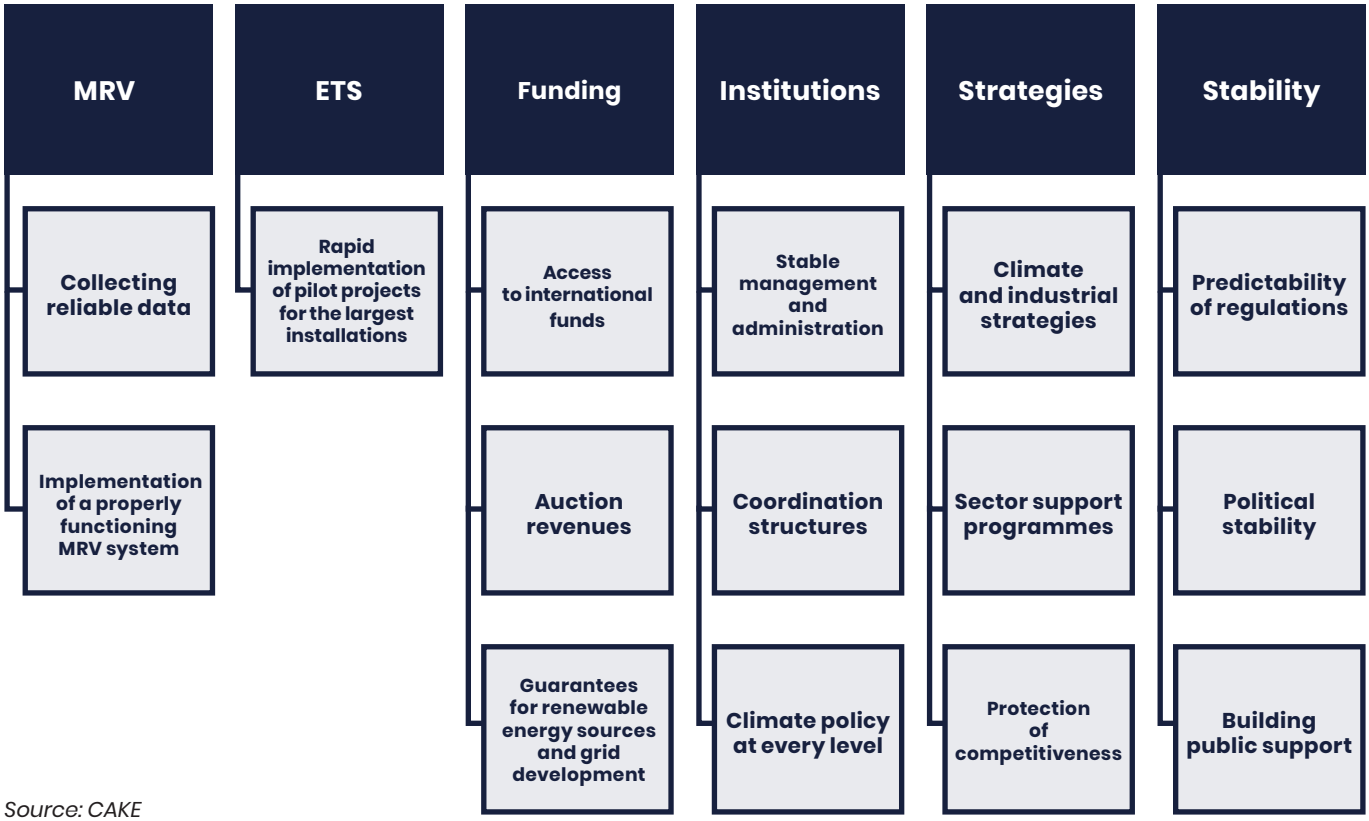
First and foremost, it is necessary to develop and maintain transparent, reliable systems for reporting emissions. A transparent MRV system is the foundation for both national climate policies and integration with EU mechanisms, including the EU ETS and CBAM.

At the same time, institutional and inter-ministerial coordination in the area of climate policy should be strengthened. In many countries in the region, the lack of a clear division of competences between the ministries of energy, environment and economy leads to delays and inconsistencies in action. The implementation of an integrated climate policy management system based on common strategies, timetables and progress assessment mechanisms will avoid duplication of tasks and increase the effectiveness of the implementation of the NECP and NDC. Such solutions have already proven successful in EU member states, where the effectiveness of decarbonisation policy stems from a clear division of roles and continuous cross-sectoral dialogue.

The last but crucial element of the measures is ensuring political stability and regulatory predictability. In many countries in the region, political instability, internal conflicts or wars, and the lack of continuity in climate programmes lead to a loss of investor confidence and a slowdown in the implementation of reforms. Maintaining a stable legal framework, building public support for the transition and actively cooperating with international partners are essential conditions for a successful transition to a low-carbon economy.

The biggest challenge for countries aspiring to join the EU will be to comply with the requirements related to the need to introduce a number of regulations designed to help the EU achieve its climate neutrality goal. The countries of the Western Balkans are making various commitments in this area, and some of them have also set targets and deadlines for achieving climate neutrality. In this context, the new EU regulations and the adoption of an updated greenhouse gas emission reduction target, which for EU countries has been agreed at 90% reduction by 2040 compared to 1990, will certainly be a major challenge.

Fig 3. Key elements for implementing climate and energy transition in the analysed countries



Source: CAKE

„Your countries (Western Balkans) can become hubs to produce, store and share clean energy with the rest of Europe. Today you are signing several investments that will do just that. From clean energy production in all six Western Balkan partners. To energy storage in Montenegro. They will bring the cost of electricity down. And they will also contribute to our collective energy independence. So let me be clear. You are building a new energy backbone not only for the Western Balkans. But for all of Europe..."

Ursula von der Leyen, President of the European Commission, 13 October 2025.

Selected actions and investments in the area of climate and energy policy

1. Energy storage systems in Montenegro

In 2025, the state-owned company Elektroprivreda Crne Gore announced a tender for the construction of two energy storage systems with a total capacity of 60 MW/240 MWh, located at the steel plant in Nikšić (Željezara). The value of the project is EUR 48 million, and the contract covers the full scope of work, from design and supply to commissioning and maintenance of the system. The storage facilities will operate on a four-hour model, which will enable grid stabilization and greater integration of renewable energy sources into the energy mix. If the project is completed on schedule (design in 45 days, installation within 8 months of signing the contract), it will be one of the first large-scale applications of storage systems in the Western Balkans.

https://balkangreenenergynews.com/montenegros-power-utility-seeks-contractor-for-two-battery-storage-systems/

2. Türkiye – hybrid wind-solar-battery project

Polat Enerji has received support (European Bank for Reconstruction and Development + Clean Technology Fund) for the construction of the first hybrid project combining wind, solar and energy storage (10 MWh) next to the existing Geycek wind farm. Total project capacity: approx. 77 MW (combination of solar and wind power).

https://renewables.az/en/news/turkiyes-first-hybrid-wind-solar-battery-project-takes-off-with-ebrd-support

3. Ukraine – 200 MW/400 MWh energy storage facility from DTEK and Fluence

DTEK, in cooperation with Fluence, has launched Ukraine's largest battery energy storage project: six installations with capacities ranging from 20 to 50 MW each, totalling 200 MW and 400 MWh of capacity. The system operates in the Kyiv and Dnipropetrovsk regions and is designed to support grid stability, especially during power outages.

https://dtek.com/en/media-center/news/dtek-and-fluence-energise-the-largest-battery-storage-facility-in-ukraine-with-a-total-capacity-of-200-mw/

4. Moldova – Green Energy Tender Nationwide

Moldova has launched its first major tender for renewable energy: wind farms (105 MW) and PV (60 MW), which is expected to cost a total of around EUR 190 million.

https://www.energias-renovables.com/panorama/moldova-attracts-record-a-190-million-in-20250625

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4 Government of the Republic of Moldova, Nationally Determined Contribution 3.0 (https://unfccc.int/sites/default/files/2025-05/MD_NDC_3.pdf, accessed: 05.11.2025 r.).

5 Joint Statement by Turkish Foreign Minister H.E. Hakan Fidan and EU Commissioner for Enlargement H.E. Marta Kos Following their Meeting in Istanbul (https://enlargement.ec.europa.eu/news/joint-statement-turkish-foreign-minister-he-hakan-fidan-and-eu-commissioner-enlargement-he-marta-kos-2025-07-28_en, accessed: 28.11.2025).

6 Kosovo's first and voluntary Nationally Determined Contributions (NDC), 2025 (https://www.ammk-rks.net/assets/cms/uploads/files/DECISION%20GRK%20NO.%2020_253%20The%20Nationally%20Determined%20Contribution%20(NDC)%20of%20Kosovo.pdf, accessed: 10.12.2025).

7 Montenegro NDC 3.0 A science-based enhancement of ambition aligned with national priorities and development needs (https://undp.org/sites/g/files/zskgke326/files/2025-06/ndc_brief_28.4.25.pdf, accessed: 10.12.2025).

8 Montenegro, UNDP (https://climatepromise.undp.org/what-we-do/where-we-work/montenegro, accessed: 10.12.2025).

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11 Sofia declaration on the Green Agenda for the Western Balkans, Regional Cooperation Council (https://www.rcc.int/files/user/docs/196c92cf0534f629d43c460079809b20.pdf 2021, accessed: 10.12.2025 r.).

12 Submission of the updated Nationally Determined Contribution of the Republic of Serbia for the period until 2035 (https://unfccc.int/sites/default/files/2025-09/NDC3%20of%20the%20Republic%20of%20Serbia.pdf, accessed: 5.12.2025).

13 Third Nationally Determined Contribution Montenegro, 21.02.2025 (https://unfccc.int/sites/default/files/2025-02/001_eng_NDC_Montenegro.pdf, accessed: 10.12.2025).

14 Update of NDC of Montenego, February 2025 (https://unfccc.int/node/645826).

15 Updated Nationally Determined Contribution of Ukraine to the Paris Agreement, 202 (https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf, accessed: 05.12.2025 r.).

16 Law No. 74/2024 on climate action, Moldova, 16 May 2024, Official Journal 209-212, Article 293 (https://www.legis.md/cautare/getResults?doc_id=143228&lang=ro, accessed: 05.12.2025).

17 Law No. 155/2020 on climate change, Albania, 17.12.2020 (https://climate-laws.org/documents/law-no-155-2020-on-climate-change_8c21?id=law-no-155-2020-on-climate-change_1817, accessed: 05.12.2025).

18 Law No. 337/21 on climate change, Serbia, 18 March 2021 (http://www.parlament.gov.rs/upload/archive/files/cir/pdf/zakoni/2021/337-21.pdf, accessed: 05.12.2025).

19 Law No. 3991-IX on Climate Policy, Ukraine, 8 October 2024 (https://climate-laws.org/documents/https-zakon-rada-gov-ua-laws-show-3991-ix-text_e74b?id=law-no-3991-ix_aa5b, accessed: 05.12.2025).

20 Law No. 7552 on climate, 2 July 2025, Turkiye (https://www.resmigazete.gov.tr/eskiler/2025/07/20250709-1.htm, accessed: 05.12.2025).

Challenges of Just Energy Transition. Case of Central Asia

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Key words: Just Transition, energy, climate, climate change, critical minerals, new technologies, energy poverty, Central Asia, decarbonisation, global stocktake, coal, fossil fuels, renewable energy.

Summary

Under the Paris Agreement, Parties to the Agreement and the UN Framework Convention on Climate Change (UNFCCC) conducted in 2023 their first Global Stocktake (GST1) of their progress towards achieving the long-term goals of the Agreement. The outcomes of the GST1 recommend that countries upscale their decarbonization actions as part of their Nationally Determined Contributions (NDCs). The energy transformation should be implemented in line with the principles of Just Transition, meaning that the transition should not undermine the rights of stakeholders and increase the levels of poverty. On the contrary, a just transition means improved energy access in countries and regions where energy is not readily accessible and increased protection of the vulnerable stakeholder groups against the costs of energy transformation away from fossil fuels. Energy transition is also recognised as an opportunity to support low-emission economic development, with important consequences for countries that are endowed with critical minerals and rare earths. This article covers potential challenges linked to just transition approaches and potential opportunities linked to green transition for economies and societies in countries that are rich in fossil fuels but also own large deposits of critical minerals, key for the global decarbonisation, discussing in more detail the case of the five states of Central Asia: Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan and Kirgyzstan. These states in the past had a common energy system, and now cooperate on the regional level in connection with the shared water resources. Kazakhstan, Uzbekistan and Turkmenistan have significant fossil fuel deposits, mainly coal and gas. In parallel, Central Asia has rich deposits of critical minerals, as well as uranium. At the same time, these countries belong to the largest GHG emitters per capita in the world, while a significant percentage of the population lives under the poverty level. Although the region was fully electrified when these countries were part of the Soviet Union, their citizens have to grapple with frequent power cuts. These countries are also highly vulnerable to climate change and have to address

the growing challenges of climate change as well as losses and damages resulting from desertification and catastrophic floods. They grapple with water shortages and the ecological tragedy of the Aral Sea. Regional cooperation and a just transition, including the transformation of the energy sector, is an opportunity for the development of the countries of this region and for mitigating the effects of climate change, which is particularly severe in Central Asia.

Abbreviations: IPCC – Intergovernmental Panel on Climate Change; COP – Conference of Parties; UNEP – United Nations Environment Programme; WMO – World Meteorological Organization; UNFCCC – United Nations Framework Convention on Climate Change, EMDE – Emerging and Developing Market Economy; LDC – Least Developing Country

The imperative of green energy transition

The assessment of the 64 new Nationally Determined Contributions (NDCs) submitted by the Parties to the Paris Agreement shows that the 1.5°C temperature target may no longer be achievable, although politicians remain convinced that the increased efforts of countries to reduce greenhouse gas emissions can still halt and reverse the trend.[1] At current rates of carbon dioxide (CO_2) emissions into the atmosphere, it is impossible to keep average global temperatures from rising to 1.5°C or higher by the end of this century.

Until recently, the scientists maintained that humanity has less than five years remaining until the global carbon budget for 1.5°C runs out.[2] This was also a diagnosis presented in the UNEP annual emission gap report on the 2024 emissions gap.[3] The next UNEP report, due soon, will likely confirm the trend. Recent data from organizations like the UN World Meteorological Organization (WMO) and Copernicus Climate Change Service indicate that 2024 was the first full year the average global temperature exceeded this threshold. According to the WMO forecasts, there is a 70% chance that the current five years period (2025-2029) will see average temperature growth exceed the 1.5 °C. Experts warn that delays in decarbonisation will make the process more costly for all countries, and climate change more impactful, probably irreversible.[4]

> *According to the WMO forecasts, there is a 70% chance that the current five years period (2025-2029) will see average temperature growth exceed the 1.5 °C.*[5]

This does not mean that a retreat from reduction efforts is advocated. On the contrary, both the UN Secretary-General and other politicians, supported by experts, are calling for accelerated decarbonisation and increased ambition

1 'Change course now': humanity has missed 1.5C climate target, says UN head. The Guardian, 28 October 2021 (https://www.theguardian.com/environment/2025/oct/28/change-course-now-humanity-has-missed-15c-climate-target-says-un-head; accessed 3.11.2025).

2 Lamboll, R.D., Nicholls, Z.R.J., Smith, C.J. et al. Assessing the size and uncertainty of remaining carbon budgets. Nat. Clim. Chang. 13, 1360–1367 (2023). (https://doi.org/10.1038/s41558-023-01848-5; accessed 3.11.2025).

3 UNEP, Emissions Gap Report 2024, 24.10 2024 (https://www.unep.org/resources/emissions-gap-report-2024; accessed 28.10.2025).

4 Copernicus: 2024 is the first year to exceed 1.5C above pre-industrial level, (https://climate.copernicus.eu/copernicus-2024-first-year-exceed-15degc-above-pre-industrial-level#:~:text=Copernicus:%202024%20is%20the%20first,above%20pre%2Dindustrial%20level%20%7C%20Copernicus; accessed 4.11.2025).

5 WRI, 1.5 Degrees C: Understanding World's Critical Warming Threshold, June 18, 2025 (https://www.wri.org/insights/1-5-degrees-c-target-explained#:~:text=Has%20the%20Earth%20Already%20Exceeded,1.5%20degrees%20C%20on%20average ; accessed 4.11.2025).

in actions under the Paris Agreement. In the past decade, despite almost all countries subscribing to climate action and supporting the collective long-term goals of the Paris Agreement, global GHG emissions continued to grow, and 95% of the increase occurred in Emerging and Developing Market Economies (EMDEs).[6] To contribute to the goals of the Paris Agreement responsibly, EMDEs must increase the pace of decarbonisation, coupled with the increase in clean energy investments, to divest from unabated coal, replace the decommissioned coal power plants with renewables, and increase energy production from low-carbon and carbon-neutral sources to meet energy needs, growing in response to the population growth and increasing prosperity of citizens.[7]

The IPCC indicated that the existing options in all sectors allow for at least halving global emissions by 2030.[8] Swift energy transitions and clean energy investment in EMDEs will put developing countries on the pathway to decarbonisation and support the achievement of SDGs adopted in policies underpinning NDCs. However, decarbonisation pathways are not without challenges. Lower-income countries and fossil fuel producers may have to spend relatively more to decarbonise their economies and continue low-emissions growth. On the other hand, there are more emissions-saving options in those countries than in more mature economies.[9]

Least-developed and lower-middle-income developing countries with higher levels of exposure to transition should receive international help to achieve their development goals through low-carbon investment from both, public and private sources, while mid-income countries and upper-middle-income countries should be able to tap the financial markets to help them accelerate their decarbonisation efforts.

6 The number of EMDEs ranges from 80 to 154, depending on the indicators used and corresponding data availability. These are all countries undergoing industrialization and experiencing economic growth that have not yet reached the status of advanced economies. Cf. World Bank (2024) Finance and Prosperity 2024. Finance and Prosperity, Washington DC.: World Bank. DOE:10.1596/978-1-4648-2060-1, License: Creative Commons Attribution CC. BY 3.0 IGO, (content - worldbank.org, accessed 3.11.2025).

7 WEF, June 2022, 3 Actions to accelerate emerging market climate transition, (3 actions to accelerate emerging market climate transition | World Economic Forum (weforum.org), accessed 4.11.2025).

8 IPCC WG III report, Climate Change 2022: Mitigation of climate change, IPCC Sixth Assessment Report (AR6), 2022, accessed 3.11.2025).

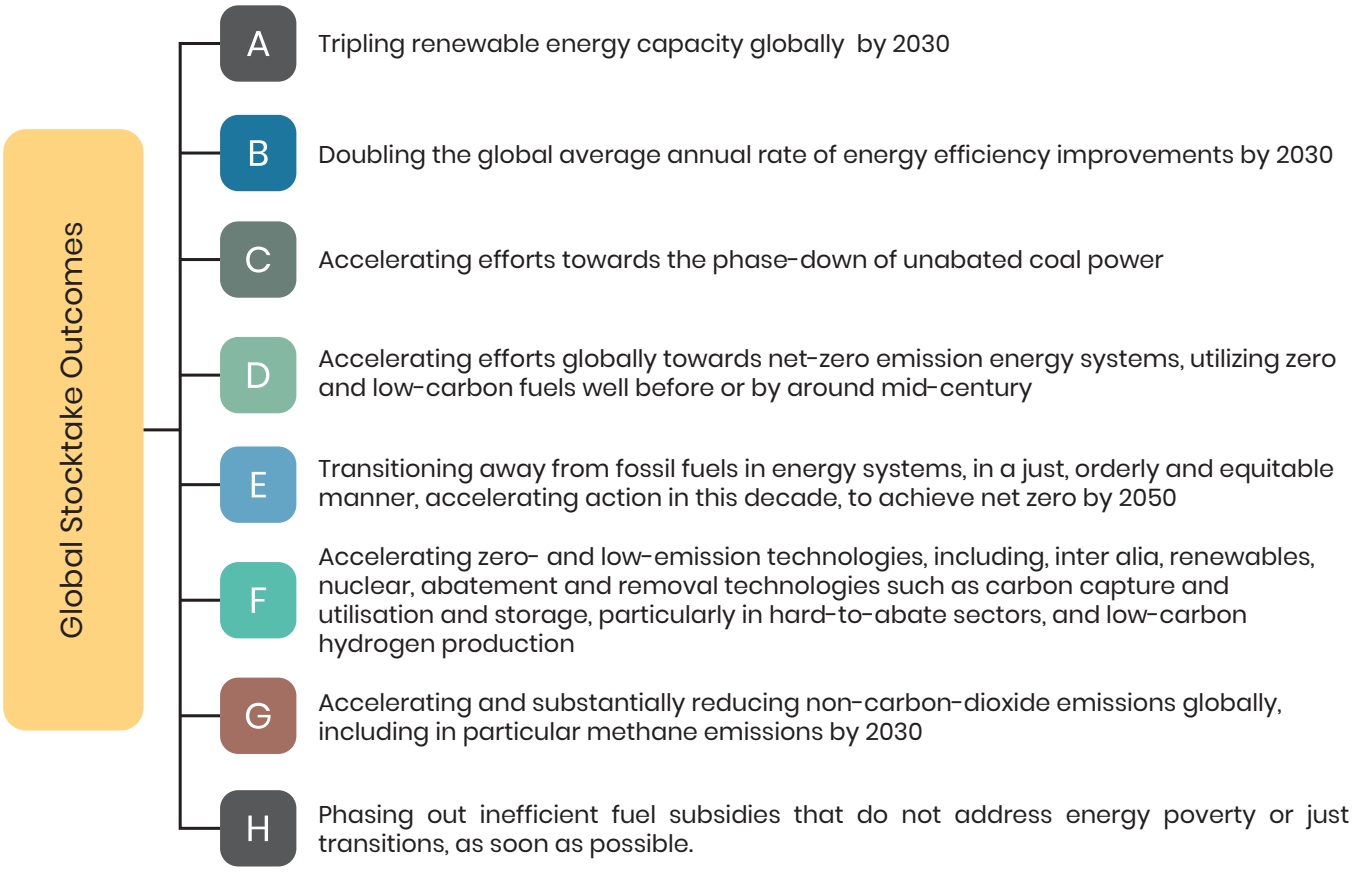
9 IEA, WB, WEF (2021), Financing clean energy transitions in Emerging and Developing Economies. World Energy Investment 2021 Special Report, p.31.

However, decarbonisation pathways are not without challenges.

The world not only needs to accelerate this transition towards a decarbonised energy system that can be supported by removals to contribute to the global net-zero balance but it is also necessary to address the connected fundamental development challenges by ensuring that we are moving fast towards all people enjoying the benefits that energy access confers on the consumers, bearing in mind that the economies can only thrive on abundant, reliable and cheap energy and that energy production and industrial use have to decarbonise rapidly to ensure that we achieve the goals of the Paris Agreement. The shift towards a climate-neutral, resilient economy in line with the 1.5°C goal will not happen without addressing the social aspects of the transition that have to be part of the domestic transition pathways. This concerns also Central Asia, used in this article as an example of challenges linked to transformation of energy systems globally.

Challenges and opportunities of Just Transition in the energy sector and industry

The first Global Stocktake reaffirmed the need to reach net-zero GHG emissions in line with 1.5°C pathways and called on Parties to the Paris Agreement to contribute to eight key global efforts focussed on energy transformation. These goals can still be achieved by countries undertaking decisive actions while reaping the transformative societal and environmental benefits and minimizing the negative impacts of this transition.



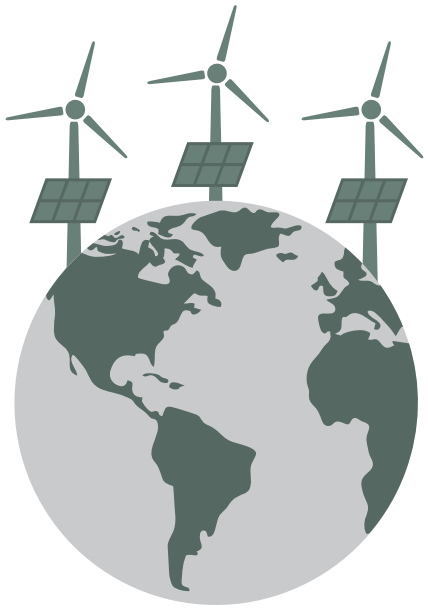
Technological challenges and opportunities

A. Tripling renewable energy capacity globally by 2030:

In 2023 up to 35% of global carbon emissions (about 37.4 GT) came from the energy generation and industry.[10] However, renewable energy sources still provide only a fraction of the global energy mix. According to some estimates, we have been able to deploy so far up to 10% of low-emission technologies that are needed by 2050.[11] Some specific solutions, such as hydrogen use need to be increased at least six-fold from the current levels. On the positive side, this is quickly changing with the overall drop in prices of, especially, solar and wind technologies.[12] The biggest progress in recent years has been noted in greening electricity generation and is expected to continue. Since 2011 total electricity generation increased annually by 2.45% but the growth of non-renewable generation maintained the rate of 1.3% annually. However, decarbonisation of electricity generation is accelerating. In the years 2023-2028, up to 3700 GW of new renewable capacity will be installed globally, accounting for over 42% of global electricity generation.[13]

> *The biggest progress in recent years has been noted in greening electricity generation and is expected to continue.*

Driven by the rapid growth of renewable energy technologies and their plummeting costs, the future global energy supply will rely on electricity produced from the low-carbon energy mix. The low investment costs call for large renewable power investments to be deployed as soon as possible.



Ensuring the stability of electricity supply to all citizens is one of the key Just Transition objectives that EMDEs must achieve on their journey towards decarbonisation. Guided by Just Transition principles of creating new, decent jobs and leaving no one behind, the governments may decide to establish new industrial sectors providing jobs in the production of equipment such as PVs, wind turbines, energy storage equipment (batteries), or developing the EV industry. Industrial policy should be linked to national education strategies to ensure that new opportunities are opening before young people and women can also benefit. Pooling resources in this area of the intersection

10 IEA (2024), CO2 Emissions in 2023, IEA, Paris (https://www.iea.org/reports/co2-emissions-in-2023, Licence: CC BY 4.0, accessed 4.11.2025).

11 McKinsey (2024), The hard stuff. Navigating the physical realities of the energy transition, p.4 (The energy transition: Navigating the physical realities | McKinsey, accessed 5.11.2025).

12 WEF (2022), Action on clean hydrogen is needed to deliver net-zero by 2050. Here's how, (Action on clean hydrogen is needed to deliver net-zero by 2050 | World Economic Forum (weforum.org), accessed 5.11.2025)

13 IEA (2024), Renewables Overview, (Renewables - Energy System - IEA, accessed 5.11.2025).

between education and new technologies should be considered to ensure that countries are well-equipped to benefit from the new industrial revolution.

B. Doubling the global average annual rate of energy efficiency improvements by 2030

Energy efficiency is a measure with negative abatement costs, optimal to reach decarbonisation targets as it combines carbon emission reductions with a net economic gain. EE measures should be deployed along with measures promoting renewables to speed up the energy transition. Energy efficiency measures lower energy demand and energy consumption so, without saying, they are good for the industry and its competitiveness and a bonus for individual customers when they reduce the amount of energy used without impacting the overall quality of services, for example, better energy efficiency standards for household appliances, energy-efficient lighting and efficient heating/cooling systems that lower the energy bills for individual households. Governments can promote energy efficiency by adopting legal and regulatory frameworks establishing norms and targets for industry and buildings.

C. Accelerating efforts towards the phase-down of unabated coal power

In the Glasgow Climate Pact (COP26), all countries were called upon to accelerate their efforts to phase down unabated coal power and inefficient fossil fuel subsidies for the first time in the history of international climate negotiations. Over 40 countries pledged to phase out coal and/or halt financing of investment in oil, gas and coal abroad. A call for accelerating efforts towards the unabated coal power phase-down was included again in the Global Stocktake decision adopted by COP28 in Dubai.

The opportunity costs of the clean energy transition are greater for countries that have abundant fossil resources and have not only produced cheap conventional energy for their domestic consumption but also are major exporters of either electricity produced from fossil fuels combustion or energy carriers such as oil, gas and coal. Countries with energy systems based on fossil fuels face the challenge of switching the established costly high-emissions assets of their current energy systems to new low-emissions assets that may be cheaper to install than large combustion plants but have to be integrated with the existing grids and provided with a back-up supply of electricity stabilising the grid. Such energy-abundant countries lack adequate carbon pricing and sometimes even subsidize domestic consumption of energy. The way forward is to adopt a national strategy of unabated coal phase-out and reject plans for the construction of new coal power plants, diverting resources to the modernisation of electricity grids to enable renewable electricity connections and seeking international financial support to complete the transition.

The opportunity costs of the clean energy transition are greater for countries that have abundant fossil resources and have not only produced cheap conventional energy for their domestic consumption but also are major exporters of either electricity produced from fossil fuels combustion or energy carriers such as oil, gas and coal.

Coal divestment is also regarded as a matter of public health. By investing in now relatively cheap technologies such as wind and solar, countries divesting from fossil fuels can reap the co-benefits of clean development such as clean air and reduce the costs of respiratory diseases to the public health system and the economy.

D. Accelerating efforts globally towards net-zero emission energy systems, utilizing zero low-carbon fuels well before or by around mid-century

Low-carbon fuels include biofuels, biodiesel, biogas and biomethane, solid biomass, renewable hydrogen and e-fuels produced from renewable hydrogen (e-kerosene, ammonia, methanol), to be used in transport, buildings and industry. Two-thirds of the growth in renewable fuel use is concentrated in India, China and Brazil, USA and Europe. IEA predicts that by 2030, bioenergy will increase to near 6% of global industry, building and transport energy demand.[14]

E. Transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner, accelerating action in this critical decade, so as to achieve net zero by 2050 in keeping with the science

It is almost a paradox but countries grappling with, until now, the biggest problems of ensuring universal access to energy to their populations are in a better position to achieve net-zero emissions while pursuing their development goals and lifting their populations out of poverty than countries that have access to conventional energy now but need to decarbonise rapidly, because of the opportunity costs that industrialised countries face in dealing with stranded conventional energy assets while simultaneously addressing the impacts of climate change on their economies and societies. Countries that have not been able until now to provide universal energy access at basic levels to their citizens will be able to incrementally add new renewable capacity starting with solar panels that can be installed everywhere but are an excellent choice especially where there are no transmission grids and solar radiation is abundant. Solar panels are also affordable and a big improvement in places without electricity, even without storage.

The affordability of green energy technologies is the opportunity to develop sustainable electricity generation leapfrogging the fossil fuel stage and providing energy that ensures clean air and for that reason brings health benefits to the population. As energy is partly lost in transmission, dispersed generation may be more efficient, especially when energy storage can be provided and an electricity grid is absent. With the remarkable drop in renewables investment costs of solar and wind became affordable and can be deployed at scale in remote areas until now deprived of electricity. For poor countries, upfront investment costs have been until recently the key barrier to cross on their electrification pathway. With the rapid fall of renewable technologies and financial institutions committing to financing renewable power generation instead of coal, this barrier is no longer insurmountable. Moreover, many older

14 IEA (2024), (Renewable fuels – Renewables 2024 – Analysis - IEA, accessed 5.11.2025).

generation fossil fuel plants are often at the end of their lifetime and will have to be replaced, providing an opportunity to modernise and reduce emissions through a fuel switch and new technologies while adding new capacity in renewable energy assets.

> *The affordability of green energy technologies is the opportunity to develop sustainable electricity generation leapfrogging the fossil fuel stage and providing energy that ensures clean air and for that reason brings health benefits to the population.*

The best results can be achieved by innovative approaches that may be proposed locally by stakeholders who know better the challenges and opportunities of green transition than the national-level authorities. A systems approach to energy transformation based on the principles of circular economy can be deployed at national and subnational levels, creating valuable economic opportunities and lowering the costs of transition while providing multiple benefits.

To speed up transitions away from fossil fuels countries should adopt net-zero compatible power sector roadmaps with deadlines for full coal phase-outs. Coal power with carbon capture and storage may be an option to consider where water resources are abundant as coal power and CCS require considerable amounts of water and CCS is energy-intensive so this solution may be not suitable for deployment in some countries at a scale.

F. Accelerating zero- and low-emission technologies, including, inter alia, renewables, nuclear, abatement and removal technologies such as carbon capture and utilisation and storage, particularly in hard-to-abate sectors, and low-carbon hydrogen production

Green manufacturing is one of the major drivers of carbon neutrality. Green manufacturing processes reduce emissions and improve energy efficiency. Countries that are rich in deposits of critical raw materials may profit from exporting these materials and establish domestic manufacturing of green technologies such as solar PVs, wind turbines, batteries or EVs. Batteries are the most known form of energy storage and are already used universally to power computers, phones, portable electric devices and EVs so other high-tech industries can flourish as well.

If countries are also divesting from fossil assets, new industrial facilities can be located in those parts of the country that are losing industry and jobs as a result of decarbonisation. Green manufacturing will provide employment opportunities for coal miners and workers likely to lose jobs due to energy and industry transformation if manufacturing facilities are set up in deindustrialising regions. For that to happen, industrial policies and regulations have to attract investment to such regions through incentives such as simplified permitting, tax breaks and access to a stable energy supply. Some of these jobs will be created by public sector interventions. However, the governments will need to provide a legal and regulatory environment enabling private investment, ensuring the right incentives, coordination, and

partnerships to capitalise on these opportunities and provide economic opportunities for their populations, applying just transition principles to their energy decarbonisation policies. Capacity building, enabling workers from fossil fuel industries to requalify, and young people to get the necessary skills, should be part of the transition packages. Women can be promoted and encouraged to get an education enabling them to join the workforce in green manufacturing using new technologies.

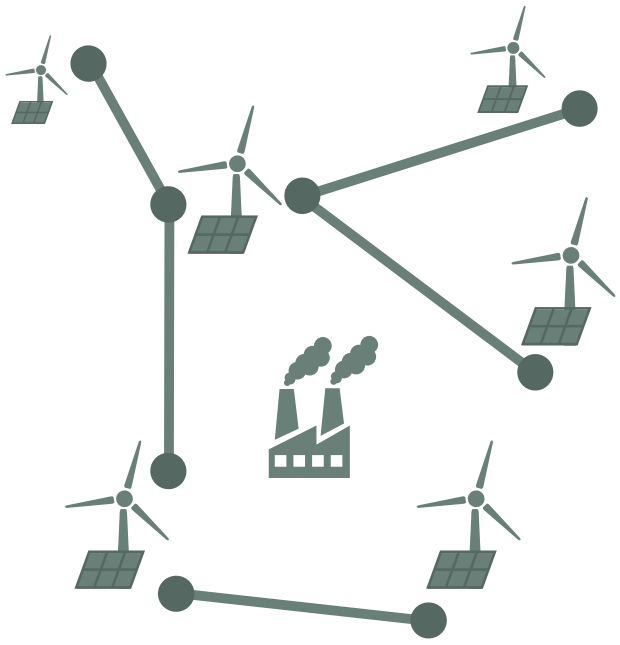
Countries that have good conditions for developing wind power or solar power plants can look at developing green hydrogen production as the next step on the renewable energy ladder. Green hydrogen can be produced at scale when sufficient expansion of renewable electricity is achieved to enable this energy-intensive production. Countries with large renewable electricity production will be able to power their transport with hydrogen and may also export it to other countries, diversifying their energy exports. Production of blue hydrogen is an option for countries that have significant natural gas resources.

G. Accelerating and substantially reducing non-carbon-dioxide emissions globally, including in particular methane emissions by 2030

Methane emissions from the energy sector, coal mines and extraction of oil and gas are a problem that should be addressed vigorously by fossil fuel producers. Gas venting, flaring, and leakage account for a significant waste of energy and profits as well as preventable methane emissions. A global effort to reduce methane emissions and tackle non-emergency flaring would save at least 210 billion cubic metres (BCM) of natural gas which could be made available to gas markets.[15] Gas flaring and venting not only harms the climate but also adversely impacts the health of local communities.

> *A global effort to reduce methane emissions and tackle non-emergency flaring would save at least 210 billion cubic metres (BCM) of natural gas which could be made available to gas markets.[15]*

Methane leaks from natural gas extraction and transmission are a serious problem in countries that are rich in fossil fuels. One of the regions affected by the leaks is Central Asia. In 2023, Kazakhstan experienced one of the worst methane leaks ever recorded, at a remote well owned by Burachi Neft near the Caspian Sea. According to the US EPA, an estimated 127,000 tonnes of the gas escaped, starting with a blowout on 9 June and followed by a fire that lasted 6 months.[16]



15 IEA (2022) The energy security case for tackling gas flaring and methane leaks (The energy security case for tackling gas flaring and methane leaks (iea.blob.core.windows.net, accessed 5.11.2025).

16 Kazakhstan: Methane mega-leak went on for months, (bbc.com, accessed 5.11.2025).

A Just Transition approach to methane emissions should take public health concerns and the health costs to the population into account and the environmental costs as well as economic considerations to prepare a phaseout strategy for methane leakage in cooperation with all the stakeholders with a 2030 target to bring these emissions to zero.

H. Phasing out inefficient fuel subsidies that do not address energy poverty or just transitions, as soon as possible

Inefficient fuel subsidies are a significant obstacle to clean energy transformation in the majority of developing countries. Subsidies may benefit all consumers or target only less affluent citizens or industries. While helping out poor citizens by providing affordable energy at the basic levels to prevent energy poverty is a recognised policy measure, subsidising conventional energy so that it is universally cheap increases carbon emissions and disincentivises people and enterprises from saving energy or investing in energy efficiency measures. Calls to end fossil fuels subsidies, which do nothing to address poverty, have been repeated since COP26 and were reiterated at COP28. However, the problem of fuel subsidies has not been resolved in countries that fear social unrest due to the removal of subsidies and are concerned about carbon leakage in their economies. There is a lack of understanding that misdirected subsidies harm economies and delay transition efforts and therefore must be phased out. The clean energy transition should incorporate national policies that ensure affordability and equity in the distribution of the costs and benefits of the transition.

Inefficient fuel subsidies are a significant obstacle to clean energy transformation in the majority of developing countries.

In Central Asia, electricity production costs have been historically on average more than one-third above tariffs charged to end users. Particularly, natural gas and electricity subsidies create market distortions which disincentivize investments in renewable energy technology and energy efficiency as tariffs do not reflect the costs of energy production, transmission and distribution. Because of that, subsidies constitute a barrier to investment in transmission and distribution infrastructure. Customers and enterprises are also less interested in renewable energy when they have unrestricted access to abundant and cheap conventional energy that is not priced in line with the carbon footprint. Subsidies are also a significant burden on public finances. The IEA estimates that in 2020, Uzbekistan's implied subsidies on natural gas, electricity and oil amounted to USD 3.8 billion, equivalent to 6.6% of the country's GDP.

In Central Asia, almost all citizens have access to electricity. However, energy tariffs applicable to electricity and heating are subsidized to ease the burden on people living below the poverty line. In Tajikistan, this is half of the population.

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Financial challenges and opportunities

The International Energy Agency (IEA) points out that the transition to clean energy in EMDEs is contingent upon the availability and affordability of capital. Currently, EMDEs hold only 10% of the global financial wealth but have to heavily invest in green energy. They have to enhance their financial stability and strengthen the resilience of the financial sector, avoiding a significant accumulation of government debt, as they are confronted with a greater level of climate risk exposure and a greater climate finance gap compared to advanced economies.[17] Since EMDEs do not have sufficient financial resources to deliver renewable capacity growth at the required levels, external financial support is needed, coming from international funds and private investors. According to IEA, to address the climate finance gap, it is necessary to shift the finance portfolio from predominantly public sources to over 70% of clean-energy investments coming from private sources.[18] Nonetheless, the costs associated with EMDEs' accelerated energy transition are estimated to be in the range of US$1 trillion annually.

Nonetheless, the costs associated with EMDEs' accelerated energy transition are estimated to be in the range of US$1 trillion annually.

EMDEs are also grappling with a low level of development in the financial sector that is exacerbating the challenge of financing the green energy transition. Building the capacity of local financial institutions will help MDBs and private investment funds allocate financial resources to support developing countries on their decarbonisation pathways. Foreign and domestic investment is needed at all stages of energy production and consumption, from mining, supply chains, generation, and manufacturing, through addressing stranded assets and energy inefficiencies, to new technologies and storage. The increase in the installed capacity will drive the investment costs down, helping the energy shift away from fossil fuels.

A blueprint for support and financing to help developing countries kick-start the transformation of their fossil fuel-dependent economies has been provided by Just Energy Transition Partnerships (JETPs). The idea behind JETPs is to provide targeted financial support under cooperation agreements between the international partners' group of advanced economies and individual developing countries in order to help the latter accelerate their decarbonisation. The first JETP was established between a group of donors and South Africa at COP26, followed by similar agreements with Vietnam and Indonesia. All these countries are characterised by a significant reliance on coal for their electricity generation. To make rapid progress on the path to decarbonisation, they must rapidly scale up near-term investment in renewable energy capacity and resign from their previous plans to expand their energy sector by investing in coal power plants. A JETP with Senegal belongs to another type of partnership as it is aiming at helping Senegal bypass a coal phase-in by developing its energy sector as a low-carbon, resilient and sustainable system ensuring

17 World Bank (2024), Finance and Prosperity 2024, Executive Summary, p. VII.

18 IEA, Financing Clean Energy Transitions in Emerging and Developing Economies, World Energy Investment 2021 Special Report, (The landscape for clean energy finance in EMDEs – Financing Clean Energy Transitions in Emerging and Developing Economies – Analysis - IEA; accessed 23.09.2025).

universal energy access for all citizens. Financing transformation through a range of innovative instruments provided by the private sector will be possible when countries ensure investment-conducive governance frameworks and adopt long-term low-emission development strategies outlining their decarbonisation pathways backed up by the consecutive NDCs.

More affluent ECA countries with robust growth are also expected to finance a major share of their transformation costs while the poorest developing countries may count on reater external support through FDA and international financial institutions.

More affluent ECA countries[19] with robust growth are also expected to finance a major share of their transformation costs while the poorest developing countries may count on greater external support through FDA and international financial institutions. The costs of transformation of developing countries and ECA countries are also not easily compared. In poor countries, the green transformation is about green growth from often a low threshold, and stranded assets are less of an issue. ECA countries must also address the opportunity costs of divesting from fossil fuels and stranded assets. To compound the problem, mature renewable energy technologies are no longer additional and as such do not qualify for carbon market projects, be it Article 6.4 or voluntary.

Human challenges and opportunities

Ensuring access to affordable, reliable, sustainable and modern energy is one of the Sustainable Development Goals (SDG7) adopted unanimously through Agenda 2030 for Sustainable Development (the 2030 Agenda) by the UN Member States in 2015. Policies designed to achieve that goal can support progress towards the majority of other SDGs, starting with SDG13 (Climate Action) and contributing to SDG1 (No poverty), SDG 10 (Reduced inequalities), SDG3 (Good health and well-being of the population coming with reduced air pollution), SDG8 (Decent work and economic growth), SDG5 (Gender equality), SDG 9 (promoting sustainable industrialisation, fostering innovation and building resilient infrastructure) and SDG11 (Promoting sustainable cities and communities). However, universal access to energy would also lead to countries making good progress towards SDG4 (Access to quality education and vocational training for all) and achieving SDG2 (Ending hunger by supporting agriculture and food production through the increased availability of clean energy in rural areas), ultimately progressing on the pathways to SDG6 (Clean water and sanitation) and SDG 15 (Life on Land) by contributing to reduced deforestation and forest degradation. Since the impacts of climate change and the impacts of mitigation activities on people and communities may differ, any potential negative consequences of decarbonisation should be addressed by the governments and other stakeholders in a just and equitable way, while all benefits should be maximized, bringing about fair outcomes. Just energy transition will lower the vulnerability of stakeholders that stand to lose from decarbonisation and address inequality, prevent the increase in poverty and create decent, green jobs for workers that have to retrain and young people looking for jobs after completing their education, providing new employment opportunities for women.

19 Europe and Central Asia (World Bank regional classification terminology).

Ensuring access to affordable, reliable, sustainable and modern energy is one of the Sustainable Development Goals (SDG7) adopted unanimously through Agenda 2030 for Sustainable Development (the 2030 Agenda) by the UN Member States in 2015.

A key approach to transformation is to ensure it is just. Just Transition is a key enabling approach for ensuring that countries are working towards strengthening governance, providing affordable financing and increased buy-in from all stakeholders including governments, businesses, financiers and non-state actors, and representatives of vulnerable population groups. For a decarbonisation strategy in any sector to be impactful, policymakers need to take into account the social and economic dimensions of the planned policies, including the costs of inaction which are expected to be debilitating for many regions and countries. The social dimensions will not be limited to workers employed by the decarbonising industry or region which developed as a hub for industrial activities using fossil fuel energy. The transition will have wider implications for workers' families and communities they are part of, and, more broadly for consumers and the society. Some workers will be impacted negatively as they will have to look for new jobs. The government interventions at both, national and local levels will not only have to replace the lost jobs but also will be expected to bestow additional benefits on the local population and kick-start the green transition of the whole economy. For underdeveloped regions with working-age populations, greenfield investments providing clean energy jobs in industries based on new technologies are a chance to develop, leapfrogging into a net-zero decarbonised future, and draw even more investment attracted by clean energy and a new low-carbon economy.

Green and just transition calls for flexible, bold policies and measures, engaging the stakeholders in decision-making and implementation by establishing an effective social dialogue and maintaining it through the transformation process. Ensuring that the transition is just and accepted by the stakeholders requires careful analysis of all the potential impacts of the energy transition taking into account the national circumstances and deciding how these can be prevented or compensated. It is also about furthering SDGs improving the economic prospects of the disadvantaged population groups and providing a stimulus to green economic growth.

A key approach to transformation is to ensure it is just.

Transition cannot be achieved without effective social dialogue promoting equitable transformation towards a low-carbon economy and environmentally sustainable society, addressing systemic and capacity constraints and creating an enabling environment through improved regulatory frameworks and policies, capacity-building and market solutions. Decarbonisation of the energy sector will affect everyone, and governments need to map all the stakeholders to determine what policies and measures will ensure that the transition is fair and inclusive. At the national level, long-term planning requires that the density of population in all regions, data on age and gender, demographic trends, education levels, mobility and public health are considered together with the economic and environmental factors that may impact the feasibility of the planned

development pathways. Stakeholders mapping enables governments to invest in infrastructure, innovation, education, and other areas, essential for developing a competitive edge in global markets, where it matters the most. Preparing green transformation plans with just transition in mind, it is necessary to identify all stakeholders that need to be consulted, engaged and empowered in the transition planning and implementation. Vulnerable population groups such as workers in coal mining and fossil fuel extraction and processing, workers in energy-intensive processing industries (EPIs), workers in the supply chains, women, youth or elderly people will be affected during energy transformation in several ways and should be included in the process identifying these impacts and designing policies that will strengthen the positive outcomes and prevent or eliminate negative ones.

> *Transition cannot be achieved without effective social dialogue.*

Social dialogue on the energy transformation at the national level should be based on cooperation and permanent interaction of the government, employers and workers. This model of cooperation is known as tripartite consultations and it is usually formalised as a Tripartite Commission or a Tripartite Council. The tripartite consultations are a forum for all matters relevant to the social dialogue which should be extended to energy production and mining and energy-intensive industry organisations, major municipalities and SMEs that are not associated with big employers organisations, consumer organisations and other NGOs.

At the local level, the identification of stakeholders is necessary to ensure high levels of stakeholders' participation in local strategic development. This process is especially important in those countries where public administration reforms have led to decentralisation and transfer of responsibilities to the lowest levels of government. The ESG standards require effective stakeholder engagement, including everyone from investors, employees and customers to the governments, and public administration of countries in which companies operate, to the local communities in the vicinity of industrial facilities. ESG materiality assessments enable companies to identify the stakeholders who are most concerned with or affected by their business. Local governments, on the other hand, need to look beyond the direct impacts of the planned business activities to assess how these will influence the local population in the long term. Stakeholders mapping will therefore yield different results, depending on the problems that are going to be addressed and the local economic and social landscape.

The best results can be achieved by innovative approaches that may be proposed locally by stakeholders who better understand the challenges and opportunities of green transition than the national-level authorities. A systems

approach to energy transformation based on the principles of circular economy can be deployed at national and subnational levels, creating valuable economic opportunities and lowering the costs of transition while providing multiple benefits.

Energy transformation will also impact the industry. Just transition principles support industrial policies by putting a greater emphasis on social and demographic contexts, in this way strengthening the implementation of these policies. Deep emission reductions will have to be achieved in transport and power-intensive sectors such as cement and other construction materials, steel, aluminium or chemicals. Transformation of the energy-intensive industry through a pivot away from using fossil fuels both as energy sources in the production of energy-intensive materials such as steel and cement and as a feedstock in the production of chemicals and plastics is the biggest challenge and options for synergistic policy interventions in different sectors should be prioritised, with adequate carbon pricing recognised as the best approach to accelerate the transition. The energy transformation may lead to changes in the production processes and changes in the employment levels, with consequences for workers such as the necessity to acquire new skills or look for other jobs. The industrial transformation will also have consequences for the supply chains and companies cooperating with energy-intensive industries. Apart from scope 1 stakeholders, all these sectors have also their scope 2 and scope 3 stakeholders that will be impacted by the rapid transformation in one way or another. They will need new jobs, fiscal instruments facilitating internal migration, training and education, housing, childcare and schools for children and other forms of support that call for integrating a just transition approach into economic and social policies.

Just transition principles support industrial policies by putting a greater emphasis on social and demographic contexts, in this way strengthening the implementation of these policies.

Decarbonisation of energy generation is not only about replacing fossil fuels with clean energy but also about providing jobs for workers employed in coal mining and crude oil extraction and refining, coal power generation, gas power plants, electricity transmission and distribution that are and will be increasingly impacted by the shifting energy paradigm. The jobs and livelihoods of these workers and their families are at stake and negative impacts will be felt also by subcontractors and suppliers of the current energy production and distribution systems and, more broadly, the economy of decarbonising countries at national and subnational levels. It is the task of the governments to ensure that the transition to net-zero climate resilient societies is not implemented at the expense of people, workers and households in vulnerable situations and that the energy systems transformation is just, reaping the societal and environmental benefits and minimising negative impacts. Investing in new green technology industries will provide new employment but the transition will not happen without the governments providing the necessary regulatory frameworks facilitating the transition, energy tariff reforms, financial assistance, incentives for investors and capacity-building.

In middle-income countries and advanced economies, poorer households that spend a significant part of their net income on food and housing may face energy poverty when the energy prices go up.

In middle-income countries and advanced economies, poorer households that spend a significant part of their net income on food and housing may face energy poverty when the energy prices go up. The measure of energy poverty is the level of expenditure on all energy services above a predefined threshold. Energy-poor households are often the working poor or the unemployed, low-skilled, chronically ill or old people, single mothers experiencing poverty or social exclusion, severe material or social deprivation and unemployed or casual workers, often in informal employment. Single-person households, working poor, single mothers with children, or old people are among the first to suffer from the increased energy costs. To address fuel poverty, the governments may either choose policies increasing the affordability of energy – aiming to reduce the proportion of income that households have to spend on energy or opt for policies supporting energy efficiency – providing financial support to energy efficiency measures such as insulation of buildings and subsidising energy efficiency and renewable energy investments for poor households. The second option may seem more expensive, engaging public administration at the local levels and not immediately felt by recipients of support but it reduces overall energy consumption and significantly contributes to countries achieving their decarbonisation goals while also creating jobs in construction, building materials, heating and cooling equipment and increasing demand for all these goods and energy-efficient household appliances and thereby providing a stimulus to the economic growth.

Just Transition potential in Energy and Industry Sectors in Central Asia

Central Asia is a region particularly vulnerable to climate change. The region comprises upper-middle and low-income countries among the most climate change vulnerable in Eurasia. It includes five countries with similar climatic circumstances, experiencing similar problems with adaptation to climate change, grappling with intermittent draughts and flush floods, and struggling to match water supply from shared waterways to the exponential water demand which calls for increased levels of transboundary cooperation and decisive actions to save and recycle water. In recent years Central Asian countries have been experiencing robust growth, based on their mining sectors, energy, construction, agriculture, food production and sectors servicing tourism (such as hospitality, food, retail and wholesale trade) and textiles industry (Kyrgyzstan)[20] Although endowed in natural resources, they grapple with high levels of poverty among their populations and are dependent, sometimes heavily, on short-term capital flows.

Heavy reliance on fossil fuels and energy-intensive industries results in per capita emissions in this region and energy consumption per unit of GDP among the highest in the world.[21] Three

20 EBRD (2023), EBRD forecasts strong economic performance in Central Asia, (accessed 7.11.2025).

21 World Bank 2024, Greening the Economy of Europe and Central Asia, (Greening the Economy of Europe and Central Asia (worldbank.org), accessed 7.11.2025).

of the five, Kazakhstan, Turkmenistan and Uzbekistan are often characterised as petrostates. These countries have abundant fossil fuel resources and export oil and gas. As exporters of fossil fuels, these countries will be particularly affected by the reduced demand and will have to replace current exports with other revenues balancing their current accounts. They will also have to address the problems with transitioning to a decarbonised energy system, upscale the production of green electricity, invest heavily in grids, decommission coal mines, initiate retraining the workforce now working in fossil-fuels dependent industries such as mining or refineries while designing social safety and compensation schemes for older workers employed in these industries, and direct vocational training and education towards new, green jobs, to mention just a few key socio-economic policy challenges ahead.

The five Central Asian states: Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan have already been linked by the Central Asian Power System - CAPS in the Soviet times.

The remaining two Central Asian economies, Kyrgyzstan and Tajikistan, which also have some coal, oil and natural gas deposits but are in a happy position to have significant hydropower potential, currently underused, could become a driving force behind renewable energy transformation. Only between 6 and 10% of that hydropower potential is generating electricity now, leaving ample room for growth. However, Tajikistan and Kyrgyzstan have been grappling with hydropower infrastructure problems and water shortages. Problems with the maintenance of decrepit post-Soviet infrastructure such as gas pipelines, grids or district heating networks affect all Central Asian states. In the case of Tajikistan and Kyrgyzstan, these problems are crippling hydropower electricity production to such an extent that over the past 30 years, especially in the summer, both countries have been rationing electricity in some rural areas.[22]

Even though the two countries are the poorest of the five, their renewable power capacity in a decarbonised world could give them an important role in the region. Not only these two countries could potentially provide backup capacity for the deployment of domestic renewables other than hydropower, but they could also increase exports of green electricity after fully satisfying domestic demand. They could also provide a similar backup service stabilizing the grid to the remaining three neighbouring countries, thereby supporting their shift to green energy (solar and wind) in the framework of the future cooperation agreement which could become a regional just energy partnership. The five Central Asian states: Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan have already been linked by the Central Asian Power System - CAPS in the Soviet times. The energy network supplied hydroelectricity generated by Kyrgyzstan and Tajikistan to

22 Tajik authorities officially introduce power rationing in rural areas, Asia-Plus, 23.09.2024, (Tajik authorities officially introduce power rationing in rural areas | Tajikistan News ASIA-Plus (asiaplustj.info), accessed 7.11.2025).

downstream countries and coal-generated electricity to the upstream countries. Regional cooperation on energy has been undermined by concerns over the water supply and growing energy demand in all five countries. In 2003 Turkmenistan disconnected from the CAPS, followed by Uzbekistan and Tajikistan. Having rejected interconnectivity, Central Asian countries embarked on setting up their internal, independent energy production capacity, in the case of Kazakhstan – mostly based on coal. A return to the regional approach, with countries reintegrating their systems, could greatly reduce the costs of energy decarbonisation and facilitate electricity greening at scale. However, the five countries would have to negotiate an agreement acceptable to all, replacing current bilateral arrangements and overcoming neighbourly distrust that emerged after gaining independence in the 1990s.[23] Efforts are made to improve the interconnectivity such as the ongoing modernisation and construction of a high-voltage power grid, co-financed by the ADB. Countries also have to improve internal connectivity, now fragmented. Regional gas networks enable gas supplies from Uzbekistan to Kazakhstan and Kyrgyzstan but, at the same time, domestic networks do not link regions at subnational levels. The existing networks are inefficient, old and leaky, adding to the general inefficiency of the power and electricity systems. It would therefore make sense to look towards strong regional cooperation and trade in energy. This is now understood by the governments of Central Asian states who increasingly look at options to deepen energy cooperation in the region.[24] It could be upscaled to green electricity to provide enough green energy to households and industries across the region.

Regional gas networks enable gas supplies from Uzbekistan to Kazakhstan and Kyrgyzstan but, at the same time, domestic networks do not link regions at subnational levels.

None of the five countries is at present producing all the energy they need. Trade in electricity, coal, gas and oil between the countries and Russia, Iran (exports and imports) and China (exports) contribute to the energy balance of all five. Kazakhstan is the number one exporter of fossil fuels in the region, accounting for 20% of its GDP in 2022, and its largest emitter of CO_2.[25] Turkmenistan is a net energy exporter, ranking second in the region after Kazakhstan and exporting up to 70% of total energy production (69.2% in 2021), 83% of which goes to China.[26] Uzbekistan, the third, historically important gas-exporting country, has significantly reduced exports due to the increasing domestic demand but continues importing oil and coal as domestic production does not cover current domestic demand. Tajikistan and Kyrgyzstan import oil and gas from Russia, Kazakhstan and Uzbekistan, while exporting coal (Kyrgyzstan) and electricity (Kyrgyzstan and Tajikistan) to Uzbekistan and Kazakhstan. Despite being exporters of hydrocarbons and electricity, all Central Asian states are regularly afflicted by power cuts. Blackouts are common and the populations are increasingly expressing their discontent about energy supply.

23 In September 2022, border hostilities erupted between Kyrgyzstan and Tajikistan.

24 On 6 August 2024, energy ministers of the five states met in Astana to discuss regional energy cooperation, starting with the gas industry.

25 S&P Global Commodity Insights, Kazakhstan's National Energy Report 2023 (NER 2023), October 2023, (Kazakhstan's National Energy Report 2023, accessed 15.11.2025).

26 UNECE Turkmenistan Policy Brief, March 2024.

> *None of the five countries is at present producing all the energy they need.*

Due to the arid climate, water is the most important resource in the region and its supply or deficit will have a direct impact on decarbonisation pathways in all the countries in Central Asia. The five countries use exceedingly high amounts of water and, the precipitation does not provide enough replenishment of surface waters to compensate for the excessive withdrawals. The two main rivers in the region, Amu Darya and Syr Darya supply around 80% of water used in Central Asia. Water competition between agriculture and energy sectors is also extended to mining, petroleum production, construction, services and housing. In recent years, the decrease in the river influx has led to lower volumes of water that can be diverted for crop irrigation, negatively impacting water supply in downstream countries. Since a significant part of the population resides in rural areas and farms the land, the unsustainable withdrawal of freshwater in some regions creates internal as well as cross-border tensions and disproportionately affects poor rural populations. Water efficiency and better management of resources are therefore urgently needed as well as just transition in providing alternative sources of stable income to farmers and agricultural workers.

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Although the hydropower potential in Tajikistan and Kyrgyzstan is sufficient to provide backup energy and stabilize the power grids, downstream countries fear that more hydropower in upstream countries could further impact abstraction levels from the two major transboundary rivers. Given the challenges of meeting water demand, any energy transition plans in Central Asia must consider both the impact of climate change on water resources and the trade-offs between water access and energy supply. Improved water management is essential to avoid potential conflicts over water supply between upstream and

downstream countries. To ensure sufficient water for their economies, all five countries must reform and manage agricultural water use, and they are taking steps to significantly reduce their water footprints. Transboundary waters in Central Asia are managed by the Interstate Commission for the Coordination of Water Management, which was established to coordinate the allocation of regional water resources among individual states. This cooperation could extend to managing energy supply from hydropower, which could benefit all five countries if water resource management is improved and none of them feels exploited. This cooperation could then be expanded to include the construction of hydropower plants. Management of the regional green electricity market could be organized similarly to the ma agement of the regional water market.

Central Asian governments are increasingly looking toward regional energy cooperation modelled on CAPS. All five Central Asian states are striving to diversity their energy sources, planning investments in renewable energy, while Kazakhstan and Uzbekisntan also plan to invest in nuclear energy. Kazakhstan is the world's largest producer of uranium from mines.[27] It provides over 40% of global production. Uranium is also produced in Uzbekistan, fifth on the list of top producers but accounting only for about one-sixth of Kazakhstan's output. Kazakhstan and Uzbekistan export mostly natural uranium (58.7% of natural uranium exports come from Kazakhstan in 2022) and comparatively small amounts of enriched uranium. Both countries plan to build nuclear power plants to contribute to the decarbonisation of their power sectors. Central Asian governments are increasingly looking toward regional energy cooperation modelled on CAPS. All five Central Asian states are striving to diversity their energy sources, planning investments in renewable energy, while Kazakhstan and Uzbekisntan also plan to invest in nuclear energy. Kazakhstan is the world's largest producer of uranium from mines . It provides over 40% of global production. Uranium is also produced in Uzbekistan, fifth on the list of top producers but accounting only for about one-sixth of Kazakhstan's output. Kazakhstan and Uzbekistan export mostly natural uranium (58.7% of natural uranium exports come from Kazakhstan in 2022) and comparatively small amounts of enriched uranium. Both countries plan to build nuclear power plants to contribute to the decarbonisation of their power sectors.

Central Asian governments are increasingly looking toward regional energy cooperation.

Upscaling the manufacturing industries producing green energy equipment will put increased stress on the water supply in the region and the economic choices have to be guided by the limits of what can be achieved with the state-of-the-art water-saving and recycling technologies supported by competent water management and circular economy. Central Asia cannot also rely on the continued use of fossil fuels because with the deployment of carbon capture and storage (CCS) technologies, the water footprint of each power plant, already using water for cooling, would significantly impact water demand. Water constraints would prevent Central Asian countries from using technologies

27 Up to 55% of uranium is produced by in situ leaching. (World Nuclear Association, (World Uranium Mining Production - World Nuclear Association (origindigital.co), accessed 15.11.2025).

capturing carbon at a scale. All currently known CCS technologies are also energy-intensive. As a result, CCS can only be deployed in[28] areas where water scarcity is not an issue. However, some abatement can be provided through nature-based solutions such as afforestation which has to be sensitively managed to safeguard the environment.

Like many energy-exporting developing countries, Central Asia states will face significant opportunity costs when transitioning away from fossil fuels. If the transition is not implemented smoothly and in ways that reflect national circumstances, existing constraints and emerging opportunities, these countries stand to lose economically from decarbonisation. However, if the transition is managed skilfully, they will be able to rewire their economies and tap into the global green transformation boom, while achieving their environmental and social goals.

The green transition provides opportunities for sustainable growth rich in green, decent jobs and improving the living conditions of the most vulnerable social groups. However, it also poses significant challenges, especially in ensuring that the transition is indeed fair and inclusive. Mainstreaming Just Transition into government policies and legislative frameworks should provide the necessary safeguards for workers and local communities while protecting the environment to the highest standards. Environmental regulations should be enforceable, monitoring and reporting of established indicators obligatory throughout the lifetime of the industrial facility, and non-compliance ending with revocation of permits and penalties. Just compensation mechanisms offsetting environmental and social costs of economic activities should be adopted by the laws. Impact assessments conducted prior to permitting should take into account the spillover effects on second-tier and third-tier stakeholders, indirectly affected by the planned facilities.

The green transition provides opportunities for sustainable growth.

The regulatory frameworks and governance are key for the government policies to be implemented as intended, through measures that will address any negative impacts and upscale all positive results of economic and social changes brought about by the rapid transformation. In the case of the energy transformation, the outcomes of policies and measures will affect everyone but not in the same way. It is therefore necessary to undertake stakeholder mapping, to identify the key interests of each stakeholder group and propose just transition measures addressing all legitimate concerns and interests.

The growth of the population is a factor increasing the need for energy transition. The five countries of Central Asia combined have a population of circa 82,226,000 (2024).[29] Their populations are still growing, at a rate below 2% each year. The growth of Central Asia populations is projected to slow to below 1% post-2050 and continue until c. 2080 at a much slower rate, but the continuous population growth puts education and jobs in the spotlight. In 2021, in Uzbekistan, the most populous

28 It could nearly double the amount of water used by coal power plants for every kilo watt of electricity produced. (The Water Cost of Carbon Capture - IEEE Spectrum, accessed 15.11.2025).

29 World Population Review, 2024 (Central Asia Population 2024 (worldpopulationreview.com))

country in the region, children and young people under working age constituted 31% of residents, 58.2% of citizens were of working age and 10.8% were older than working age.[30] The number of women (49.7%) was lower than the number of men (50.3%). More people lived in urban areas (50.6%) than in the countryside (49.4%).

Population trends and GDP growth will continue putting pressure on the energy demand. In Uzbekistan, electricity demand[31] is projected to double to 120 TWh by 2030 mandating the upscaling of low-carbon electrification based on the existing renewable energy potential. Growing populations of working age on the one hand and vast deposits of CRMs on the other are key assets that the governments of the five states can use to attract foreign investors and in this way build up national capacities in clean technology manufacturing.

Population trends and GDP growth will continue putting pressure on the energy demand[31].

Central Asian states increasingly look towards regional cooperation on energy modelled on CAPS and further diversification of energy sources, planning investments in renewable energy generation (all five countries) and nuclear power (Kazakhstan and Uzbekistan).

Critical Raw Materials as an Opportunity for Just Energy Transition

Central Asia is rich not only in fossil fuels but in critical raw materials (CRMs) key for clean energy and other modern technologies. The region has diverse mineral resources, including reserves of base and precious metals, rare metals and minerals such as copper, iron, lead, silver, manganese, nickel, zinc, cadmium, cobalt, silicon, gallium, germanium, graphite, lithium, molybdenum, tellurium, tin, titanium and rare earth elements: dysprosium, neodymium and praseodymium. Reportedly up to 38.6 % of global manganese ore reserves, 30.07 % of chromium, 20% of lead, 8.7% of titanium, 5.3% of cobalt and 5.3% of copper, to name some. The largest deposits of a variety of CRMs have been identified in Kazakhstan, having practically all critical raw materials, and Uzbekistan.

Central Asia is rich not only in fossil fuels but in critical raw materials (CRMs) key for clean energy and other modern technologies.

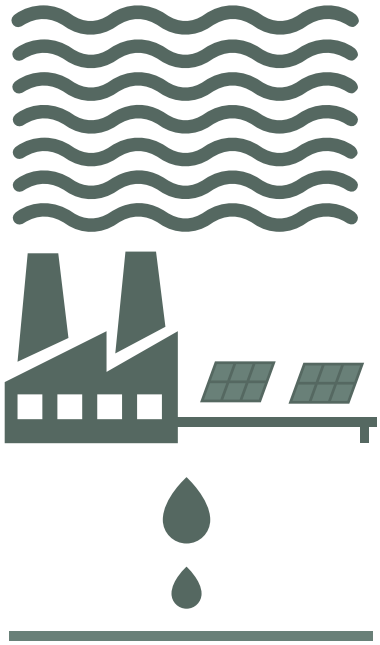
Central Asian states are already among the top producers of several CRMs. They could build on their mining sector base and know-how by shifting to new minerals and thereby supporting not only the transformation of their regional economy but also the global clean energy transition. Some of these minerals are present in quantities insufficient to dominate global output but the broad range of what is available provides the competitive advantage that could enable these countries to move up the value chain from exporting commodities to producing and exporting high-tech goods.

Rare earth minerals are also used in the production of LCD screens, glass optical fibres, chemical formulation for LEDs, CRT displays and fluorescent bulbs, automotive and aeroplane parts

30 The State Committee of the Republic of Uzbekistan on Statistics, 2021 (demografiya_en_18012021pdf.pdf (stat.uz), accessed 15.11.2025).

31 EBRD (2024).

or military equipment. Domestic production of high-technology goods developed in line with the requirements of green manufacturing could replace current exports of oil, coal and gas and provide much higher revenues to state budgets. The development of new high-technology sectors of industry would provide high-quality jobs and offset the shift away from economies based on fossil fuels.



All governments of countries rich in critical raw materials plan to expand their extraction and processing for domestic use and export. Central Asian countries have similar plans. This would create thousands of new jobs, bringing enormous benefits to the economy and ensuring the livelihoods for workers and their families. However, the mining sector must be regulated to ensure high environmental, social, and governance (ESG) standards and benefit local communities. The extraction of critical raw materials cannot come at the expense of the environment and local communities, as this would undermine the principles of just transition towards a decarbonized future and the development of a clean and sustainable economy.

Summary

With the right social and economic policies, governments can ensure the energy transition is orderly, fair and equitable for everyone – including communities currently dependent on fossil fuels. Decarbonisation of energy and industry sectors may be accelerated by the governments through focusing on achieving the Sustainable Development Goals at the highest policy level. In Central Asia, the transformation of energy and industry will [should] focus on accelerating the creation of green jobs and a just transition to formalization, social protection and the principle of climate justice, contributing to poverty reduction (SDG1), gender equality (SDG5), improving the livelihoods, social protection and providing decent jobs to the young people, women and other vulnerable groups (SDG8), ensuring access to affordable, sustainable, reliable and modern energy (SDG7), reducing inequalities, green climate resilient energy deployment (SDG13), and strengthening the means of implementation of partnership for sustainable development (SDG17).

Decarbonisation of energy systems must address the fundamental challenge of ensuring energy security, SDGs aspirations and the energy-water nexus, a key challenge in Central Asia. Decarbonisation of industry calls for sectoral decarbonisation roadmaps and plans at the company levels, policies supporting opportunities to develop and grow new industrial sectors (RES, EE, Circular Economy) based on assessments of technology and investment needs, regulatory and financial incentives to decarbonise embedded in sectoral policies, better regulation, effective carbon pricing and other measures reflecting national circumstances.

> *Decarbonisation of energy systems must address the fundamental challenge of ensuring energy security, SDGs aspirations and the energy-water nexus, a key zhallenge in Central Asia.*

For each industrial sector, starting with the energy-intensive industry, sector-specific decarbonisation roadmaps have to be adopted and implemented. These roadmaps have to reflect Just Transition work plans guiding Just Transition away from coal, focussing on coal-mining areas and regions and addressing the opportunities that come with the natural resources and working-age population ready to fill in the workplaces. Clean energy will draw in the investment that all of Central Asia needs to capitalise on green transformation, enabling the governments to address several development issues that are currently unresolved.

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