



CARBON BUDGET FOR UKRAINE:

international experience and pathway
to implementation

2026



The Green Transition Office is an independent advisory body to the Ministry of Economy of Ukraine, which supports implementation of reforms in the area of green transition, energy and climate policy. The work of the Green Transition Office is supported by the UK's International Development Agency and implemented by NGO DiXi Group.

The views expressed in the study are solely those of the NGO DiXi Group (Green Transition Office).



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INTRODUCTION

Ambitious long-term climate mitigation targets adopted by many countries elevate the need for more stringent climate policies and significant investment in green transition and low-carbon development. Operationalization of climate neutrality goals requires comprehensive frameworks to monitor the progress towards achieving interim targets and effectiveness of implemented policies and investment.

The national carbon budget concept, as proven by several countries, can serve as a practical framework to monitor progress towards climate goals and adjust policy and investment decisions taking into account technology development, cost-effectiveness, behaviour changes and other factors.

International experience shows that the most structured approaches to carbon budgeting combine a national emissions limit with sectoral details and regular progress review:

- The United Kingdom applies legally binding five-year carbon budgets that set an economy-wide emissions limit and are supported by package of policies and measures covering key sectors of the economy;¹
- Ireland also uses five-year carbon budgets with decomposition to sectoral emissions ceilings;²
- France defines five-year carbon budgets within its National Low-Carbon Strategy, including relevant sectoral details;³
- New Zealand sets consecutive multi-year budgets accompanied by emissions reduction plans for individual sectors.⁴

For Ukraine, the introduction of a carbon budget may have practical relevance as a tool for aligning established climate targets with sectoral policies and post-war recovery in the context of European integration. Ukraine's Second NDC notes that the scale of destruction, reconstruction needs, the future structure of the energy balance, and the pace of economic growth and decarbonization create a high level of uncertainty for climate target planning. In addition, Ukrainian industry is entering a period of transformation due to CBAM requirements and the introduction of a greenhouse gas Emissions Trading System (ETS). In this context, a carbon budget could serve as an analytical basis for more manageable decarbonization planning, with a defined cumulative volume of emissions, sectoral allocation, assessment of emissions reduction costs, identification of investment needs, and regular progress monitoring.

1 UK Policy paper Carbon Budget Delivery Plan, <https://www.gov.uk/government/publications/carbon-budget-delivery-plan/carbon-budget-delivery-plan#appendix-f-summary-of-impact-of-proposals-and-policies-across-sectors-of-the-economy>

2 Climate Change Advisory Council, Ireland Carbon Budget Proposal 2031-2040, <https://www.climatecouncil.ie/carbonbudgets/>

3 National low carbon strategy of France (SNBC), https://unfccc.int/sites/default/files/resource/en_SNBC-2_complete.pdf

4 Emissions budgets and the emissions reduction plan of New Zealand, <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-reductions/emissions-budgets-and-the-emissions-reduction-plan/>



The carbon budget transforms NDC2 from a commitment to the UNFCCC into a domestic policy tool and a financial signal to the outside world – and this is precisely what Ukraine needs to ensure that its reconstruction is funded by international capital, rather than solely by donor grants. The carbon budget can guide the implementation of transforming climate policies, such as national ETS, and large-scale climate finance attraction.

1. The concept of carbon budget

The Paris Agreement, adopted in 2015, established the global goal of holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit global warming to 1.5°C. To achieve this goal, Parties to the Paris Agreement prepare nationally determined contributions (NDCs), through which they communicate their national efforts and actions to reduce greenhouse gas (GHG) emissions and adapt to the impacts of climate change. The likelihood of achieving the goals of the Paris Agreement is directly linked to the progress in reducing global GHG emissions.

On a global level, the carbon budget defines the maximum cumulative volume of emissions that can still be generated while limiting global warming to a specified level, such as 1.5°C or 2°C.

Its scientific basis is linked to the fact that the level of global warming is largely determined by the cumulative volume of anthropogenic greenhouse gas emissions. The IPCC Sixth Assessment Report states that every additional 1,000 Gt CO₂ of emissions leads to an increase in global temperature of approximately 0.45°C.⁵ Therefore, it is important to assess not only the level of emissions in the target year, but also the cumulative volumes. The longer high emissions persist, the faster the available carbon budget is depleted and the more challenging the subsequent emissions reduction trajectory becomes.

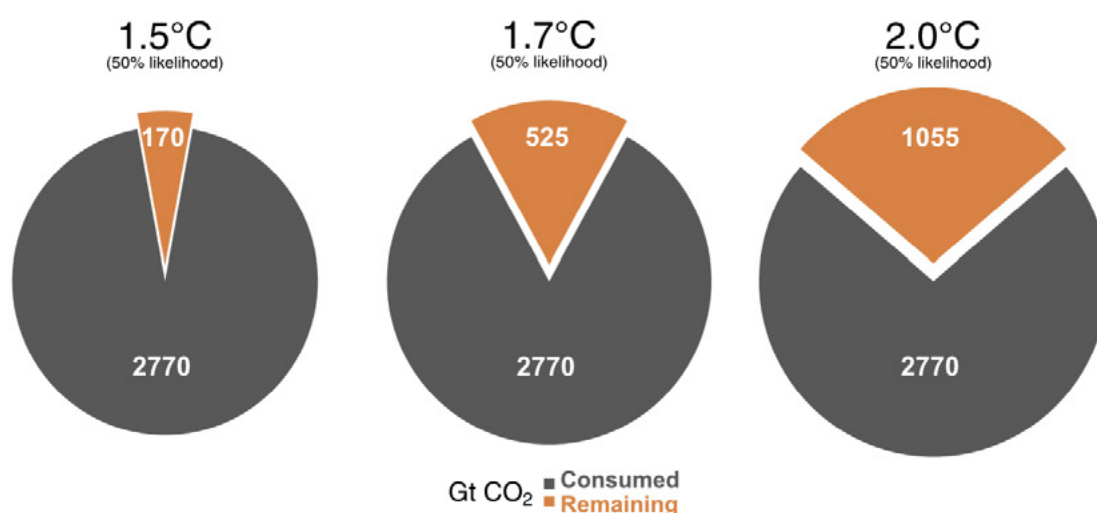


Figure 1. Remaining global carbon budget for limiting warming

Source: Global Carbon Project⁶

5 IPCC Climate change 2023 Synthesis Report, https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_FullVolume.pdf

6 Key Messages from GCB 2025, <https://globalcarbonbudget.org/gcb-2025>



Historically accumulated CO₂ emissions have already used up a significant share of the global budget, while the remaining amount of emissions compatible with limiting warming to 1.5°C or 2°C is steadily shrinking. In the 6th Assessment Report IPCC estimated the remaining carbon budget at 400 Gt CO₂e to limit warming to 1.5°C and at 1150 Gt CO₂e to limit warming to 2°C (67% probability).⁷ The Global Carbon Budget project, which tracks the trends in global carbon emissions and sinks on an annual basis, in its most recent report estimated the remaining carbon budget already as 170 Gt CO₂e and 1,055 Gt CO₂e respectively (50% probability).⁸ Global carbon dioxide emissions from fossil fuels continue to rise and at current emission rates, the remaining carbon budget would be exhausted in about 4 and 25 years depending on the selected temperature limit.⁹

Therefore, when planning climate mitigation action, it is important to consider the cumulative volume of emissions already accumulated, the pace of emissions reductions, and the resulting level of emissions in the target year.

At the national level, a similar concept of a carbon budget is used as a tool for monitoring and managing the effectiveness of climate policies. The national carbon budget framework allows translating long-term climate targets into a measurable emissions limit for a defined period and linking it with climate policy and sectoral emissions reduction pathways.

The national carbon budget defines the maximum cumulative amount of greenhouse gas emissions, usually expressed in tonnes of CO₂ equivalent, that a country may emit over a defined budget period to be able to comply with its climate targets, international commitments, and chosen decarbonization pathway.

Such a budget may be established for the entire economy and further disaggregated by sector creating a quantitative basis for comparing planned and actual emissions trajectories. If emissions exceed the established budget, this indicates that existing measures are insufficient and need to be strengthened or expanded. If emissions remain within the budget, this means that policies are generally aligned with the defined decarbonization pathway.

A climate target for a specific year and a carbon budget are complementary instruments. A target for a given year sets the expected level of emissions at a defined point in time, while a carbon budget defines the cumulative volume of emissions over a specified period that enables achievement of the target. Higher emissions at the beginning of the period deplete the available budget more quickly and increase the requirements for subsequent reductions. This may require a faster decarbonization pathway in later years, accelerated investment mobilization, and a review of sectoral policies. An earlier start to emissions reductions creates more opportunities for the gradual transformation of energy, industry, agriculture, transport, and other sectors.

As a Party to the Paris Agreement, Ukraine has developed and submitted its first NDC (updated NDC in 2021) covering the period up to 2030 and the second NDC covering the

7 IPCC Frequently Asked Questions, https://www.ipcc.ch/report/ar6/wg1/downloads/faqs/IPCC_AR6_WGI_FAQ_Chapter_05.pdf

8 Global Carbon Budget 2025, <https://essd.copernicus.org/articles/18/3211/2026>

9 National carbon budgets: the UK experience and prospects for Ukraine, <https://gto.dixigroup.org/en/news/natsionalni-vuhletsevi-biudzhety-dosvid-velykobrytanii-ta-perspektyvy-dlia-ukrainy>



period up to 2035 (approved in 2025).¹⁰ In its second NDC, Ukraine set a target to reduce net greenhouse gas emissions by more than 65% by 2035 compared to the 1990 level. At the same time, targets set for a specific year do not reveal the expected emissions reduction trajectory and contribution of specific sectors. The concept of a carbon budget links a single-year target with the cumulative volume of emissions over a defined period and can demonstrate a plausible pathway to reaching the target.

2. International practice of implementing carbon budgets

Carbon budgets are used to plan GHG emissions reduction at the national level by several countries. Typically, the overall national carbon budget for a defined period (e.g. 5 years) is combined with sectoral allocation and is accompanied by regular progress monitoring.

In the **United Kingdom** the carbon budget system was established under the Climate Change Act 2008 and foresees legally binding economy-wide five-year emissions limits.¹¹ Budgets are set in advance, 12 years before the start of the relevant budget period, which creates predictability for public policy, businesses, and investors (e.g. the Seventh Carbon Budget published in 2025 covers the period 2038 to 2042). The UK Climate Change Committee provides independent advice on the level of each carbon budget and after the review by the UK Government and approval by Parliament, the carbon budget becomes legally binding.

After a budget is set, the UK Government implements policy packages designed to deliver the approved emission reductions, and the progress is independently monitored by the UK Climate Change Committee. In particular, section 14 of the Climate Change Act requires the Government to prepare reports setting out proposals and policies for meeting the carbon budgets for the current and future budgetary periods. For example, the most recent report was published in 2025 as the Carbon Budget and Growth Delivery Plan and contains a package of proposals and policies for delivering approved carbon budgets (4th, 5th, and 6th carbon budgets). The Technical Annex to the Carbon Budget and Growth Delivery Plan describes approaches to baseline modelling, the calculation of emissions reductions from policies, and sectoral modelling.¹² Earlier carbon budgets were supported by similar reports, including the Carbon Budget Delivery Plan 2023¹³, Clean Growth Strategy¹⁴, and UK Low Carbon Transition Plan 2009.¹⁵

10 UNFCCC, Ukraine Second NDC, <https://unfccc.int/documents/498015>

11 Climate Change Act 2008, <https://www.legislation.gov.uk/ukpga/2008/27/contents>

12 Carbon budget and growth delivery plan, <https://www.gov.uk/government/publications/carbon-budget-and-growth-delivery-plan>

13 Carbon Budget Delivery Plan, <https://www.gov.uk/government/publications/carbon-budget-delivery-plan/carbon-budget-delivery-plan>

14 Clean Growth Strategy, <https://www.gov.uk/government/publications/clean-growth-strategy>

15 The UK Low Carbon Transition Plan, National strategy for climate and energy, <https://assets.publishing.service.gov.uk/media/5a74b4b1e5274a3cb2866852/9780108508394.pdf>



The Climate Change Committee assesses emissions reduction and publishes progress reports.¹⁶ This makes it possible to compare actual emissions trends with the trajectory required to meet the carbon budgets and to identify policy gaps.

Apart from the UK, national carbon budget frameworks with sectoral breakdown are used by Ireland, France, Greece, and New Zealand (see Table 1).

Table 1. Examples of the implementation of national carbon budgets

Geography	Approach to the application of the carbon budget
United Kingdom	Carbon budgets are legally binding five-year emissions limits established under the Climate Change Act 2008. They cover the country's entire economy, are expressed in MtCO ₂ e, and are set 12 years before the start of the relevant budget period. The government also puts in place a package of sectoral proposals and policies intended to deliver the relevant carbon budget. ¹⁷ The Seventh Carbon Budget for 2038-2042, which is to be set in 2026, amounts to 535 MtCO ₂ e. ¹⁸
Ireland	Under the Climate Action and Low Carbon Development Act 2015 ¹⁹ Ireland applies successive five-year carbon budgets expressed in MtCO ₂ e. The approved budgets amount to 295 MtCO ₂ e for 2021-2025 and 200 MtCO ₂ e for 2026-2030. ²⁰ After a carbon budget is approved, the government determines sectoral emissions ceilings. If the budget is exceeded, the excess emissions are carried forward to the next budget period and reduce the available limit.
France	Within the National Low-Carbon Strategy, carbon budgets are defined as greenhouse gas emissions ceilings, expressed as an annual average over a five-year period in MtCO ₂ e, with a breakdown by sector. ²¹
Greece	The National Climate Law provides for five-year sectoral carbon budgets for seven sectors. The sum of the sectoral budgets is equal to the country's total budget for the respective period. The first budgets for 2026-2030 were submitted for public consultation in 2025. ²²

16 UK CCC, <https://www.theccc.org.uk/publicationtype/report/progress-reports-net-zero>

17 UK Policy paper, Carbon budget and growth delivery plan (Section 14 Report), <https://www.gov.uk/government/publications/carbon-budget-and-growth-delivery-plan/carbon-budget-and-growth-delivery-plan-section-14-report-accessible-webpage>

18 UK Seventh Carbon Budget, <https://www.theccc.org.uk/publication/the-seventh-carbon-budget>

19 Climate action and low carbon development Act 2015 of Ireland, <https://revisedacts.lawreform.ie/eli/2015/act/46/revised/en/html>

20 Consultation on Carbon Budgets, Ireland 2025, <https://www.gov.ie/en/department-of-climate-energy-and-the-environment/consultations/consultation-on-carbon-budgets>

21 France's National Low-Carbon Strategy (SNBC) 2025, <https://www.ecologie.gouv.fr/politiques-publiques/strategie-nationale-bas-carbone-snbc>

22 Greece Sectoral Carbon Budgets and the NECP, https://thegreentank.gr/wp-content/uploads/2024/12/202412_%CE%A4heGreenTank_Brief_Sectoral-Carbon-Budgets_ENG.pdf



Geography	Approach to the application of the carbon budget
New Zealand	New Zealand applies carbon budgets under the Climate Change Response Act. The first three budgets were set by the government in 2022: 290 MtCO ₂ e for 2022-2025, 305 MtCO ₂ e for 2026-2030, and 240 MtCO ₂ e for 2031-2035. The budgets are accompanied by emissions reduction plans, which define policies and measures for delivering the respective budget. Progress is monitored by the independent Climate Change Commission. ²³ The first emissions reduction plan includes separate sectoral plans for transport, energy and industry, buildings, agriculture, forestry, waste, and fluorinated gases. ²⁴

In Ireland and Greece, the sectoral logic is expressed through emissions ceilings or budgets for individual sectors. In France, sectoral detail is integrated into the National Low-Carbon Strategy. In the United Kingdom and New Zealand, the budget is set at the economy-wide level, while its implementation is supported through sectoral plans, policies, and regular progress monitoring.

Other countries also use certain features of the carbon budgeting concept in establishing NDCs or planning national climate mitigation actions:

- Switzerland's NDC combines a target for a specific year with a multi-year emissions budget. The first NDC provides for a reduction in net emissions of at least 50% by 2030 compared to the 1990 level and is implemented as an emissions budget for 2021-2030. The second NDC sets a reduction target of at least 65% by 2035 and an emissions budget of 106.8 MtCO₂e for 2031-2035.²⁵
- Australia uses a budget-based approach within its NDC and under the Climate Change Act 2022. The 2030 target provides for a reduction in greenhouse gas emissions of 43% below the 2005 level and is accompanied by a multi-year emissions budget of 4,394 MtCO₂e for 2021-2030. For 2035, the NDC sets a target to reduce net national emissions by 62-70% below the 2005 level by 2035. This target is implemented as an emissions budget for 2031-2035, with an indicative value of 1,248-1,395 MtCO₂e. The target is economy-wide and covers all sectors and all greenhouse gases. At the same time, Australia applies sectoral emissions reduction plans to implement its Net Zero Plan, but does not establish separate sectoral carbon budgets.^{26,27}
- Chile's 2020 NDC established a national greenhouse gas emissions budget for 2020-2030 of no more than 1,100 MtCO₂e, with emissions peaking no later than 2025 and a target emissions level of no more than 95 MtCO₂e in 2030. Chile's 2021 Long-Term Climate Strategy defines the pathway to 2050. The strategy establishes

23 Emissions budgets and the emissions reduction plan of New Zealand, <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-reductions/emissions-budgets-and-the-emissions-reduction-plan>

24 New Zealand's first emissions reduction plan 2022, <https://environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan>

25 UNFCCC, Switzerland's second nationally determined contribution under the Paris Agreement 2031–2035, <https://unfccc.int/sites/default/files/2025-01/Switzerland%20second%20NDC%202031-2035.pdf>

26 UNFCCC, Australia's 2035 Nationally Determined Contribution, <https://unfccc.int/sites/default/files/2025-09/Australias%20Second%20NDC.pdf>

27 Australia's emissions projections 2025, <https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2025>



sectoral CO₂e emissions limits based on the national budget defined in the NDC. The implementation of these budgets is to be ensured through sectoral climate change mitigation plans.²⁸

- Costa Rica's 2020 NDC provides for an economy-wide multi-year carbon budget of 106.53 MtCO₂e for 2021-2030, as well as a separate absolute net emissions limit of 9.11 MtCO₂e for 2030. The budget covers all emissions and all sectors included in the national greenhouse gas inventory.²⁹
- In Germany, the Federal Climate Change Act sets annual economy-wide emission levels up to 2030 and annual sectoral values for the main sectors. Following the 2024 reform, the main focus of control shifted to compliance with the overall emissions reduction trajectory, while sectoral values are used to monitor progress.³⁰
- In Portugal, the Framework Climate Law provides for the use of carbon budgets as a planning instrument. At the end of 2024, Portugal presented an official proposal for carbon budgets for 2023-2025 and 2026-2030, which underwent public consultation in 2025.³¹
- In Colombia, Law 2169/2021 provided for the establishment of carbon budgets³², while the decision of Colombia's Intersectoral Commission on Climate Change of 18 September 2024 established national carbon budgets up to 2035: 1,635 MtCO₂e for 2020-2025, 1,050 MtCO₂e for 2026-2030, and 775 MtCO₂e for 2031-2035. The establishment of future carbon budgets up to 2050 is also envisaged.³³

There are also other examples of using the "carbon budget" term in different contexts, including for allocation of emission allowances for organizations and at the sub-national level. For instance, in South Africa, the Climate Change Act 2024 includes provisions on carbon budgets for organizations carrying out specified activities.^{34,35} At the sub-national level, the carbon budget concept is used by Oslo³⁶ and Stockholm.³⁷

National carbon budgets are used in a number of countries, although their legal status, scope, and level of detail differ. A common feature of these approaches is the shift from a

28 Chile's long-term climate strategy the path to carbon neutrality and resilience by 2050, https://unfccc.int/sites/default/files/resource/CHL_LTS_2021_EN_0.pdf

29 UNFCCC, Costa Rica's Nationally Determined Contribution, <https://unfccc.int/sites/default/files/NDC/2022-06/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf>

30 Germany's climate action strategy, [https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767182/EPRS_BRI\(2024\)767182_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767182/EPRS_BRI(2024)767182_EN.pdf)

31 Carbon Budgets in the Framework of Climate Law, Portugal, <https://www.lexpoint.pt/Fileget.aspx?FileId=55946>

32 Colombia Climate Action Law 2169/2021, <https://www.suin-juriscol.gov.co/viewDocument.asp?id=30043747>

33 Colombia Agreement No. 013/2024 on National Carbon Budgets, https://www.minambiente.gov.co/wp-content/uploads/2025/12/Acuerdo-013-de-2024_CICC-XVIII_DNP_VoBo-DDA-Firmada.pdf

34 Republic of South Africa, Climate Change Act 2024, https://www.gov.za/sites/default/files/gcis_document/202407/50966climatechangeact222024.pdf

35 South Africa Draft Carbon Budget and Mitigation Plan Regulations, 2025, <https://cer.org.za/wp-content/uploads/2025/08/Draft-for-Comment-National-Greenhouse-Gas-Carbon-Budget-and-Mitigation-Plan-Regulations-under-Climate-Change-Act-2024-1-August-2025.pdf>

36 Oslo Climate budget 2024, <https://www.klimaoslo.no/wp-content/uploads/sites/2/2024/08/Climate-budget-2024.pdf>

37 Stockholm Climate Action Plan 2030, <https://start.stockholm/globalassets/start/om-stockholms-stad/politik-och-demokrati/styrdokument/climate-action-plan-2030.pdf>



target for a specific year to the management of the cumulative volume of emissions over a defined period. Most comprehensive national carbon budget frameworks include detailed sectoral analysis and projections supported by modelling, policy packages and monitoring mechanisms.

For Ukraine, this means that a potential national carbon budget could be developed in several stages: first as a national emissions limit, and subsequently as a system of sectoral pathways, policies, and monitoring indicators.

3. Carbon budget in the climate governance architecture

In the area of climate policy Ukraine will be facing a unique challenge in the next decade as the key task would be not GHG emission reduction per se but low carbon and climate resilient post-war economic recovery. During the war total GHG emissions reported in the national inventory decreased by 32% due to economic downturn, destruction of infrastructure and enterprises, and large numbers of people fleeing the country. As of 2023, the level of emissions was only 24% compared to 1990, which translates to 76% of emission reduction. At the same time, large-scale investment during post-war reconstruction and economic recovery will result in rebounding of GHG emissions from current low levels.

Taking into account existing national policies, EU integration process, and alignment of key IFIs with Paris Agreement goals, the new investments to a significant extent will be directed towards low-carbon and green solutions. Nevertheless, a significant role of agriculture and other hard-to-abate sectors in the national economy, as well as large-scale needs of carbon intensive materials for reconstruction will drive significant GHG emissions.

The **scale of emission growth will be defined by both policy and investment decisions**, and the **national carbon budget framework could provide a practical tool to** manage GHG emission levels and **link decision-making process to long-term national and EU targets**. The national carbon budget will provide a clear understanding of current and future GHG emission levels by sectors and sub-sectors to manage the transition to low carbon development and achievement of long-term climate goals.

In October, 2024 Ukraine has adopted a **Climate Law**³⁸, which set the basis of state climate policy and for the first time put into the legislation a climate neutrality target. Based on the law, the state climate policy is aimed at achieving Ukraine's **climate neutrality by 2050**, ensuring climate change mitigation and adaptation, low-carbon and sustainable development, and environmental, food and energy security of Ukraine. The interim target established by the Climate Law was aligned with the first NDC of Ukraine and corresponds to the reduction of greenhouse gas emissions by at least 65% by 2030 compared to 1990 levels. Climate Law also defines that the mid-term state climate policy goals are defined by the Long-term low-emissions development strategy (LT-LEDS) and should inform the development of Nationally Determined Contribution under the Paris Agreement.

38 Law of Ukraine "On the Basic Principles of National Climate Policy", <https://zakon.rada.gov.ua/laws/show/3991-20#Text>



According to the most recent NDC, Ukraine aims to reduce its greenhouse gas emissions in 2035 by more than 65% from 1990 level. The difference between current emission levels and the NDC target is more than 100 Mt CO₂e.³⁹ However, Ukraine is also actively working on the EU accession process, and, at some point, long-term EU targets will become our joint goal. The EU's new NDC reiterates the EU's goal of achieving a net reduction of 55% in greenhouse gas emissions by 2030 and introduces an indicative contribution of 66.25% to 72.5% for 2035 on the path towards carbon neutrality by 2050.⁴⁰ This means that Ukraine would need to accelerate decarbonization in key sectors on its way to EU accession and as a future member of the European Union. Detailed information on GHG emission mitigation potential by sectors would be also needed for adoption of EU climate policies into national legislation and amendment EU regulation that govern setting national targets of EU members (e.g. Efforts Sharing Regulation).

Despite being fixed in the national Climate Law and LT-LEDS⁴¹ Ukraine's **climate neutrality target remains highly uncertain**. Current projections and models used in national policy planning do not provide detailed and transparent pathways for achieving the balance between total anthropogenic greenhouse gas emissions and total greenhouse gas removals (by forests, soils, or technological solutions). Information on residual emissions in hard-to-abate sectors and carbon removal potential of both nature-based and technological solutions is needed for the operationalization of the long-term climate-neutrality goal. The national carbon budget informed by sectoral decarbonization studies is aimed to **decompose long-term targets into feasible sectoral pathways and provide understanding of potential GHG emission levels in every sector of the economy**.

Climate mitigation targets and goals need to be supported by strengthened climate governance, enabling policy environment and large-scale investment in order to trigger transformational changes in different sectors of the economy. Climate considerations should be embedded into sectoral policies and investment projects.

In June 2024 the Government of Ukraine adopted the **National Energy and Climate Plan (NECP) to effectively coordinate energy and climate policies**.⁴² The NECP was designed to align environmental, energy, and economic policies for Ukraine's sustainable development and covers decarbonization of energy generation, improving energy efficiency, green transition in industry and agriculture, as well as supporting research and innovation in the field of energy and climate. The NECP includes more than 140 policies, measures and targets.

39 Based on the most recent national inventory with the reported total net GHG emissions of 916,4 Mt CO₂e in 1990 and 216,9 Mt CO₂e in 2024. The 65% emission reductions would correspond to 320,7 Mt CO₂e target level. See details in Ukraine. 2026 National Inventory Document (NID), <https://unfccc.int/documents/656417>

40 The nationally determined contribution of the European Union and its Member States, <https://unfccc.int/sites/default/files/2025-11/DK-2025-11-05%20EU%20NDC.pdf>

41 Draft LT-LEDS has been presented in December, 2025 by the Ministry of Economy, Environment and Agriculture, <https://me.gov.ua/download/ba4565a8-544b-4c90-af84-49b2b718f629/file.pdf> and the document was adopted in June, 2026 by the Cabinet of Ministers of Ukraine, <https://www.kmu.gov.ua/npas/pro-zatverdzhennia-dovhostrokovoi-stratehii-nyzkovuhlets-i-561>

42 The updated version of the National Energy and Climate Plan has been approved by the Cabinet of Ministers of Ukraine in June, 2026. See Order of the Cabinet of Ministers of Ukraine #562-p dated 10.06.2026, <https://www.kmu.gov.ua/npas/pro-skhvalennia-natsionalnoho-planu-z-enerhetyky-ta-klimatu-na-period-do-2030-roku-i-562>



The Government of Ukraine with the support of the Green Transition Office has also established a transparent and detailed framework and a digital system for tracking the process of the NECP implementation. Each NECP policy and measure has been decomposed into clear actions with defined timelines and responsibilities. This framework is used for regular collection of data and information and reporting on progress to the national stakeholders and Energy Community in line with the existing international obligations. Ukraine submitted a first integrated report on the implementation of the NECP to the Energy Community Secretariat in March, 2025.⁴³

Based on the experience of the NECP monitoring framework a broader climate policy monitoring⁴⁴ system is being developed and operationalized with the following key components:

- collection and analysis of information on implementation of climate policies and measures, including information related to the monitoring of the National Energy and Climate Plan implementation;
- preparation of reports on the progress in implementation of climate policies and measures, including implementation of LT-LEDS, NECP, climate change adaptation strategy etc. (i.e. annual information on climate policy implementation and NECP implementation prepared by the Ministry of Economy based on the results of climate policy monitoring, as well as biannual progress report on NECP implementation submitted to the Energy Community);
- assessment of effectiveness of implemented measures in terms of GHG emissions reduction and strengthening climate resilience, as well as alignment with state climate policy goals and principles (to be conducted by the Scientific and Expert Council on Climate Change and Ozone Layer Preservation and published in annual reports);
- development of recommendations for the central executive authorities on the improvements of state climate policy tools (to be prepared by the Ministry of Economy based on the results of climate policy monitoring and assessment and by the Scientific and Expert Council on Climate Change and Ozone Layer Preservation as a part of annual reporting).

Results of climate policy monitoring and assessment will be a crucial element of assessing progress in the achievement of climate targets. However, to be informative and well-grounded such assessments should be based on granular data on GHG emissions and emission reductions. **The national carbon budget could provide a basis for linking data on GHG emissions and related emission drivers with specific policies and measures allowing more robust assessment of implemented climate policies.**

43 Green Transition Office. Independent Monitoring and Integrated Report: Ukraine Reports on Progress in Implementing the National Energy and Climate Plan, <https://gto.dixigroup.org/en/news/nezalezhnyi-monitorynh-ta-intehrovanyi-zvit-ukraina-rozpovila-pro-prohres-u-vtilenni-natsionalnoho-planu-z-enerhetyky-ta-klimatu>

44 The framework includes monitoring and evaluation of national climate policy implementation, effectiveness of specific climate change mitigation and adaptation policies and measures, as well as their alignment with the goals and principles of national climate policy. Monitoring of the implementation of the National Energy and Climate Plan will be an integral part of a national climate policy implementation monitoring system.



Experience of European Climate Councils demonstrates that national carbon budgets can serve as a core element of climate policy assessment frameworks. For instance, Mitigation Monitoring Framework applied by the UK CCC⁴⁵ includes assessment of progress in each sector towards achieving the emissions reductions set by the Government's Carbon Budget Delivery Plan. The assessment of the overall progress towards carbon budgets is complemented by a hierarchy of indicators, including headline indicators (current level of emissions from each sector and sub-sector), implementation indicators (technological and behavioural), policy milestones (e.g. funding mechanisms), and other drivers (technology costs, supply chains, international agreements etc.). The review against the national and sectoral carbon budgets also constitute a core element of climate policy assessment frameworks in Ireland (annual reports of Climate Change Advisory Council / An Chomhairle Chomhairleach um Athrú Aeráide) and France (annual reports of The High Council on Climate / Haut Conseil pour le climat).

Use of national carbon budget framework with detailed sectoral analysis and regular updates allows addressing a high level of uncertainty on future GHG emission levels due to the impact of ongoing large-scale Russian invasion of Ukraine, including destruction of infrastructure and enterprises, impact on supply chains and logistics, access to land and other impacts that define the level of current and future GHG emissions.

Five-years cycles with the potential to improve the evidence base and methodological approaches for each subsequent national carbon budget will reduce the impact of current data gaps related to data publication restriction during the martial law and insufficient granularity of national GHG emissions reporting, as well as limitations of the methodological approaches used in the national inventories. The national carbon budget approach will create a clear and transparent framework for regular data validation and methodological improvements.

Another important challenge in operationalization of climate mitigation targets is the **conversion of GHG reduction potential into specific investment projects and programs.**

Development of national carbon budgets include analysis of cost-effectiveness of climate mitigation options and building marginal abatement cost curves for individual sectors and the national economy in general. Estimation of abatement cost at a technology level also allows tracking cost-effectiveness over time and adjusting the assumptions in line with market trends and technology adoption rates. The national carbon budget framework can serve as a strategic tool for prioritization of public investment in decarbonization, as well as for matching investment projects with suitable climate finance opportunities maximizing both emission reductions and value for money.

One particular example of an approach, where a national carbon budget could serve as a framework for prioritization of investments, is **the concept of country sector platforms** that is being promoted by leading IFIs. Such platforms are established to shift from individual projects to a programmatic approach structured around country-driven platforms with clear, ambitious, and monitorable targets. The country sector platform approach consists of specific country-focused packages of policy, investment, and capacity-building activities to implement sectoral or thematic components of the transition to a low carbon

45 UK CCC, CCC Mitigation Monitoring Framework. Assessing UK progress in reducing emissions, <https://www.theccc.org.uk/publication/ccc-monitoring-framework>



and climate resilient economy. Country-led platforms aim at bringing together national and international players with private-sector finance to build greater momentum for greening national economies. Examples of such platforms include Türkiye Industrial Decarbonisation Investment Platform, Nexus of Water, Food and Energy program in Egypt and In-Country Platform to Accelerate a Just Energy Transition in North Macedonia.

The country platform can support establishing a programmatic approach for Ukraine's reconstruction and recovery investment that would channel funds to green transition and contribute to the goals of the National Energy and Climate Action Plan, as well as long-term goals of achieving climate neutrality and climate-resilient development.

The national carbon budget could provide transition pathways that will inform identification of projects and investment needs and support finance mobilization from both the public and private sector.

4. Methodological approaches to developing a carbon budget

4.1. Emissions forecasting under the BAU scenario

A fundamental element in the development of a carbon budget is the establishment of a baseline (business-as-usual / BAU) scenario against which future emission reductions can be assessed. The baseline serves as a reference pathway representing a hypothetical future in which no additional decarbonization policies and measures are implemented beyond the current state of the economy, and low-carbon technologies generally remain at their current levels of deployment and retain their present-day efficiencies. The purpose of the baseline is not to predict the most likely future scenario of emissions, but rather to provide a consistent reference framework for quantifying the emissions reductions, investment requirements, costs, and savings associated with achieving climate targets.

Under this approach, future changes in emissions are driven primarily by external socio-economic and environmental factors rather than by decarbonization measures. These factors include population growth, economic development, fuel prices, and changes in climatic conditions. As a result, baseline emissions are projected over time by combining current technological conditions with forecasts of activity growth and other key drivers of emissions.

The baseline explicitly excludes assumptions regarding future climate policies, planned decarbonization measures, or market-driven expansion of low-carbon technologies. The rationale for this approach is to ensure that the full scale of action required to transition from the current situation to Net Zero can be clearly identified, quantified, and costed. Consequently, the baseline is intentionally designed as a "no further decarbonization action" scenario rather than a forecast of expected market behaviour.

The development of baseline emissions projections requires sector-specific modelling approaches. While the overarching principle remains consistent across all sectors, the methods used to estimate future activity levels vary according to sectoral characteristics.



For example, in most sectors, including industry, agriculture, fuel supply, waste management, and non-residential buildings, the UK CCC relies on government modelling and Energy and Emissions Projections (EEP), adjusted to exclude emission reductions associated with future policy measures. In the transport sector, projections are based on forecasts of travel demand while maintaining the current distribution of vehicle technologies. For aviation and shipping, baseline projections are derived from dedicated transport models in which fleet composition remains unchanged and activity growth is primarily linked to economic development.

UK CCC's Seventh Carbon Budget analysis indicates that, in the absence of further decarbonization action, total UK greenhouse gas emissions would increase over the long term, reaching levels above those observed today. Growth in baseline emissions is particularly pronounced in surface transport and aviation sectors, where rising demand associated with population and GDP growth outweighs improvements resulting from existing technological progress.

The baseline scenario subsequently becomes the foundation for emissions forecasting and carbon budget development. Once baseline emissions have been projected, alternative decarbonization pathways can be constructed by introducing specific mitigation measures and assessing their impact relative to the baseline. The difference between baseline emissions and emissions under a decarbonization pathway represents the abatement potential attributable to individual measures or groups of measures. This approach enables the calculation of cumulative emission reductions, marginal abatement costs, investment requirements, and overall pathway costs.

Baseline projections are inherently uncertain because they depend on assumptions regarding future demographic, economic, climatic, and technological developments. For this reason, emissions forecasting is complemented by uncertainty analysis and contingency planning to ensure that carbon budgets remain robust under a range of future conditions.

In the context of carbon budget development, the baseline therefore performs a strategic function. It establishes the reference emissions trajectory that would occur in the absence of additional mitigation action and provides the analytical foundation for assessing the scale of intervention required to achieve long-term climate objectives. By comparing alternative decarbonization pathways with the baseline trajectory, policymakers can identify the most effective combination of measures, estimate the associated costs and benefits, and determine whether the proposed actions are sufficient to achieve Net Zero emissions within the required timeframe.

4.2. Sectoral scenarios for developing a carbon budget

General boundaries of the national carbon budget shall be aligned with the boundaries of the nationally determined contribution of Ukraine⁴⁶ under the Paris agreement and cover the whole economy of the country and all sectors of GHG emissions defined in the annual greenhouse gases inventory.⁴⁷

46 Second Nationally Determined Contribution of Ukraine to the Paris Agreement, https://unfccc.int/sites/default/files/2025-11/2%20Ukraine%20NDC2_adj_v2.pdf

47 Ukraine. 2026 National Inventory Document (NID), <https://unfccc.int/documents/656417>



In line with the common approaches defined by the Intergovernmental Panel on Climate Change⁴⁸ the following sectors are used in the national GHG emissions inventories:

- Energy,
- Industrial Processes and Product Use (IPPU),
- Agriculture,
- Land Use, Land Use Change and Forestry (LULUCF),
- Waste.

In each sector, individual categories are defined depending on the source of emissions and detailed methodological guidance is available for each category. For instance, the Energy sector covers emissions from fuel combustion activities (in energy industries, manufacturing industries and construction, transport and other sectors) and fugitive emissions from fuels (solid fuels and oil and natural gas). In the Industrial Processes and Product Use sector, GHG emissions are broken down by key industries and production processes. For example, the mineral industry category includes emissions from cement production, lime production, glass production and other process uses of carbonates. The metal industry covers GHG emissions from the production of iron and steel, ferroalloys, aluminium, magnesium, lead and zinc.

At the same time, the breakdown of GHG emissions for the purpose of national accounting and international reporting differs from the typical breakdown of economic activities in the national economy. Cement producing plants or iron and steel plants generate both emissions from the fuel combustion and emissions from industrial processes. Similarly, operation of agricultural enterprises result in GHG emissions reported at least in the Energy sector (fuel combustion activities in transport and other sectors), the Agriculture sector (emissions from enteric fermentation, manure management, agricultural soils etc.), and the LULUCF sector (GHG emissions linked to the loss of soil organic carbon in the Cropland sub-category).

Therefore, a multi-layer categorization approach is required to ensure alignment with both the nature of economic activities and the national and international GHG emissions reporting. Under such an approach, the emissions should be analysed and forecasted with both the breakdown by key economic sectors and within each sector also by key GHG emissions sources defined by the IPCC.

Other important considerations for defining sectoral boundaries of the national carbon budget include importance of each particular sector in the national economy, differences in emission drivers and methodological approaches, as well as policy coverage and relevance. Some sectors can be aggregated, while others can have more detailed breakdown, depending on the approach selected.

The Energy sector in national inventories covers both emission sources that are defined by energy supply activities (i.e. fuel and electricity supply) and by demand-side activities (e.g. fuel combustion by different industries, energy consumption by buildings and transport). Due to the scale of related emissions and different emission drivers and policy levers, supply side and demand side energy related emissions are typically considered separately in the national carbon budgets.

48 IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, <https://www.ipcc-nggip.iges.or.jp/public/2006gl>



For each sector, GHG emissions could be further structured by policy coverage, such as emissions to be covered by the national emission trading scheme, emissions to be covered by Effort Sharing Regulation or LULUCF Regulation etc. This additional layer could be added after introducing respective policies to enable not only assessment of the overall progress against GHG reduction targets but also the effectiveness of specific climate policies.

UK CCC designed sectoral classification taking into account policy relevance (i.e. consistency with the main policy levers involved), alignment to previous modeling projects, Net Zero Strategy (NZS) sectors, Territorial Emissions Sectors used for the UK's emissions inventory, National Communication (NC) sectors, and sector classifications defined in devolved climate legislation. In particular, the methodology behind the UK's carbon budget breaks down the transport sector into surface transport, aviation, and shipping due to different policy levers used in each sub-sector. At the same time, the Land use sector covers all LULUCF (land use, land use change, and forestry) and is sometimes considered together with the Agriculture sector. In addition, the methodology also defines F-gases and Engineered removals as separate sectors.⁴⁹

The national carbon budget for Ukraine may cover the following sectors:

- Energy: emissions from energy (electricity and fuel) supply, including electricity and heat energy generation, as well as fugitive emissions from fuels;
- Transport: emissions from fuel combustion and electricity consumption by road, railway, air and water transport;
- Buildings: emissions from electricity, heat energy and fuel consumption by residential, public, commercial and other buildings;
- Industry: emissions from key carbon-intensive industrial sectors, such as iron and steel, cement production and others;
- Agriculture: emissions from agricultural soils, enteric fermentation and manure management, land use and land use change on cropland areas, fuel combustion activities in agriculture, as well as other relevant sources;
- Forestry: carbon sequestration and GHG emissions from forests;
- Waste: emissions from waste and wastewater management.

In some analytical applications, there could be a need for a different classification system and the multi-layer classification approach (e.g. by defined sectors, by IPCC categories, by policy levers applicability, by gases etc.) will ensure flexibility and allow designing datasets and models that would meet needs of different stakeholders.

The sectors are interlinked and such linkages should be explored and considered in sectoral methodologies and decarbonization studies. For instance, emissions from electricity and heat generation in the Energy sector determine emission intensity from electricity and heat consumption in Buildings or emissions from electricity consumption in Transport. Decarbonization technologies linked to agricultural biomass use in Agriculture will determine the supply of renewable energy to other sectors, including Energy, Buildings, and Transport.

49 UKCCC (2025). Methodology report Methodology behind the CCC's carbon budget advice for the UK, Northern Ireland, Wales, and Scotland, published in 2025, <https://www.theccc.org.uk/publication/methodology-report-uk-northern-ireland-wales-and-scotland-carbon-budget-advice>



4.3. Cumulative emissions trajectory within a carbon budget

One of the key issues for a carbon budget development is the **cumulative emissions trajectory**, which represents the total volume of greenhouse gas emissions released over a defined planning horizon.

Carbon budgets are developed by defining an emissions pathway that is consistent with achieving Net Zero greenhouse gas emissions while remaining within a final cumulative emissions allowance. The trajectory therefore establishes how emissions should evolve over time to ensure that total emissions released between the baseline year and the target year do not exceed the available carbon budget. This approach enables climate targets to be translated into a measurable sequence of annual or multi-year emissions limits and provides a structured framework for monitoring progress toward long-term decarbonization objectives.

The cumulative emissions trajectory is derived through the integration of projected annual emissions over the planning horizon. Emissions are first estimated under the baseline scenario, representing the evolution of emissions in the absence of additional decarbonization measures. For the first carbon budget, alternative decarbonization pathways are then developed by incorporating mitigation (decarbonization) measures across all relevant sectors of the economy over its planning horizon. For carbon budgets of subsequent periods, alternative decarbonization pathways and the cumulative emissions are subsequently calculated and compared against the available (previous) carbon budget. This comparison enables the identification of pathways that achieve the required level of emissions reduction while remaining consistent with climate targets.

An important feature of the carbon budget approach is the recognition that the timing of emissions reductions significantly influences cumulative emissions outcomes. Delayed implementation of mitigation measures may still allow achievement of a specific target but often results in substantially higher cumulative emissions and costs over the transition period. Conversely, earlier deployment of decarbonization measures reduces cumulative emissions and increases the likelihood of remaining within the available carbon budget. As a result, pathway design is not limited to determining the final emissions level but also considers the optimal sequencing and timing of interventions across sectors.

The cumulative emissions trajectory also serves as a key tool for evaluating the contribution of individual sectors and decarbonization measures to overall decarbonization objectives. These sector-specific trajectories are aggregated to form an economy-wide emissions pathway. The resulting cumulative emissions trajectory provides a comprehensive assessment of how individual measures collectively contribute to achieving the overall carbon budget.

Within the carbon budgeting framework, cumulative emissions trajectories are closely linked to the assessment of mitigation potential and investment requirements. This information supports the prioritisation of mitigation actions and provides an analytical basis for the development of marginal abatement cost curves (MACCs), investment roadmaps, and sectoral decarbonization strategies.

Cumulative emissions trajectories are subject to uncertainty arising from economic, demographic, technological, and policy-related factors. For this reason, pathway



development is accompanied by sensitivity analysis and periodic reassessment of assumptions to ensure that the carbon budget remains achievable under changing circumstances.

In the context of carbon budget development, the cumulative emissions trajectory provides a mechanism for evaluating alternative decarbonization pathways and mitigation measures. By focusing on cumulative emissions, the carbon budgeting approach supports the development of transition pathways that are consistent with climate objectives while enabling the effective allocation of resources across sectors and mitigation measures.⁵⁰

4.4. Assessment of emissions reduction costs using MACC

One of the key tasks in developing a carbon budget is to determine how emission reductions should be distributed across sectors of the economy and to identify the most cost-effective measures to achieve these reductions. To do this, policymakers and analysts widely use the **marginal abatement cost curve (MACC)** methodology.

WHAT IS A MACC?

Marginal Abatement Cost Curve is a commonly used tool for evaluating emissions reduction technologies and an effective communication instrument for discussions of abatement strategies. MACC presents decarbonization measures, sector-specific abatement potential and cost-effectiveness of different decarbonization options in a user-friendly way.

MACCs emerged as a helpful visual tool for cost-effective environmental planning back in the 1970s. However, the framework gained prominence with McKinsey & Company's adaption to help businesses and governments understand the economic implications of greenhouse gas emissions reductions and prioritize cost-effective actions.⁵¹ The MACC approach has become widely used for national and sectoral net-zero planning, as well as evaluation of emission reduction strategies at a corporate level.⁵²

HOW TO READ A MACC?

In a MACC chart, each emission reduction measure (decarbonization measure) is represented by a separate rectangular bar. The height of the bar reflects the marginal cost of emission reduction (marginal abatement cost), i.e. the cost or positive economic effect per tonne of CO₂e of reduced emissions. If a bar is above the zero line, the implementation of the corresponding measure is associated with additional costs. If a bar is below the zero line, the measure is economically beneficial and provides not only emission reductions, but also cost savings over its operating lifetime. The width of a bar characterizes the emission reduction potential that can be achieved through the implementation of the corresponding

50 The section is based on the experience of UK CCC in developing carbon budgets as reflected in the following publications: UK CCC. Proposed methodology for the Seventh Carbon Budget advice, <https://www.theccc.org.uk/wp-content/uploads/2023/11/CCC-Proposed-methodology-for-the-Seventh-Carbon-Budget-advice.pdf> and UK CCC, The Seventh Carbon Budget, <https://www.theccc.org.uk/wp-content/uploads/2025/02/The-Seventh-Carbon-Budget.pdf>

51 Making marginal abatement cost curves work for decarbonization actions, <https://alignedincentives.com/marginal-abatement-cost-curve-macc-decarbonization>

52 McKinsey Quarterly Understanding the price of decarbonization, <https://www.mckinsey.com/capabilities/sustainability/our-insights/understanding-the-price-of-decarbonization#>



measure (in tonnes of CO₂e). The wider the bar, the greater the amount of emissions that can be reduced due to implementation of a specific measure. The area of the bar reflects the overall economic scale of the measure, combining its cost and emission reduction potential.

Decarbonization measures on a MACC chart are arranged from left to right in an order of increasing marginal emission reduction costs allowing easy identification of the most cost-effective measures. The horizontal axis of a graph reflects the accumulated potential for emission reductions from the implementation of decarbonization measures. As moving from left to right, the potential of individual measures is sequentially added allowing assessing the total amount of emission reductions that can be achieved as a result of the implementation of the entire set of decarbonization measures (see example at Figure 2).

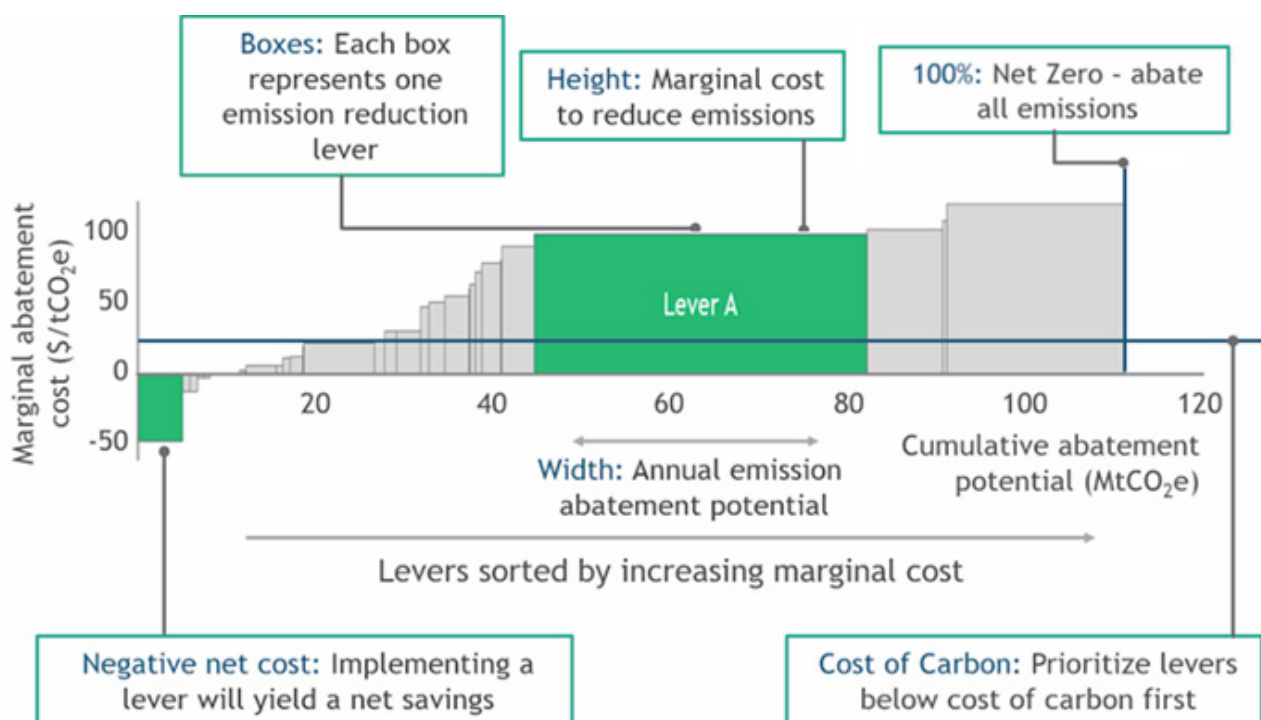


Figure 2. Example of a MACC with prioritization of decarbonization levers

Source: *The Climate Drive*⁵³

DETERMINING THE BASELINE FOR CALCULATING MARGINAL ABATEMENT COST

When calculating the marginal cost of reduction for a specific decarbonization measure, it is necessary to determine a baseline that serves as a reference scenario for assessing the emissions and cost. Such a baseline should reflect the technology choices and behaviour under business-as-usual circumstances without consideration of any low carbon policy interventions.⁵⁴ The baseline for a specific measure characterizes the state of the system

⁵³ Understand the cost and impact of decarbonization, <https://www.theclimatedrive.org/guidebook/reduce/step-3-build-your-decarbonization-roadmap/understand-cost-and-impact-leverage-abatement-curve-to-identify-reduction>

⁵⁴ Policy brief. Marginal Abatement Cost (MAC) Curve, <https://publications.tno.nl/publication/34632093/9Zj8N6/o11017.pdf>



or technological process in the absence of the implementation of this measure. It reflects the expected indicators of energy consumption, resource use and related greenhouse gas emissions that would arise if the existing technology, equipment or business practices were maintained.

The emission reduction potential is defined as the difference between the emissions in the baseline scenario and the emissions after the implementation of the decarbonization measure. This reduction potential is used when calculating a marginal abatement cost (MAC) indicator.

In addition to determining the emission reduction potential, the baseline is used to determine the additional costs or savings associated with the implementation of the decarbonization measure. This takes into account both the capital costs of implementing the measure and changes in operating costs (i.e. additional costs or savings) compared to the baseline scenario.

To ensure the correctness of the comparison of different decarbonization measures, the baseline should be formed on the basis of consistent methodological principles and take into account the forecasted conditions for the facility/system throughout the entire calculation period. If a decarbonization measure replaces an existing technology, the baseline is treated as the continuation of the operation of the existing technology until the end of its normative or economically feasible operational life.

Thus, the baseline for a separate decarbonization measure is a key element of a MAC calculation, as it determines both the amount of emission reductions and the economic effect achieved as a result of the implementation of the corresponding decarbonization measure.

DYNAMIC NATURE OF MACC FOR LONG-TERM PLANNING

Traditional approaches to MACC development have some limitations⁵⁵ that need to be addressed especially for long-term planning.⁵⁶ Static analysis does not meet the needs of strategic planning and it is challenging to keep data relevant and project-specific in changing circumstances. In practice, marginal abatement costs can be subject to large fluctuations between years modelled.⁵⁷ Traditional MACCs are static and lack the flexibility needed for strategic planning. This limits the ability to make informed decisions taking into account changes in the project's technical and economic conditions and external influencing factors (policies, market conditions, energy prices, etc.). To address these limitations and ensure a thorough strategic planning process, estimation of MACCs should be dynamic in nature and include regular updates of input factors and scenario analysis

55 Making marginal abatement cost curves work for decarbonization actions, <https://alignedincentives.com/marginal-abatement-cost-curve-macc-decarbonization>

56 Jimenez Gomez, Pedro Pablo. (2023). Marginal Abatement Cost : A Literature Review. Cognitive Sustainability. 2. 10.55343/cogsust.58, https://www.researchgate.net/publication/371970135_Marginal_Abatement_Cost_A_Literature_Review

57 Policy paper Valuation of greenhouse gas emissions: for policy appraisal and evaluation Published 2 September 2022, <https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation#introduction>



(e.g. via using the dedicated modelling tools).^{58, 59}

The dynamic approach to MACC development allows adapting to rapid technological changes, including changes in the cost and efficiency of technologies, as well as capital cost and other external factors. A dynamic MACC allows making informed decisions when prioritizing emission reduction measures for both sectoral decarbonization strategies and a national carbon budget in general. This is especially important for long-term planning, which is subject to high uncertainty levels.

UK CCC concluded that technological improvements in abatement potential and reductions in the cost of low-carbon technologies will have a downward impact on abatement costs between 2025 and 2050. For example, abatement costs for electric cars and vans fall from £220/tCO_{2e} to -£210/tCO_{2e} over the 25-year period.⁶⁰

THE ROLE OF A MACC IN CARBON BUDGET DEVELOPMENT

MACC plays a central role in the preparation and assessment of carbon budgets, and is used typically for several interrelated purposes.

- 1. Identifying cost-effective emission reduction pathways** - the main application of MACC is to identify decarbonization actions and measures that can deliver the largest emission reductions with the minimum cost. By ranking emission reduction measures according to their marginal costs, policymakers can prioritize early implementation of low-cost measures while scheduling the implementation of more capital-intensive technologies for later budget periods.
- 2. Allocation of carbon budgets by sectors** - a MACC methodology provides an analytical framework for determining how the overall carbon budget can be allocated across sectors of the economy to ensure a realistic emission reduction trajectory for each sector, taking into account technological complexity and capital intensity of emission reductions, a realistic implementation timeline and the potential of residual (unabated) emissions.
- 3. Assessment of the adequacy of the carbon price** - the marginal cost of emission reductions is closely linked to carbon pricing instruments such as emissions trading systems (ETS) or carbon taxes. The marginal costs of emission reductions estimated in the MACC analysis can be compared with expected carbon prices to determine whether these prices provide sufficient market incentives to attract investment in specific decarbonisation measures or whether, at this stage, the measures are still not cost-effective at given carbon prices. Such analysis allows on a reasonable basis to identify the need for additional mechanisms to support the implementation of such projects.

58 Making marginal abatement cost curves work for decarbonization actions, <https://alignedincentives.com/marginal-abatement-cost-curve-macc-decarbonization>

59 McKinsey Quarterly Understanding the price of decarbonization, <https://www.mckinsey.com/capabilities/sustainability/our-insights/understanding-the-price-of-decarbonization#>

60 The Seventh Carbon Budget, <https://www.theccc.org.uk/wp-content/uploads/2025/02/The-Seventh-Carbon-Budget.pdf>



4. Long-term investment planning - a MACC analysis helps to assess future investment needs and identify technologies that are expected to become economically profitable over time due to scaling effects, reducing the cost of renewable energy, strengthening carbon regulation, and other factors.

UK CCC: using MACC for the selection of technologies and timing of their implementation when developing a decarbonization pathway^{61,62}

UK CCC's approach aims to develop pathways that achieve the transition to Net Zero in a feasible, cost-effective manner, whilst also considering other benefits. It is based on the three key components described below.

1) «Snapshot» of cost-effectiveness

While developing sectoral pathways, the UK CCC identifies the most cost-effective choice between alternative reliable low-carbon, zero-carbon technologies, decarbonization measures and possible timelines for their implementation.

The general approach is that technologies under consideration are only included in the pathway when they become economically feasible and their abatement cost is more cost-effective than the UK «target-consistent» carbon price values. These values have been developed by the UK Government with a view to achieving the 2050 carbon neutrality target and using a least-cost approach to minimise cumulative greenhouse gas emissions over the period to 2050.

Unlike carbon prices observed in markets such as the UK Emissions Trading Scheme, carbon values (or greenhouse gas emissions values) is an element of an analytical approach used in policy appraisal and assessment of the impact of policy interventions on GHG emissions. The government applies carbon values during both policy design and evaluation to estimate the climate-related costs and benefits of proposed or implemented measures. Their main purpose is to support objective, consistent, and evidence-based decision-making within broader cost-benefit analysis frameworks.

Since 2009, a "target consistent" or "abatement cost" approach has been used to estimate the carbon values, where these are calculated as the marginal abatement cost of meeting targets. Under this approach, carbon values are set at levels of marginal abatement costs required to reach the adopted targets (e.g. reaching net zero emissions by 2050 and a series of interim 5-year carbon budgets, NDC climate targets under the Paris Agreement).

Given estimates of the volume and required emission reduction trajectory and a list of abatement options, the level of effort (A*) required to achieve the set emission reduction targets is determined. The resulting intersection point of the level of effort (A*) with the abatement cost of the corresponding decarbonization measure is projected onto the Y axis, which corresponds to the "target-consistent" carbon value (see Figure 3).

61 UK CCC, The Seventh Carbon Budget, <https://www.theccc.org.uk/wp-content/uploads/2025/02/The-Seventh-Carbon-Budget.pdf>

62 UK CCC. Proposed methodology for the Seventh Carbon Budget advice, <https://www.theccc.org.uk/wp-content/uploads/2023/11/CCC-Proposed-methodology-for-the-Seventh-Carbon-Budget-advice.pdf>

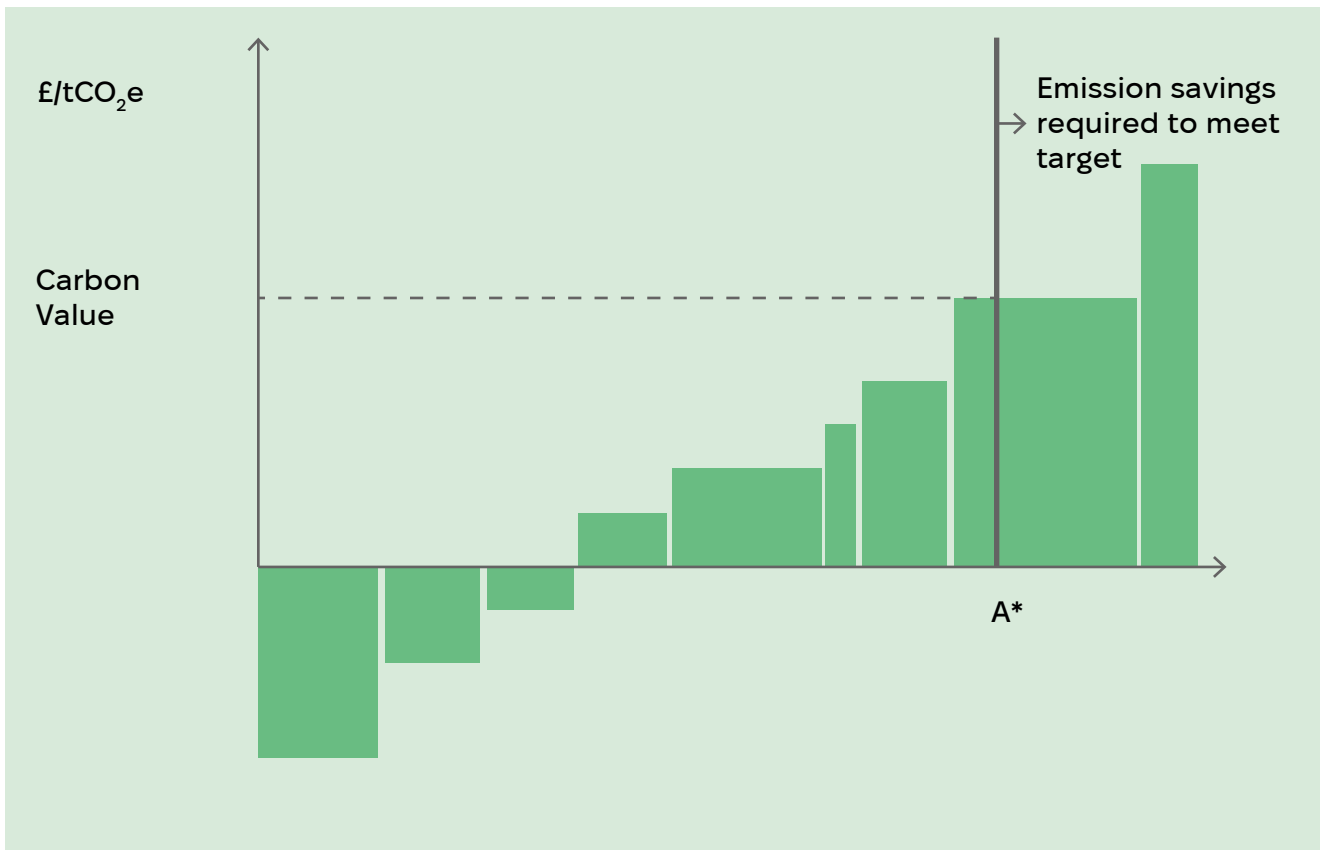


Figure 3. Illustrative representation of the approach to determining a carbon “target” value

Source: Department for Energy Security & Net Zero; Department for Business, Energy & Industrial Strategy⁶³

Cost-effectiveness is determined by comparing the cost per tonne of abatement ($\text{£/tCO}_2\text{e}$, considering both the capital and operating expenditure) in a specific year for alternative options with the «target-consistent» carbon value defined for that year.

2) «Dynamic» cost-effectiveness assessment

After defining a list of decarbonization measures, an analysis of dynamic cost-effectiveness is performed. The scope of this analysis determines the feasibility of including in the decarbonization pathway those measures and early actions for their implementation that are still not cost-effective as of a given year, but with the potential of overcoming the cost-effectiveness threshold in the future due to decreasing cost.

3) Determining feasible roll-out rates

The cost of abatement is considered alongside a number of other factors to determine the appropriate and feasible pace of implementation of each technology on the pathway. These factors include maturity of technology, skills, supply-chains and resources required to deliver the technology at scale, availability of low-carbon infrastructure, site planning, consumer behavior, feasible private sector action, some additional considerations (imported emissions, resilience to a changing climate, integrity and verifiability etc.).

63 Policy paper. Valuation of greenhouse gas emissions: for policy appraisal and evaluation, <https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation#introduction>



4.5. Modelling approaches: opportunities and limitations

Modelling is a core element of carbon budget development, as it translates long-term climate targets into quantitative emissions pathways and helps assess whether a proposed budget is technically feasible, economically realistic and consistent with sectoral transformation needs. In practice, carbon budget modelling usually combines several analytical components, including emissions projections, sectoral decarbonisation pathways, assessment of policy impacts, technology and cost assumptions, and sensitivity analysis.

Baseline projections are used to estimate future emissions under existing policies or without further decarbonisation action, providing a reference point against which additional mitigation efforts can be assessed. A variety of modelling tools and approaches are then used to develop an economy-wide decarbonization pathway:

- › sectoral bottom-up models describe emissions reduction options at the level of specific sectors, technologies, and activity drivers;
- › energy system optimisation models, such as TIMES-based models⁶⁴, are used to identify least-cost technology pathways across energy supply and demand sectors;
- › macroeconomic and computable general equilibrium (CGE) models help assess broader economy-wide effects, including impacts on trade, output, and sectoral structure;
- › land-use models are used to analyse emissions and removals from agriculture, forestry, and other land-use categories.

In addition, marginal abatement cost analysis and policy appraisal tools are used to compare mitigation options by cost-effectiveness and to estimate the emissions impact of specific policy interventions. In turn, modeling also plays a key role in the development of MAC curves, typically using the following general approaches⁶⁵:

- › a bottom-up individual assessment of technologies/abatement measures, where abatement costs are defined at a technology level, commonly using cost-benefit models;
- › system modeling approach where various bottom-up (e.g., MARKAL and TREMOVE) and top-down (CGE) system models have been used to generate MAC curves in order to include interactions among technologies and policies;
- › macro-economic modeling derived using CGE models, where emissions are usually modeled by using fuel as an input, using fuel emission coefficients and introducing constraints on emissions.

Each modeling type has its own benefits and deficiencies and are used depending on the goals and complexity of the modeling.

64 TIMES stands for The Integrated MARKAL-EFOM System. It is a technology-rich, bottom-up energy system optimisation model generator developed within the IEA-ETSAP community. Introduction to TIMES, ETSAP, <https://iea-etsap.org/times-the-integrated-markal-efom-system>

65 Dissemination Note Series. Romania: Toward a Low Carbon and Climate Resilient Economy. Marginal Abatement Cost Curve Analysis, <https://documents1.worldbank.org/curated/en/859881468197634735/pdf/103914-WP-P145943-PUBLIC-Dissemination-Note-Marginal-Abatement-Cost-Curve-Analysis.pdf>



International experience shows that countries rarely rely on a single model. Instead, they use a modelling framework that brings together sector-specific analysis and economy-wide assumptions, as shown by the UK Climate Change Committee's sectoral modelling approach, Ireland's use of TIMES-Ireland analysis, and Australia's CSIRO multi-model framework combining macroeconomic, energy system, and land-use models.

UNITED KINGDOM: MODELLING THE BALANCED PATHWAY TO NET ZERO

For the Seventh Carbon Budget, the UK Climate Change Committee (CCC) uses the Balanced Pathway, an emissions reduction pathway from 2025 to Net Zero by 2050, as the analytical basis for its advice on the 2038-2042 budget period. The pathway is designed to be consistent with the UK's legislated carbon budgets and stated NDCs.⁶⁶

The Balanced Pathway is developed through detailed sectoral modelling and then aggregated into a cross-economy pathway. The CCC methodology report explains that the pathway is based on modelling of cost-effective and feasible decarbonisation options, with sector-specific assumptions and supporting evidence used to assess the contribution of each sector.⁶⁷

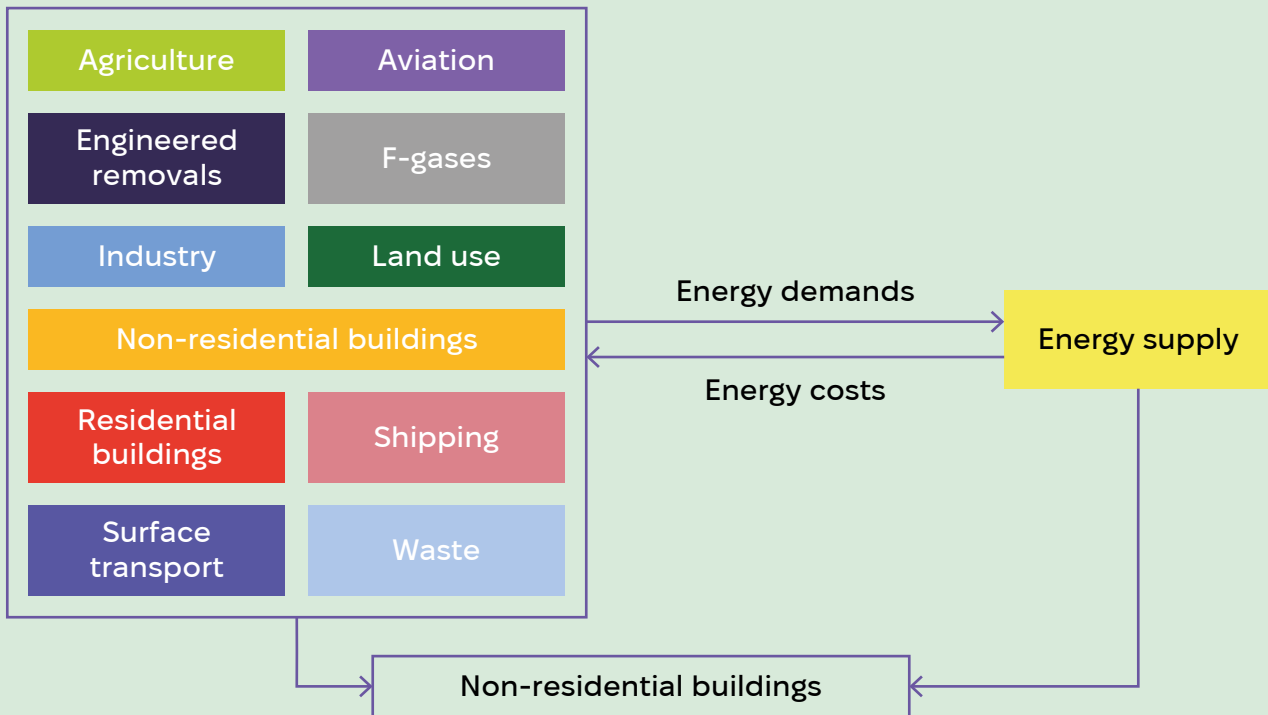


Figure 4. Structure of sectoral modelling for the UK CCC Balanced Pathway

Source: UK CCC⁶⁸

66 UK Seventh Carbon Budget, <https://www.theccc.org.uk/publication/the-seventh-carbon-budget>

67 UK Policy paper, Carbon budget and growth delivery plan (Section 14 Report), <https://www.gov.uk/government/publications/carbon-budget-and-growth-delivery-plan/carbon-budget-and-growth-delivery-plan-section-14-report-accessible-webpage#appendix-a-sector-definitions>

68 Methodology behind the CCC's carbon budget advice for the UK, Northern Ireland, Wales, and Scotland, published in 2025, https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN010166-001194-CESL_CQLCP_D5_APP-K_%20Methodology-report-CCC-2025.pdf



The UK approach also links modelling with policy delivery. The Government's Carbon Budget and Growth Delivery Plan sets out the package of proposals and policies intended to deliver Carbon Budgets 4, 5 and 6. Its Technical Annex provides sector-specific modelling approaches for quantified emissions savings, including the Dynamic Dispatch Model for the power sector, COMIT for industry, RoCaFF and the National Transport Model for road transport, a maritime emissions model for shipping, and evidence-based modelling approaches for agriculture, land use and waste. This shows that policy delivery is assessed through a combination of sector-specific models and assumptions.⁶⁹

Overall, the UK example shows a modelling framework that combines a Net Zero pathway, sectoral modelling, economy-wide aggregation, policy impact assessment and uncertainty analysis. This allows the carbon budget to be used both to set the emissions limit and to assess whether the policy package is sufficient to deliver it.

IRELAND: SCENARIO-BASED MODELLING AND TIMES-IRELAND

In Ireland, modelling for carbon budgets relies strongly on scenario analysis and the TIMES-Ireland Model (TIM), developed by University College Cork. TIM is used to assess decarbonisation pathways for Ireland's energy system and covers electricity, transport, industry, residential and commercial sectors, as well as fuels such as hydrogen and bioenergy.⁷⁰

For the 2024 carbon budget proposal, the Climate Change Advisory Council did not choose a single preferred scenario. It assessed a large set of national GHG emissions scenarios, developed from combinations of energy, agriculture and land-use modelling outputs. Also, the Climate Change Advisory Council shortlisted 15 pathways consistent with Ireland achieving climate neutrality by 2050 in the context of global efforts to limit warming to 1.5°C, and used the average of the associated carbon budgets to inform the proposal.⁷¹

Ireland links national carbon budgets to implementation through Sectoral Emissions Ceilings. After carbon budgets are approved, the Government sets ceilings that divide the overall budget among sectors for the relevant budget period.⁷²

NEW ZEALAND: DEMONSTRATION PATHWAYS AND THE ENZ MODEL

New Zealand uses modelled pathways to test whether emissions budgets are achievable. For the first three emissions budgets, the Climate Change Commission developed a demonstration path and two alternative paths and carried out sensitivity analysis to test how the budgets could be met under different assumptions on technology implementation

69 UK Policy paper, Carbon budget and growth delivery plan: technical annex, <https://www.gov.uk/government/publications/carbon-budget-and-growth-delivery-plan/carbon-budget-and-growth-delivery-plan-technical-annex-accessible-webpage>

70 University College Cork, Energy Policy and Modelling Group, TIMES-Ireland Model (TIM), <https://www.ucc.ie/en/epmg/models/tim>

71 Carbon Budget Proposal Report 2024, Climate Change Advisory Council, Ireland, <https://www.climatecouncil.ie/media/CCAC%20Carbon-Budget%20Proposal%202024-final.pdf>

72 Sectoral Emissions Ceilings, Ireland, September 2022, <https://assets.gov.ie/static/documents/sectoral-emissions-ceilings-summary-report.pdf>



and behaviour change.⁷³

Also, the Commission uses ENZ – Emissions in New Zealand as a key modelling tool.⁷⁴ ENZ is a bottom-up, technology-rich model that produces economy-wide emissions estimates and covers the main emitting sectors, including energy, industry, transport, agriculture, forestry, product use and waste. It can reflect changes in technologies, emitting activities, behaviour and sectoral linkages.

New Zealand links modelling with implementation through emissions reduction plans. The second emissions reduction plan is the Government's plan for meeting the second emissions budget for 2026-2030.⁷⁵

FRANCE: AMS REFERENCE SCENARIO

France uses modelling through the National Low-Carbon Strategy (SNBC). The SNBC is based on a reference scenario known as AMS (Avec Mesures Supplémentaires / With Additional Measures). This scenario includes additional public policy measures, beyond those already in place, that are needed to meet France's climate and energy objectives. It is used as the basis for defining carbon budgets and for steering the energy transition. The AMS scenario is sectoral. It presents emissions reduction trajectories for the main sectors, including transport, buildings, agriculture and forestry, industry, energy production and waste.

The main limitation is that the AMS scenario is an indicative reference pathway rather than a detailed sectoral implementation plan. It is used to define carbon budgets and provide elements for monitoring and steering the energy transition.⁷⁶ France has sectoral policy guidelines and implementation measures within the broader SNBC and NECP framework.

Across these examples, the main limitation is that modelled pathways depend on assumptions about future economic activity, technology deployment, behaviour change, policy implementation and data quality. For Ukraine, international modelling practices show an opportunity to develop a flexible carbon budget framework that combines sectoral analysis, policy impact assessment and sensitivity testing to support evidence-based climate planning.

4.6. Key assumptions and uncertainties in carbon budget modelling

National carbon budgets define indicative targets for future GHG emissions trajectories and, as in any projection, are subject to uncertainty linked to specific assumptions made while constructing sectoral models and the overall economy-wide GHG emissions pathway. Though it is not possible to eliminate such uncertainty, a transparent documentation of

73 Advice to the New Zealand Government on its first three emissions budgets and direction for its emissions reduction plan 2022-2025, <https://www.climatecommission.govt.nz/assets/Inaia-tonu-nei-a-low-emissions-future-for-Aotearoa/Inaia-tonu-nei-a-low-emissions-future-for-Aotearoa.pdf>

74 Technical Annex, Modelling and analysis to support final advice on New Zealand's fourth emissions budget, <https://www.climatecommission.govt.nz/assets/Advice-to-govt-docs/Target-and-budgets-final-reports/Technical-Annex-Final-reports-on-the-fourth-emissions-budget-and-2050-target-review-Dec-2024.pdf>

75 New Zealand's second emissions reduction plan 2026-2030, <https://environment.govt.nz/publications/new-zealands-second-emissions-reduction-plan>

76 National low carbon strategy of France (SNBC), https://unfccc.int/sites/default/files/resource/en_SNBC-2_complete.pdf



key assumptions and assessing key drivers of uncertainty provide grounds for meaningful stakeholder engagement, incorporation of feedback, defining priority gaps driving uncertainties and identification of other improvements.

Key assumptions used for the development of a national carbon budget could be divided into cross-sectoral assumptions and sector-specific assumptions.

For the purposes of preparing Ukraine's carbon budget, the cross-sectoral assumptions can be summarised in the following categories:

- Historical GHG emissions levels – information from the Annual Greenhouse Gases Inventory Document submitted to the United Nations Framework Convention on Climate Change and the Paris Agreement, as well as Common Reporting Tables for the electronic reporting of greenhouse gas inventories (CRTs);
- Historical energy consumption – information from the national statistics published by the State Statistical Service of Ukraine and other data owners (e.g. NPC Ukrrengo, the National Energy and Utilities Regulatory Commission, Ministry of Energy of Ukraine), as well as data reported in CRTs;
- Economic development forecast – short-term, mid-term and long-term GDP growth forecast published by the Government of Ukraine, the National Bank of Ukraine, IMF, EBRD and other IFIs, as well as research institutions; economic development projections for key sectors of economy (e.g. sectoral value-added forecasts);
- Population dynamics - short-term, mid-term and long-term population forecasts based on the official documents and strategies, information of the Mykhailo Ptoukha Institute for Demography and Life Quality Research of the National Academy of Sciences of Ukraine, as well as other research institutions and international organizations;
- Carbon pricing – projections of carbon pricing scale and coverage based on existing and future policies and forecasts of EU ETS allowances prices developed by EU institutions and international organizations (e.g. scenarios from the International Energy Agency, the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) etc.);
- Energy cost – projections of the cost of key primary and secondary energy carriers (e.g. electricity, natural gas, oil and oil products, coal etc.) based on the existing and future policies and forecasts developed by international organizations (e.g. scenarios from the International Energy Agency or NGFS).

Sector-specific assumptions may differ in the scope and nature for each specific sector and can be summarized in the following categories:

- Historical activity data – information from the national statistics published by the State Statistical Service of Ukraine, information used in the preparation of the Annual Greenhouse Gases Inventory Document, as well as other activity data from sectoral associations, key enterprises and other sources; the information could include production volumes, use of raw materials etc.;
- Low-carbon technologies cost – information on capital expenditures (CAPEX) and operational expenditures (OPEX) associated with the introduction of climate technologies in specific sectors and the factors determining the cost (e.g. economy of scale);



- Low-carbon technologies adoption rates – information on both the global or, where possible, regional trends and national data on adoption rates and technical characteristics of specific technologies derived from international organizations, research institutions, industry associations and other sources;
- Assumptions on shifting consumer choices – information from global and national research on the observed and expected behaviour changes leading to demand-side shifts in activity levels and energy consumption (e.g. increased use of active mobility and public transport, lower indoor heating temperatures and change in the average size of buildings / apartments, dietary changes with increased consumption of plants based products, adoption of EVs, heat pumps and energy efficient appliances etc.).

The approach used in sectoral decarbonisation studies should be applied for the overall national carbon budget and aims for alignment with national GHG emissions accounting to the maximum extent possible. Nevertheless, there may be some differences as accounting for some decarbonization levers requires higher granularity of data or different methodological approaches than those used in the national inventories. Recommendations on the improvement of national inventories constitute an important element of each sectoral decarbonization study (e.g. with respect to changes in methodological approaches for tracking soil organic carbon changes, data sources and data quality control procedures, improvement of national data collection system etc.).

5. National carbon budget development process

The Green Transition Office is working on a national carbon budget for Ukraine in cooperation with other stakeholders moving from sectoral decarbonization studies to a comprehensive national carbon budget framework.

During the last two years, the Green Transition Office has developed several sectoral decarbonization studies and continues its work on modelling sectoral decarbonization pathways for key sectors of Ukrainian economy. The aim of the sectoral decarbonization studies is to support the overall net-zero aspirations of Ukraine by well-defined trajectories of emission reductions for key carbon intensive sectors that consider current conditions, maturity of technologies, costs, co-benefits and other factors. Sectoral studies provide a detailed review of both technical climate mitigation potential and cost-effectiveness of specific measures as demonstrated by marginal abatement cost curves for each sector.

Agriculture is a key sector of the Ukrainian economy and a major source of GHG emissions, contributing about one quarter of national emissions. The sectoral study prepared by the Green Transition Office⁷⁷ considered agriculture in a broad context and analysed emissions from crop production activities (e.g. due to the use of mineral nitrogen fertilisers), livestock production (e.g. emissions from enteric fermentation and manure management), unsustainable land use (loss of soil organic carbon due to intensive tillage and limited

⁷⁷ Green Transition Office (2025). Agriculture: Sustainable Practices for Food Security and Advancing Climate Goals. Sectoral Study on Greenhouse Gas Emission Reduction and Carbon Sequestration Potential, <https://gto.dixigroup.org/research>



crop rotation), land use change (e.g. loss of soil organic carbon due to pasture conversion to arable land), as well as emissions from fuel and energy consumption by agricultural enterprises. Combined these sources generated 76 million tonnes of CO₂e of greenhouse gas emissions in 2021 accounting for about 23% of Ukraine's total emissions. Due to the impact of war and the economic downturn caused by Russian military aggression, reported emissions dropped during recent years but their share in the total emissions increased. The sectoral study analyzed emission drivers and 22 technologies offering total annual mitigation potential of 39 Mt of CO₂e. This includes not only measures that could reduce emissions in agriculture but also covers the enabling role of agriculture in reducing GHG emissions in energy, buildings and transport sectors. The largest potential impact comes from using crop residues and other products for biogas, power and heat, as well as cover cropping and application of carbon-rich soil amendments. The study informed expert discussions on Ukraine's second NDC highlighting the agricultural sector's role in enabling residual emissions for other sectors by preventing soil organic carbon loss and enhancing carbon sequestration. Besides, the findings of the study were used in developing policies and measures for the updated version of the National Energy and Climate Plan till 2030 (adopted in June, 2026).

Cement production industry is an important source of GHG emissions in Ukraine and will play a crucial role in post-war reconstruction of the country. The sectoral study for cement industry⁷⁸ combines a top-down analysis based on existing sectoral research and standards with the bottom-up analysis based on validation of assumptions via interviews with industry experts and review of available plant-level information. At the core of the sectoral study for the cement industry, there is a technical and economic digital modelling tool, which models key production technologies, including mass, energy and heat balance, as well as associated GHG emissions. Input parameters for each technology allow analyzing decarbonization potential of various modernization approaches, building scenarios and assessing environmental, technical and economic outputs. In particular, the model analyzes impact of different fuel mixes (e.g. different combinations of coal, natural gas, Refuse Derived Fuel (RDF) and Solid Recovered Fuel (SRF), biomass and biogas, hydrogen etc.), partial replacement of raw material with non-carbonate materials (e.g. blast furnace slag), waste heat utilization, switching from wet to dry technological process, as well as carbon capture and utilization technologies.

The action plan for the national carbon budget development includes the following key elements:

- 1. Finalization of sectoral decarbonization studies and MACC** – detailed sectoral studies should cover all seven sectors defined above and provide information on GHG emissions reduction and removal potential, technology cost and other key assumptions required, as well as estimation of cost-effectiveness of different mitigation options via designing a marginal abatement cost curve for the entire economy and categorization of mitigation measures by economic feasibility.
- 2. Developing sectoral decarbonization pathways** – results of the sectoral studies should be integrated into modelling tools and aligned with cross-sectoral assumptions to build

78 Green Transition Office (2025). Decarbonization of Ukraine's Cement Industry: Challenges and Opportunities, <https://gto.dixigroup.org/research>



future GHG emission scenarios; the number of scenarios can vary but should include at least the baseline (business-as-usual) scenario and a balanced pathway scenario reflecting the most plausible emission trajectories based on assumptions elaborated in the sectoral studies (additional scenario could include accelerated decarbonisation trajectory in case of more ambitious climate policies and access to additional sources of climate finance).

- 3. Preparing detailed methodological framework for a national carbon budget** – documenting all methodological approaches and assumptions based on the results of work described above; the methodological framework will be publicly disclosed and used for the developing of the national carbon budget with subsequent reviews based on lessons learned. Methodological framework will also include a dataset of cross-sectoral assumptions designed based on the analysis of existing economic forecasts and modelling work in a broader economic and demographic context. The dataset will define the data points and values that would affect all sectors covered by the national carbon budget and would be aligned with existing policies and strategies; this work should also identify the key sources of relevant information and the processes of regular review and update of cross-sectoral assumptions.
- 4. Developing and institutionalization of the national carbon budget** – based on the studies conducted and documented methodological framework the initial carbon budget will be developed (e.g. for the period 2030-2035). The national carbon budget framework will be integrated into the state climate governance system via amendments to be proposed to the Ukrainian Climate Law and developing secondary regulations governing the elaboration and use of national carbon budgets. Information on the mitigation potential and cost-effectiveness of different mitigation options could be used for the identification of priorities for the public investment management system, cooperation with IFIs, and designing investment support policies for the private sector.

The Green Transition Office will lead the development of a national carbon budget for Ukraine, however, effective implementation of the actions outlined above will require active engagement of various stakeholders, in particular:

- › Ministry of Economy, Environment and Agriculture – providing institutional support during preparation of sectoral decarbonization studies and the national carbon budget;
- › Other ministries (Ministry of Energy, Ministry for Development of Communities and Territories etc.) and agencies (e.g. State Agency On Energy Efficiency And Energy) – providing relevant data and policy context;
- › Budgetary institution National Center for GHG Emission Inventory – providing inputs on historical GHG emissions accounting data and incorporating relevant results of the studies in methodological approaches for GHG emissions calculation;
- › International organizations and development partners – providing inputs to sectoral decarbonization studies and the national carbon budget based on ongoing technical assistance projects (e.g. project-level feasibility studies, sectoral analysis and roadmaps, policy advisory work etc.);
- › International Financial Institutions (IFIs) – supporting sectoral decarbonization studies via technical components of existing and planned projects and linking



investment programs with the priority initiatives to be defined in the national carbon budget.

Broad stakeholder engagement process via dedicated events and presentations, calls for inputs and other formats to collect feedback on the initial results of sectoral decarbonization pathways and assumptions used in the analysis (e.g. cost of technologies, expected adoption rates etc.) is crucial for well-designed and realistic carbon budgets. The substantial feedback supported by industry data, project-level evidence and expert analysis will be incorporated in the process of national carbon budget development.

6. Implementing carbon budgeting in Ukraine: priorities for 2026-2030

Ukraine's recovery and reconstruction agenda (estimated needs – over \$500 billion) is being financed primarily through international public and private capital. Every major financier (EBRD, WB-IFC, EIB, bilateral DFIs etc.) conditions financing on alignment with Paris Agreement goals and decarbonization pathways. A carbon budget framework may transform Ukraine's long-term climate commitments from aspirational declarations into investable opportunities.

Based on international experience and taking into account the Ukrainian context, four concrete steps would allow Ukraine to begin implementing a carbon budget approach within existing institutional capacity and reconstruction frameworks.

STEP 1 – OPERATIONALISE THE CLIMATE LAW (2026-2027)

The Law "On the Basic Principles of National Climate Policy" (October 2024) already establishes the legally binding 2050 climate neutrality goal. The immediate task is operationalisation of the Law through:

1. Designation of the newly constituted Climate Change Council (Scientific and Expert Council on Climate Change and Ozone Layer Preservation) as the body mandated to recommend successive carbon budgets consistent with the NDC targets and the 2050 net-zero pathway. The Green Transition Office will be able to provide all the necessary support to organise this process, involving the relevant international partners and stakeholders in Ukraine.
2. By building on existing climate policy monitoring mechanisms and the National Energy and Climate Plan monitoring framework, requesting each line ministry to monitor and report annually on progress against its sectoral carbon budget, and, where deviations occur, submit a corrective action plan within three months.

STEP 2 – PRODUCE A NATIONAL CARBON BUDGET (2026-2027)

Develop a technical carbon budget disaggregating Ukraine's NDC2 target (>65% below 1990 by 2035) into key sector-level budgets. Use the National GHG Inventory submitted to UNFCCC as the baseline, supplemented by post-war damage and reconstruction scenario modelling. To date, the GTO has already developed sectoral decarbonisation pathways for



the agricultural sector, with those for cement, the waste sector and metallurgy currently being finalised. The next step is to cover the energy sector, including buildings and transport. These pathways should form the basis for the sectoral budgets.

Application case 1 – Strengthening Ukraine’s NDC with Carbon Budgets

Ukraine’s Second Nationally Determined Contribution (NDC2) sets a target of reducing economy-wide GHG emissions by **more than** 65% below 1990 levels by 2035 – a single-year target covering the period 2031-2035.

However, NDC2 still lacks the sectoral targets and roadmaps that would make it fully credible to investors and operational for domestic implementation: there are no binding sector-by-sector emission allocations, no intermediate annual or five-year milestones between now and 2035, and no independent advisory mechanism analogous to the UK CCC to recommend and monitor budget compliance.

Adopting a carbon budget approach – within the framework of the new Climate Law – would address these gaps. A structured process may involve:

- › Disaggregating the NDC2 target into binding five-year sector budgets for key sectors – drawing on the most recent National GHG Inventory submitted to UNFCCC as the baseline;
- › Establishing annual sectoral emission ceilings with a parliamentary/government review mechanism. Specifically, the energy-sector carbon budget will be extremely important for providing the long-run investment signal that energy transition finance requires.
- › Setting intermediate milestones (e.g., 2029 and 2032 review points) within the NDC2 implementation period, enabling investors and international partners to track progress on a sub-cycle basis.

STEP 3 – ANCHOR THE UKRAINE RECOVERY FINANCING FRAMEWORK TO CARBON BUDGETS (2027–2028)

Carbon budgets are not primarily an environmental instrument, but rather an economic and financial architecture tool. For Ukraine, their most immediate value lies in the near-term ability to structure bankable climate finance, satisfy IFI due diligence requirements, comply with CBAM, and carbon pricing in general.

The sectoral budget may become the anchor for IFI project financing discussions and the scientific input to the post-war reconstruction and industrialisation in at least two aspects:

1. Issuance of sovereign sustainability bonds or green gilts with the carbon budget as the scientific boundary. This could be a large-scale financial facility for the reconstruction, modernization, and industrialization of Ukraine, with clear indicators, commitments from the Government, and Ukraine’s contribution to achieving the EU’s climate goals.



2. Sectoral decarbonisation program – a dedicated mechanism/vehicle (for example, country platform^{79, 80}) following the example of other countries applied to mobilise additional funding for decarbonisation projects (e.g. Turkey⁸¹).

Application case 2 – Attracting Decarbonisation Finance

Carbon budgets are enablers for accessing large-scale international climate finance. The financial logic is straightforward: investors and lenders need a credible, science-based GHG trajectory to assess whether their capital is consistent with Paris-aligned portfolios and to structure sustainability-linked financial instruments.

A Ukrainian carbon budget framework would unlock several financing mechanisms:

1. IFI Project Financing

The EBRD, IFC, and EIB all require borrowers to demonstrate alignment with the Paris Agreement as part of their Environmental and Social Due Diligence. A national carbon budget disaggregated to the sectoral level allows individual companies (in steel, energy, agriculture) to position their operations within a credible national trajectory, which in turn supports approval of Environmental and Social Action Plans (ESAPs) and Sustainability Performance Targets (SPTs) for sustainability-linked loans.

Ukraine's iron and steel and energy sector are among the largest emitters and the largest potential recipients of transition finance. A sectoral carbon budget for energy and industry would allow these companies to issue credible transition bonds benchmarked against a government-set trajectory, rather than relying on self-declared pathways that face scepticism from ESG ratings agencies and institutional investors.

2. Sovereign Green and Sustainability Bonds

Ukraine may explore sovereign green bond issuance as part of its reconstruction financing architecture. A carbon budget provides the mandatory boundary and the independent verification mechanism that green bond standards (ICMA Green Bond Principles, EU Green Bond Standard) require. For example, the UK issued its first sovereign green gilt in 2021. The accompanying Green Financing Framework was aligned with the UK's broader net-zero strategy and legally binding carbon budgets established under the Climate Change Act, which are informed by advice from the UK Climate Change Committee.

STEP 4 – DESIGN THE ETS CAP TRAJECTORY FROM THE SECTORAL BUDGET (2028–2030)

The industry and energy sector carbon budgets may be used to calculate the ETS cap for Phases 1-2 and the Linear Reduction Factor. Given the criticality of the carbon pricing issue, introducing a carbon price floor (consistent with early-stage ETS in comparable economies) and a price stability reserve derived from the budget trajectory will provide a scientifically proven foundation for the national ETS. Moreover, the sectoral budgets may be utilised for post-accession linkage with the EU ETS.

79 EBRD, Country sector platforms, <https://www.ebrd.com/home/who-we-are/ebrd-values/ebrd-environmental-social-sustainability/EBRD-green/country-sector-platforms.html>

80 EBRD, <https://www.youtube.com/watch?v=FVgmugh-s2A>

81 EBRD, https://www.youtube.com/watch?v=ls_PGhtvEhY

**Application case 3 – Designing and Launching Ukraine’s ETS**

Ukraine has committed to establishing an Emissions Trading System (ETS) as part of its EU accession process and the way of mitigating the impacts of the EU Carbon Border Adjustment Mechanism (CBAM). An ETS without an underlying carbon budget is effectively a cap-and-trade system without a meaningful cap – politically vulnerable to industry lobbying and reasonable criticism from international partners over time.

The carbon budget framework resolves this problem by:

- › Defining the ETS cap trajectory: the total number of allowances issued each year is derived directly from the sectoral carbon budget, securing the cap from ad hoc political interventions;
- › Setting the Linear Reduction Factor (LRF): the annual rate at which the cap declines is determined by the carbon budget pathway, providing long-term price predictability – essential for investment in climate mitigation based on analysis of abatement costs;
- › Enabling cross-border linking: the EU ETS is underpinned by the EU’s legally binding climate targets. Aligning Ukraine’s ETS cap with an equivalent national budget is a prerequisite for eventual EU ETS linkage, which would dramatically reduce compliance costs for Ukrainian exporters;
- › Providing a benchmark for CBAM calculations: Ukrainian exporters subject to CBAM must demonstrate the carbon price paid domestically. A functioning ETS with a budget-derived cap and verifiable prices is the most straightforward mechanism for CBAM compliance in the long-term.

ETS Design Element	Role of Carbon Budget
Annual emissions cap	Derived directly from the sectoral carbon budget; politically insulated from annual lobbying
Linear Reduction Factor	Calculated from the carbon budget trajectory to 2030 and 2050
Free allocation vs. auctioning	Carbon budget quantifies the value of allowances, enabling modelling of revenues and its use for decarbonisation
Price stability mechanism	Carbon budget path defines the long-run price corridor; supports introduction of a carbon price floor
EU ETS linkage (post-accession)	Precondition for EU ETS linkage is a comparable national carbon budget under the European Climate Law

These practical steps in introducing a national carbon budget framework and described application cases would significantly strengthen national climate governance via data-driven mid-term planning, policy design and climate finance attraction.



The Green Transition Office is an independent advisory body to the Ministry of Economy of Ukraine, which supports implementation of reforms in the area of green transition, energy and climate policy. The work of the Green Transition Office is supported by the UK's International Development Agency and implemented by NGO DiXi Group.

The views expressed in the study are solely those of the NGO DiXi Group (Green Transition Office).