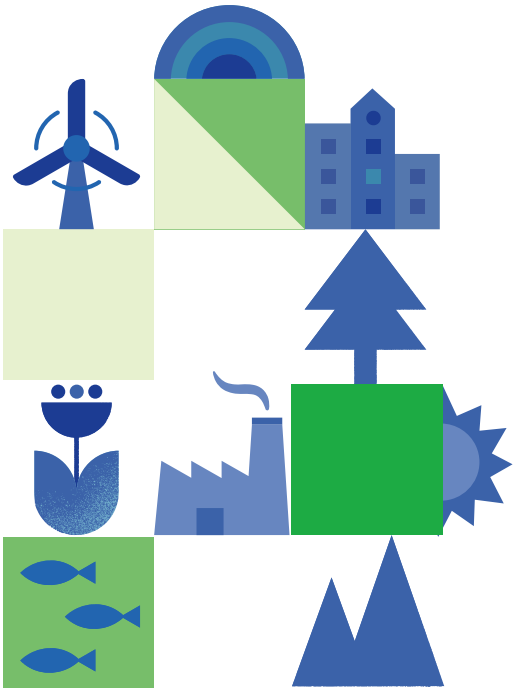
CLIMATE ACTION NETWORK EUROPE



POSITION PAPER

ON CARBON DIOXIDE REMOVAL AND SEQUESTRATION IN ECOSYSTEMS

OCTOBER 2025

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SUMMARY OF THE POSITION

1. Halting dangerous climate change is only possible with immediate and deep cuts in global greenhouse gas emissions, phasing out all fossil emissions, ending the destruction of ecosystems and protecting and restoring nature to health on land and in the ocean.

2. All current peer-reviewed climate scenarios, including those by the IPCC that keep global warming within the Paris Agreement's 1.5°C limit, rely on removing large amounts of carbon dioxide from the atmosphere using both natural sequestration in ecosystems and novel technical geological carbon removal methods, in addition to immediate, deep, and sustained emission reductions.

3. Accelerated emission reductions limit the reliance on CDR. The use, or planned future use, of CDR must not delay or replace efforts to cut greenhouse gas emissions. Given that the global 1.5°C compliant carbon budget has been nearly exhausted and CDR is limited, all available CDR should be directed towards addressing the historic legacy concentration until fossil emissions are fully eliminated. Current and future emissions must be tackled through emission reductions.

4. The precautionary principle must be strictly applied to CDR. The deployment of any CDR technology or approach should proceed with great caution, especially where potential risks cannot be predicted with certainty due to existing knowledge gaps. In such cases, decision makers should err on the side of caution and refrain from taking risks to uphold the precautionary principle fully.

5. To qualify as CDR, the CO_2 needs to be removed from the atmosphere, thereby delivering a real reduction in atmospheric concentrations. It cannot merely relocate carbon from the biosphere to another storage medium when, after accounting for all factors and impacts on the LULUCF sink, it does not result in genuine near-term net removals. Under the CRCF, the EU is preparing to adopt methodologies for BioCCS and biochar that risk allowing activities which may add emissions to the atmosphere instead of removing them.

6. All removal methods have distinct trade-offs and are constrained by their technical, economic, social, and environmental limits, including constraints linked to planetary boundaries, particularly for land and water. Individual projects can also trigger local impacts and conflicts over resources. There are still profound uncertainties related to the feasibility and effectiveness of technological CDR. Placing too much reliance on CDR represents a serious risk to achieving the 1.5°C climate goal.

7. All CDR activities need to comply with the Do No Significant Harm principle, while fully respecting human rights, including the rights of indigenous peoples, local communities, and other rights holders directly or indirectly affected. This includes the right to free, prior and informed consent, as well as the provision of just and equitable benefits for those impacted by the project or contributing to its climate benefits.

8. In EU climate policy governance, 1) emission reductions, 2) natural sequestration in ecosystems (LULUCF for the moment), and 3) permanent carbon removals must be fire-walled from one another, governed under three separate targets, and supported by dedicated instruments, with priority given to emission reductions.

9. CDR must not be included in the ETS. The EU ETS still has a large emission reduction potential, and introducing offsetting options will cause mitigation deterrence (and reduce revenues). The potential for CDR is scarce and must not be wasted on offsetting emissions that should and could be mitigated.

10. In the context of biogenic sequestration, only standing forests and resilient terrestrial and marine ecosystems provide immediate climate benefits (reforestation takes time). The safest and fastest method to remove CO_2 from the atmosphere is to protect and restore forests and other terrestrial and marine ecosystems. Therefore, preserving the LULUCF sink is an immediate priority.

INTRODUCTION

Halting dangerous climate change is only possible with immediate and deep cuts in global greenhouse gas emissions. This requires the phase-out of fossil fuels, a shift to 100% renewable and decarbonised energy, rapid improvements in energy efficiency across all sectors, and the protection and restoration of ecosystems on land and at sea. Yet, past and current European and global efforts have proven insufficient to curb the continued rise of atmospheric CO_2 concentrations. As a result, staying within the 1.5°C limit can no longer be achieved through emission reductions and ecosystem restoration alone, making additional geological CO_2 removals necessary. However, no removal technology is currently available at the scale required without generating significant risks for sustainability, food security, and the wider economy.

Efforts to develop governance instruments and incentives for carbon dioxide removal (CDR) within EU climate policy are underway. Integrating CDR requires careful handling to avoid unintended consequences such as weakening the land carbon sink, increasing pressure on renewable energy and water resources, harming ecosystems, or disrupting the ocean carbon cycle. Poorly designed policies risk undermining both climate action and ecosystem health, eroding impact and credibility rather than delivering benefits. Some CDR methods should not be pursued at all, while others require significant efficiency gains before becoming viable. Public policy and budgets must prioritise research and development of sustainable, reliable, efficient, and long-term permanent CO_2 removal practices.

This Climate Action Network Europe position paper explores the critical issues surrounding the development and integration of domestic CDR into EU policy. It addresses potential risks and trade-offs, and recommends governance approaches that outline pathways for CDR to complement emission reduction efforts while protecting food security, biodiversity, ecosystems, and people.

This position paper should be read alongside CAN Europe's position on Land Use, Land Use Change and Forestry (LULUCF), which emphasises that the most immediate climate benefits come from preserving standing forests and maintaining resilient ecosystems in the land sector.

In Brussels. October 2025

1. WHAT IS CDR, AND WHAT IS NOT?

The EU's current definition of carbon dioxide removal can be found in the EU Carbon Removal and Carbon Farming (CRCF) Regulation:

> *'carbon removal' means the anthropogenic removal of carbon from the atmosphere and its durable storage in geological, terrestrial or ocean reservoirs, or in long-lasting products;*

The CRCF definition is aligned with the current IPCC definition[1]. While not comprehensive or adequate[2] for policy implementation as such, it includes some important basic requirements of carbon dioxide removal. Carbon needs to be removed from the 'atmosphere' to a 'durable' storage.

Fossil Carbon capture and storage (CCS) and carbon capture and utilisation (CCU) are not CDR as they do not remove carbon from the atmosphere, but aim to capture emissions from emission sources. Fossil CCS refers to the capture of CO_2 emissions from fossil-based point sources and their permanent storage in geological formations. It is therefore an abatement measure, preventing emissions from entering the atmosphere. CCU, by contrast, involves using captured CO_2 in other processes or products. While it can create value chains, the carbon is typically re-released over time and does not constitute permanent climate mitigation.

The requirement for 'anthropogenic' excludes natural CO_2 uptake not directly caused by human activities, such as photosynthesis in unmanaged forests, carbon uptake by oceans, or carbon stored in natural soils.

Current definitions of carbon dioxide removal (CDR) often conflate carbon removal from the atmosphere with carbon removal from the biosphere (e.g. BioCCS and Biochar). Any removal from the biogenic carbon stock depletes the natural carbon stock in the short term and the ecosystems' ability to sequester carbon, and it may also harm biodiversity and other ecosystem services. Sustainable biomass regrowth is possible, but can take significant time, and is not automatically given, but rather a choice that needs to be made and implemented. To qualify as CDR, the CO_2 needs to be removed from the atmosphere, thereby actually reducing the CO_2 concentration. It cannot simply shift carbon from the biosphere to another storage medium when the overall impact of that process does not deliver genuine, near-

[1] IPCC 2018 Global Warming of 1.5°C: Glossary
[2] The IPCC is working on a new carbon removal and sequestration methodology report, due to be adopted in 2027

term net removals when all factors are taken into account, including impacts on the LULUCF sink.

CAN Europe has identified four key criteria, adopted from the work by Tanzer and Ramirez[3], for determining what constitutes carbon removal.

1. Carbon dioxide is physically, involving deliberate human intervention, removed from the atmosphere, thereby actually reducing the concentration of CO_2 in the atmosphere.
2. Removals qualifying as permanent in specific EU legislation should be bound for at least several centuries, with a high likelihood of continued storage over a timeframe exceeding 1000 years[4].
3. All emissions that are associated with the removal (e.g. in the case of biomass-based CDR, including harvesting, transfer, processing of biomass, and foregone sequestration) are accounted for through a broad and comprehensive life cycle assessment.
4. The total quantity of greenhouse gases removed and stored is greater than the emissions associated with the process over a climate-relevant time frame. Including the associated emissions in the end balance is important to be able to assess the quantified net benefit of the removal activity.

The European Scientific Advisory Board on Climate Change (ESABCC), in its recent CDR report[5], highlights the importance of separating permanent removals from temporary biogenic natural sequestration. This is an important top-level categorisation following the differences in the length of the storage: The biogenic carbon cycle (typically ranging from a few years to centuries), the geological (or fossil) carbon cycles (of 100-200 million years) and the length of CO_2 remaining in the atmosphere (hundreds to thousands of years). The CRCF Regulation also endorses this separation.

Grouping different methods together for governance or support policies is inherently difficult, given that all methods vary greatly and have various trade-offs, e.g. regarding their permanence, costs, negative side effects, and co-benefits. When it comes to land use, carbon sequestration is only one of the multiple functions of the land sector and can only be considered together with the other life-supporting functions of nature.

[3] Tanzer, S. E., & Ramirez, A. (2019). When are negative emissions negative emissions?
[4] Brunner, C., Hausfather, Z. & Knutti, R. (2024). Durability of carbon dioxide removal is critical for Paris climate goals.
[5] ESABCC. (2024). Scaling up carbon dioxide removals – Recommendations for navigating opportunities and risks in the EU

2. THE ROLE OF CDR IN CLIMATE POLICY

Carbon dioxide removal cannot substitute for immediate and deep emissions reductions, but all current IPCC scenarios[6] that keep global warming within the Paris Agreement's 1.5°C limit rely on removing large amounts of carbon dioxide from the atmosphere using both natural sequestration in ecosystems as well as novel technical carbon removal methods, in addition to immediate, deep and sustained emission reductions. While transformative societal change is widely acknowledged as essential, it is not yet fully translated into scenario pathways. Peer-reviewed scenarios modelling degrowth policies show that the reliance on CDR can be largely reduced by such societal change.[7] As the science evolves, it is essential that assessments of CDR potential move beyond theoretical estimates. Instead, they must rigorously account for real-world trade-offs, including land use, energy demand, biodiversity impacts, and other limits imposed by planetary boundaries. Overstating technical potential without integrating these constraints risks creating misleading expectations and undermining sustainable climate strategies.

Carbon dioxide (CO_2) accumulates in the atmosphere, and the level of accumulated emissions defines the level of warming. The global carbon budget is an estimate of the total amount of CO_2 that can be emitted into the atmosphere while limiting global warming to a certain level, such as the 1.5°C target in the Paris Agreement. The IPCC provides[8] remaining global carbon budget figures from 2020 onwards for 67% (400 $GtCO_2$) and 83% (300 $GtCO_2$) likelihood of global temperature peaking at 1.5°C or below. With current annual emissions of 40$GtCO_2$ since the beginning of 2020, the remaining carbon budget has shrunk by another 240$GtCO_2$. With current emissions, the high likelihood (83%) budget will be exhausted in 2027. The real-world warming[9] appears to align with the IPCC budget estimate.

Future carbon dioxide removal and sequestration deployment needs projected in the scenarios are largely dependent on how deep and rapid global decarbonisation will be in the near term. There are also important scientific uncertainties on how climate and ecosystems react to the crossing of climate tipping points, such as the collapse of the Arctic winter sea ice or die-off of low latitude coral reefs or the so-called 'overshoot and return scenarios', where for example the Paris Agreement's target of 1.5°C is exceeded, and the global average temperature is hoped to be brought back down with net-negative emissions.[10][11]

[6] IPCC AR6 CDR factsheet
[7] Keyßer L. & Lenzen M. (2021). 1.5 °C degrowth scenarios suggest the need for new mitigation pathways
[8] IPCC 6th Assessment Report, Working Group I, Table SPM.2
[9] Copernicus. (2024). Annual Climate Summary Global Climate Highlights 2024
[10] Armstrong et al. (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points
[11] Climate Analytics. (2021). The science of temperature overshoots

The IPCC in its 6th Assessment report in 2022 identified three distinct roles for CDR: 1) complementing emission reductions in the near term, 2) neutralising hard-to-abate residual emissions to achieve net-zero CO_2 or greenhouse gas emissions balance, and 3) delivering net negative emissions in the long term. Given that the global 1.5°C compliant carbon budget has effectively been used and CDR is limited, all available CDR should be directed towards addressing the historic legacy concentration until fossil emissions are fully eliminated. Current and future emissions must be tackled through emission reductions.

The EU needs removals both for achieving the EU's own net-negative greenhouse gas emission goals and for the EU to contribute its fair share in reversing climate change and stabilising the global climate.

3. KEY PRINCIPLES FOR THE EU'S CDR POLICY GOVERNANCE

3.1. Emissions reductions are the primary tool to stop climate change

Rapid and deep emissions reductions are the most effective and urgent response to the climate crisis. EU climate policy must prioritise emission mitigation across all sectors as the core strategy for limiting global warming and safeguarding ecosystems. Reducing fossil fuel use and deforestation emissions (cutting gross emissions) accounts for over 80% of total greenhouse gas reductions on the pathway to global net-zero CO_2, regardless of how stringent the climate target is.[12]

While CDR has a role to play in achieving the EU's climate neutrality and net-negative targets, it must be treated as a complement to, not a substitute for, ambitious emission mitigation. Governance frameworks must be designed to reflect this hierarchy: CDR should only be pursued in addition to, and not instead of, cutting emissions.

All removal methods come with distinct trade-offs and are limited by technical, economic, social, and environmental constraints. Because large-scale deployment of technological CDR remains unproven and its long-term feasibility and effectiveness are deeply uncertain, over-reliance on it poses a serious risk to achieving the EU's fair share of the 1.5°C target.

Accelerated emission reductions reduce future dependence on removals. The use, or planned future use, of CDR must not delay or replace the systemic efforts needed to cut greenhouse gas emissions at source. The EU's own modelling for the 2040 climate target showed that advancing the transition in the agriculture sector - addressing its stagnating emissions along with modest shifts to healthier diets - can drastically reduce the future reliance on removals. CDR should not be used to justify ongoing pollution, but should first be directed toward addressing legacy CO_2 concentration.

Embedding this principle is essential to maintain policy credibility, environmental integrity, and a just transition. It helps ensure that resources and political attention remain focused on reducing emissions at source, while supporting the responsible development of CDR where it can contribute meaningfully without undermining mitigation ambition.

[12] Ganti et al. 2024 Evaluating the near- and long-term role of carbon dioxide removal in meeting global climate objectives

3.2. CDR must not be used to compensate for continued emissions

Carbon dioxide removal must not be treated as a licence to pollute. Using CDR to offset ongoing emissions undermines the EU's climate ambition and delays the structural changes needed to phase out fossil fuels and transform high-emitting sectors.

Offsetting creates a false equivalence between emissions and removals, despite fundamental differences in their timing, durability, and risks. Most removals presently are temporary or uncertain, whereas fossil emissions have long-lasting atmospheric impacts. Treating them as interchangeable carries high environmental risks.

The EU's CDR governance framework must prohibit the use of removals to meet compliance obligations for emission reductions, such as within the EU ETS or other carbon pricing mechanisms. Instead, CDR should be pursued as a separate and additional climate action track, with clear guardrails to prevent greenwashing, double-counting, and the distortion of mitigation incentives.

See also CAN International's position paper on carbon offsetting here.

3.3. Separate targets for the LULUCF sector and permanent industrial removals

Biogenic sequestration and permanent industrial carbon removals will only be able to play a limited role in the overall climate mitigation efforts. For them to have a desired impact on the atmosphere, they need to be additional to emission reductions. CAN Europe calls for the EU to establish a strong firewall between emissions reductions, land sequestration and permanent removals, and set three separate targets in the revision of the 2040 climate package.

1. A greenhouse gas emission reduction target of at least 92% gross reductions compared to 1990 levels (as part of reaching net zero), to a maximum level of 419 Mt CO_2e gross emissions in the year 2040.[13]
2. A net sequestration target in the LULUCF sector of at least 400 $MtCO_2e$ by 2040, with a clear trajectory toward 600 $MtCO_2e$.[14]
3. A permanent removal target following a thorough assessment of the risks, benefits, trade-offs, and sustainable limits.

The scale of the permanent removal target should be a result of a rigorous sustainability impact assessment conducted in a holistic and interdisciplinary manner, taking into account all potential impacts of industrial removals on planetary boundaries (including land and

[13] CAN Europe's position paper on greenhouse gas targets and equitable carbon budget
[14] CAN Europe's Position Paper on the EU LULUCF Regulation

water use and pollution, indirect land use change, terrestrial and marine biodiversity and biosphere integrity) and on energy consumption and human rights.

Setting independent targets prevents the risk of using land-based sequestration and/or permanent carbon removals as offsets for actual emissions cuts, and can help define a sustainable role for carbon removals. Any form of offsetting or compensating emissions in the sectors covered by the Emissions Trading System (ETS) and the Effort Sharing Regulation (ESR) must be explicitly excluded.

3.4. No CDR in the EU ETS

The EU Emissions Trading (ETS) Directive mandates the European Commission in 2026 to report and possibly propose legislation on whether and how permanently stored removals could be included in the EU ETS without compromising emission reductions.

The EU ETS still has significant untapped mitigation potential. Fossil fuel combustion, including coal, remains a major source of emissions. Shifting the focus to removals at this stage would delay the transformation of energy and industrial sectors and distract from the need to phase out fossil fuels.

Recent studies[15][16] outline that CDR integration is not necessary for the ETS to function up to 2040. If emissions reductions are implemented for the ETS 1 sectors, as foreseen by the S3 scenario in the EC 2040 target impact assessment, this would lead to a surplus of 157 million European Union Allowances (EUAs) in 2040.3 To deal with the expected scarcity of EUAs towards 2040, both studies recommend that an assessment is done in 2035, and therefore, no integration should be foreseen.

The EU Emissions Trading System (EU ETS) must remain a dedicated tool for reducing greenhouse gas emissions at source. Including CDR in the ETS would fundamentally undermine this purpose. It risks mitigation deterrence by lowering pressure on emitters to decarbonise, distorting the price signal, and shifting investment toward the cheapest options, rather than the most effective, as also demonstrated in Sandbag's report.[16]

Inclusion of removals would also create governance and integrity problems. Removals vary widely in quality, permanence, and measurability, and the forthcoming Carbon Removal

[15] Carbon Market Watch. (2025). Fit for 2040 - Adding international carbon credits and carbon removals will undermine EU ETS contribution to the climate target
[16] Sandbag. (2025). Simulating CDR in the EU ETS: The Risks of Premature Integration

Certification Framework (CRCF) is unlikely to guarantee the environmental integrity or accountability needed for market use.[17][18]

Market-based mechanisms in general have challenges when it comes to CDR, as they prioritise the lowest-cost compliance options rather than the highest-quality or most sustainable outcomes. This creates a structural bias towards cheaper, lower-quality approaches.

[17] Öko-Institut. (2025). Revised methodologies under the EU CRCF continue to lack integrity
[18] A joint NGO briefing. (2025). Greenwashing carbon removals

4. INCENTIVISING CDR IN THE EU

Supporting the responsible development of CDR requires both public and private investment, quality that exceeds the CRCF floor requirements, rigorous oversight, and strong environmental and social safeguards. CDR, like other mitigation measures, should be primarily paid by the polluters.

To achieve net-negative emissions after 2050 as enshrined in the European Climate Law and to send credible investment signals for carbon removal and sequestration, the EU must provide clarity on the expected role and volume of net-negative emissions in the decades ahead. As part of the 2040 climate policy package, in addition to the 2040 emission reduction targets, the EU should also set long-term targets for both LULUCF and permanent technical removals extending beyond 2050, also to reflect Europe's historical responsibility.

Given the fundamental differences associated with biogenic sequestration and the technical permanent removal methods, it is paramount to govern and incentivise them with separate and different types of instruments.

4.1. Activity-based support for land-based sequestration

The current total global CDR deployment is approximately 2.0 $GtCO_2$ per year, of which 99,9% is conventional sequestration on land, and only a tiny fraction is achieved via novel removal methods.[19] Land-based carbon sequestration is coupled with the short carbon cycle that risks providing only temporary storage as it is vulnerable to human or natural disturbances, but if enhanced through nature restoration activities and sustainable agricultural and forestry practices, it has multiple benefits for biodiversity and ecosystems. Restoration is among the cheapest and rapidly implemented nature-based climate mitigation measures.[20]

CO_2 sequestration and storage are only one of the many crucial functions of nature. Ecosystem resilience, food production, and water and air purification are a few examples of nature's functions that cannot be ignored when dealing with nature and land use. Any EU policy instrument aiming at nature-based sequestration and storage needs to give at least equal consideration to the other functions, making carbon-centric results-based, quantified support models unsuitable for incentivising ecosystem-based activities.

Activity-based support instruments are better suited to capture nature's other essential functions, such as biodiversity protection and ecosystem resilience. The difficulties of

[19] Smith et al. (2024). The State of Carbon Dioxide Removal, 2nd Edition
[20] Pörtner et al. (2021). Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change

accurately accounting for biogenic carbon flows further highlight why quantified, results-based funding is inappropriate for biogenic sequestration. Funding should instead reward actions that enhance carbon sequestration, biodiversity, adaptation and ecological resilience, thereby recognising the multiple public goods ecosystems provide. To succeed, farmers and land managers also need independent technical support, peer-to-peer learning, and space to experiment, which results-based finance does not provide.

Protecting, restoring and strengthening the land and ocean sinks is essential to reversing current declines and ensuring resilience in the face of climate impacts. Funding should, in part, come via the very extensive existing public funds available through legislation, such as the Common Agricultural Policy (CAP). In addition, dedicated funding for nature restoration and protection should be instituted to ensure stable, long-term investment in safeguarding ecosystems. Such funding would support large-scale restoration of degraded habitats, protection of biodiversity-rich areas, and measures that strengthen ecosystem resilience to climate impacts. It should be additional to existing climate and agricultural budgets, accessible to local actors, and designed to deliver multiple benefits for climate, biodiversity, and communities.

Private funding should also play a role through investment within or beyond company value chains, following a contribution-based approach.

4.2 Targeted investment in permanent technical removals

Permanent removals offer the potential to store CO_2 durably, but remain at low technology readiness levels, high cost, and are not yet deployed at a meaningful scale. Currently, novel CDR methods contribute only 1.3 million tons (0.0013 Gt) of CO_2 removal per year. That is less than 0.1% of the total CDR. [21]

The EU should, after a thorough assessment of the risks, benefits and trade-offs, adopt separate permanent industrial removal targets for 2040, 2050 and 2060. The scale of the industrial removal target should be a result of a rigorous impact assessment conducted in a holistic and interdisciplinary manner, taking into account all potential impacts of industrial removals on planetary boundaries (including biomass, land and water use and pollution, indirect land use change, biodiversity and biosphere integrity) and on energy consumption and human rights.

CDR should be incentivised in a very targeted and risk-conscious way through dedicated public funding for research, demonstration, and early deployment of high-integrity removal methods, taking into account the precautionary principle. The support policy design must

[21] Smith et al. (2024). The State of Carbon Dioxide Removal, 2nd Edition

reflect the fact that removal methods are at very different stages of technological readiness (TRL), maturity, and scalability. Their cost structures, risk profiles, and environmental impacts vary widely. As such, a one-size-fits-all approach is inappropriate. Tailored support instruments will be needed to reflect the specific characteristics of each method, ensure accountability, and avoid unintended consequences.

Private investment in CDR will also be needed, but it must be channelled through transparent, high-integrity mechanisms, and must not be used to justify emissions (or reduced reduction efforts) elsewhere. CDR claims must remain contribution-based based non-compensatory, and additional to companies' mitigation obligations.

5. CDR IS LIMITED, AND REAL-WORLD BOUNDARIES MUST GUIDE ITS ROLE IN CLIMATE POLICY

In the EU's climate policy design, the scale of CDR use must be guided by a clear understanding of the technical, economic, and ecological limits. Policymakers should avoid assuming large-scale removals without accounting for real-world feasibility, infrastructure needs, and trade-offs. The precautionary principle and 'do no harm' principles should be adhered to, meaning prioritisation of mitigation and enhancement of resilience of ecosystems.

CDR deployment faces multiple barriers. CDR is limited by environmental and resource constraints that place clear boundaries on its sustainable deployment. Land, ocean, and biomass availability are finite and face growing pressures from many current and future drivers, and often compete with the EU's natural LULUCF sink and biodiversity goals. In particular, CDR must not drive additional biomass harvesting that undermines ecosystem carbon stocks or weakens the LULUCF sink.

Many technical CDR methods have extremely high renewable electricity needs. There is currently hardly any infrastructure for CO_2 transport and geological storage, as well as insufficient monitoring, reporting, and verification (MRV) capacity. Many methods remain at low technology readiness levels, with limited demonstration at scale. Most technical removal methods involve high capital and operational costs. Long-term public funding is uncertain, current policy frameworks do not provide strong or predictable price signals, and non-offsetting funding mechanisms remain underdeveloped.

Social and political challenges include concerns about public acceptance. Governance gaps persist. The CRCF quality, including its sustainability criteria, is largely inadequate to create trust or confidence in actual environmental delivery.

Geological carbon storage is a scarce planetary resource. A recent study found that of the world's theoretically available capacity, only around 1,460 $GtCO_2$ can be considered risk-free once technical, social, and environmental factors are taken into account. This means that the world's usable reserves of geological carbon storage are significantly more limited than most estimates suggest.[22]

[22] Gidden et al. (2025). A prudent planetary limit for geologic carbon storage

6. DIFFERENT CDR METHODS HAVE DISTINCT CHARACTERISTICS, POTENTIALS AND RISKS

Not all CDR is equal, and policy should not treat it as such. Carbon dioxide removal and sequestration encompass a wide range of methods, each with its own trade-offs, constraints, and governance challenges. A precautionary, evidence-based approach is needed to determine which methods are permitted or supported, at what scale, under what conditions, and through which policy instruments.

Sequestration in ecosystems, such as ecosystem-based afforestation, restoration of many degraded types of ecosystems, not limited to forests, and soil carbon enhancement, is relatively easy compared to novel technological approaches, and if implemented correctly, can offer biodiversity and adaptation co-benefits. However, they are limited, typically subject to reversibility risk, and vulnerable to climate impacts, land availability, and social conflict. The primary role of ecosystem-based sequestration should remain the restoration and protection of ecosystems.

Geological storage-based methods, such as direct air capture with storage (DACCS) or carbon mineralisation, offer the highest durability but are at an early stage of development, with high costs, significant electricity needs, and limited deployment to date. These methods may be needed for a small share of removals in the longer term, but are not ready to play any relevant role in the near term.

Biomass-based methods like biochar and bioCCS, such as bioenergy with carbon capture and storage (BECCS), reduce the biogenic carbon stock and will face challenges related to biomass availability, land competition, and sustainability of feedstocks - including the real climate impacts associated with their extraction, transport, and processing. Current efforts to develop CRCF methodologies for biomass-based CDR risk are undermining biodiversity and forest protection. Instead of delivering removals, they may end up certifying activities that increase overall greenhouse gas emissions.[23] BioCCS and biochar do not remove CO_2 directly from the atmosphere but from the biosphere, merely moving it to another storage form (soil or geological). Doing so risks increasing demand (and therefore harvesting) in the context of declining land sinks and over-extraction of biomass from the land sector in Europe.

Ocean-based methods, including ocean fertilisation, alkalinity enhancement, or biomass sinking, are still largely experimental and include high concerns in terms of reversibility and risks to marine ecosystems and food chains. Current knowledge insists that these approaches should not be implemented.[24]

[23] A joint NGO briefing. (2025). Greenwashing carbon removals
[24] A joint NGO position. (2024). The Blue Manifesto

Marine CDR policy in Europe must align with global commitments by upholding bans on technological marine CDR, including ocean fertilisation, ocean alkalinity enhancement and biomass cultivation for carbon removal, in accordance with international decisions under the Convention on Biological Diversity (CBD)[25] and the London Convention and Protocol[26]. These instruments impose a moratorium on such activities until the environmental, social, economic and cultural risks of these are adequately assessed using robust science. Since the ecological and social uncertainties generally outweigh the known benefits, the precautionary principle to protect biodiversity should be applied consistently.

Differentiated governance is essential, with clear distinctions between nature-based and permanent removals, and between methods that serve public goods (e.g. restoration) and those that require strict regulatory oversight. CDR methods should be assessed, not only for their climate potential, but also for their particular characteristics, some of which are listed below.

Harms and risks. Carbon removal methods may have negative side effects, even significant enough to negate or undermine the initial intended benefits. Therefore, regulation and proper assessment of removal methods are crucial. Harms and risks vary greatly depending on the removal activity and the scale at which it is implemented. Negative impacts relate, for example, to loss of biodiversity, competition for land, resource use, albedo changes, or removal activities may also have negative social consequences.

Co-benefits. Some of the currently discussed removal methods can come, if done well, with significant co-benefits that can overlap with other societal goals, such as biodiversity conservation, ecosystem resilience, adaptation, job creation, and food security. Identifying co-benefits can help to maximise positive impacts for society and contribute to the decision-making on which removal methods are to be favoured.

Permanence refers to the duration and security with which captured CO_2 remains stored. It is a key consideration, particularly when the sole benefit of an activity is its climate impact, as in the case of many permanent removal activities. If the captured CO_2 is intentionally or unintentionally released back into the atmosphere, it negates the intended impact fully and most likely results in increased emissions in the atmosphere due to emissions from the initial capturing and storage process. Permanence is a key consideration, especially when climate impact is the only benefit of the said activity. A fossil carbon cycle and a biogenic carbon cycle operate on very different time scales. The former typically lasts millions of years, the latter typically from a few years to a few centuries.

[25] Convention on Biological Diversity (CBD) Decision 29.10.2010
[26] 45th Consultative Meeting of Contracting Parties to the London Convention and the 18th Meeting of Contracting Parties to the London Protocol

The economic costs of the carbon removal method are also important to consider because they closely impact the feasibility, scalability, competitiveness, and general affordability of the particular method. Cost-effectiveness impacts both political and financial decisions on which removal methods will be prioritised. Economic costs need to be balanced against the benefits, including possible additional social or environmental benefits.

The cost structure and technology readiness level (TRL) of different methods vary significantly. Some methods might require significant upfront investment and/or constant upkeep, or resource and energy inputs. Looking at the cost structure is equally needed to inform decision-making about the economic feasibility, long-term viability and identify appropriate financing options. Assessing the TRL of different methods is necessary in the first place to assess whether the method in question is feasible within relevant timeframes. Reliance on CDR within climate policy should be limited across the board, and particularly with the low-TRL CDR options, as these methods remain speculative, unproven at scale, and carry significant technical and environmental risks.

Accurate accounting and MRV (Monitoring, Reporting, and Verifying) are essential to ensure that the intended removal is real. Soil or nature-based carbon sequestration is particularly challenging to measure accurately because ecosystems and the variables that impact the biogenic carbon cycle are complex. There is natural and spatial variation as well as gaps in knowledge, technology, and common accounting rules. Modelling natural carbon fluxes includes assumptions that affect the accuracy of measurements.

Lead times for CDR climate-relevant delivery are often longer than commonly assumed. For example, ecosystem-based reforestation requires decades, often more than 100 years[27], to have a substantial effect, while preventing deforestation contributes to climate protection immediately, maintaining the co-benefits, such as biodiversity. Avoided deforestation is not a carbon removal or sequestration method, but it deserves to be mentioned in this context. Technological approaches face long development and deployment timelines due to their early maturity, infrastructure needs, and cost barriers. These extended lead times must be fully considered when determining the appropriate role of CDR in EU climate policy.

While carbon dioxide removal is needed, it is very difficult, expensive, it takes time, and it is challenging to do in a way that benefits society as a whole.

[27] Wilcox et al. (2021) CDR Primer

Annexe: Current EU policies on carbon dioxide removal and sequestration

The European Climate Law

The European Climate Law[28] mandates that the EU must achieve net-zero greenhouse gas emissions by 2050, followed by a transition to net-negative emissions thereafter.

The European Commission published in June 2025 a legislative proposal amending the Climate Law by setting a single net 90% emissions reduction target for 2040 compared to 1990 emissions. The Commission proposal includes several "flexibilities", including the possibility of using international carbon credits. The European Scientific Advisory Board on Climate Change recommends a domestic emissions reduction target of 90-95% for 2040.

The proposal remains vague on the possible inclusion of permanent removals certified under the CRCF in the ETS. Overall, the proposal does not offer any clarity on the future role of removals and risks creating mitigation deterrence.

The 2024 European Commission's Communication on a 2040 Climate Target[29] assumed a minimum of 400 Mt CO_2 of industrial carbon removals and land-based sequestration in ecosystems. The accompanying Impact Assessment[30] further divides the latter into a -75Mt CO_2 of industrial removals and -317Mt CO_2e net sequestration from LULUCF.

The CRCF - the EU Carbon Removals and Carbon Farming Certification Regulation

The EU CRCF Regulation[31] that entered into force at the end of 2024 is the EU's first effort to govern and incentivise carbon removal and sequestration activities by creating a voluntary framework of certification processes and governance. The regulation outlines only top-level quality criteria on quantification, additionality, long-term storage, and sustainability for four different types of certifiable activities.

Various certification methodologies are being prepared pursuant to this Regulation. Once adopted, the methodologies will be published as Delegated Acts, with the first batch expected to be adopted in the fourth quarter of 2025. So far, the draft methodologies cover activities for permanent removals, carbon storage in products, and carbon farming.

[28] European Climate Law
[29] Communication on a 2040 Climate Target
[30] European Commission Impact Assessment on Europe's 2040 climate target and path to climate neutrality by 2050
[31] The EU Carbon Removals and Carbon Farming Certification (CRCF) Regulation

The permanent methodologies involve direct air capture and storage, biomass with carbon capture and storage and biochar. The carbon storage in products methodology focuses on long-term temporary biogenic carbon storage in buildings. The carbon farming methodologies involve tree planting, agriculture and agroforestry in mineral soils, and peatland rewetting and restoration.

In case the methodologies are adopted in their current form, they will set even a much lower standard than the Paris Agreement Crediting Mechanism (PACM) and best practice in the voluntary carbon market.[32] If the European Commission does not fundamentally improve these methodologies, the vast majority of CRCF units will not represent any actual emission reductions or removals.

The first review of the CRCF will take place in 2026. This review will not concern the methodologies, but is likely to focus on the use case for units and alignment with the PACM, among other issues. At present, the European Commission is working on new methodologies, including enhanced rock weathering, ocean alkalinity enhancement and livestock emission reductions.

The policy package of 2040 implementing legislation

Following the adoption of the 2040 amendments to the Climate Law, the policy package of 2040 implementing legislation is expected in 2026. This includes setting the new 2040 LULUCF targets and identifying the scale of permanent removals and their governance.

Land Use, Land Use Change and Forestry Regulation (LULUCF)

Land Use, Land Use Change and Forestry Regulation (LULUCF)[33] sets a separate land-based net carbon sequestration target of 310MtCO_2e by 2030 and lays down rules for accounting for the LULUCF sector's carbon fluxes. The Regulation aims to set common accounting rules and to drive sequestration and emission reductions. The LULUCF Regulation will also be revised in 2026.

For CAN Europe's LULUCF position, please see here.

[32] Öko-Institut. (2025). Revised methodologies under the EU CRCF continue to lack integrity
[33] Regulation for Land Use, Land Use Change and Forestry (LULUCF)

The EU Emissions Trading (ETS) Directive

The EU Emissions Trading (ETS) Directive[34] mandates the European Commission in 2026 to report and possibly propose legislation on whether and how permanently stored removals could be included in the EU ETS without compromising emission reductions.

The Industrial Carbon Management Strategy[35] outlines the European Commission's vision for scaling up CCS, CCU and industrial CDR technologies and developing infrastructure for carbon storage and transport.

The Directive on the geological storage of CO_2 (CCS Directive)[36] provides rules for geological carbon storage, including for site selection, permitting, development, operation and liability. These provisions also apply to geological storage under the CRCF Regulation.

The Directive for the Substantiation of Explicit Environmental Claims (Green Claims Directive)[37], once adopted, will require companies to substantiate the voluntary green claims they make, including claims such as "net zero" or "carbon neutrality", and will define rules on offsetting in corporate climate communication.

The European Ocean Pact[38] is a strategy to better protect the ocean, promote a thriving blue economy (including blue carbon) and support the well-being of people living in coastal areas. It underlines that appropriate consideration of associated risks and impacts must be ensured before deploying emerging technologies that intervene in marine environments for climate change mitigation. Emerging marine climate technologies, including ocean-based CDR, should only move forward based on strong science, precaution, and thorough risk assessment.

[34] Emissions Trading Directive (ETS)
[35] The Industrial Carbon Management Strategy
[36] Directive on the geological storage of CO_2 (CCS Directive)
[37] Proposal for a Directive on substantiation and communication of explicit environmental claims (Green Claims Directive)
[38] The European Ocean Pact

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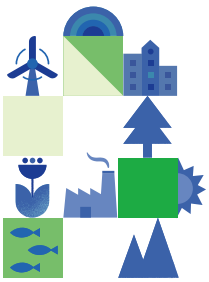
POSITION PAPER

ON CARBON DIOXIDE REMOVAL AND SEQUESTRATION IN ECOSYSTEMS



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