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**Quantifying and Deploying Responsible Negative Emissions in Climate Resilient Pathways**

# How do NETPs fit in existing climate frameworks?

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# Executive Summary

The Intergovernmental Panel on Climate Change (IPCC) paints a stark picture of how global heating will impact human societies and natural ecosystems if urgent climate mitigation action is not rapidly undertaken. While reducing emissions is of the utmost importance, the IPCC also confirms we will need carbon dioxide removals (CDR), also referred to simply as carbon removals, to deal with the leftover emissions that cannot be cut (so-called 'hard to abate') and to reach negative emissions, i.e. remove more carbon from the atmosphere than is emitted into it.

Previous analysis in the context of the Horizon 2020 NEGEM project has shown that CDR methods and their supply chains are complex systems, which can have transboundary implications for different jurisdictions. They can also have negative environmental and social repercussions related to, among other things, land usage, the uses and sources of energy, the rights of local communities and human health. This evidence highlights the need for comprehensive governance frameworks of carbon removals that consider these factors.

Moreover, technologies and processes to remove carbon dioxide from the atmosphere require dedicated targets and accounting frameworks that are kept separate from those regulating emissions reduction. This helps prevent carbon removals from being used as a fig leaf to avoid or slow down emission reductions (so-called "mitigation deterrence") and ensures that CDR fulfils the complementary climate function designated to it by the IPCC. To guarantee real-world benefits for the climate, these frameworks need to include robust definitions of what constitutes removals, accurate measurement, reporting and verification (MRV) methodologies, and rigorous certification and quality criteria. This is particularly important because high-quality removals are currently scarce. Yet, many countries and companies are making net-zero pledges or claims that are either partially or fully based on CDR.

The aim of this briefing is to assess existing climate policy frameworks for CDR. Based on the above assumptions, we evaluated whether the selected framework incorporated the following four core environmental criteria:

1) **Clear vision of the climate function of removals as supplement to emissions reduction.** Does the framework contain a clear vision for the role of carbon removals as supplementing, rather than replacing, emissions reductions?
2) **Separate CDR target by law.** Does the framework prevent or minimise 'mitigation deterrence' by establishing a firewall between removals and reductions, and is the separate CDR target enshrined in law?
3) **Robust definition of CDR**. Does the framework provide a definition of CDR as a process that captures CO2 from the atmosphere and stores it permanently with a net-negative emissions balance?
4) **Robust accounting, MRV and certification rules.** Does the framework provide rigorous rules to assess and address reversals, understand and avoid undesired negative effects, and ensure only real removals are certified?

We selected a variety of case studies with direct relevance to removals, including three global frameworks: the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the Kyoto Protocol's Clean Development Mechanism (CDM), and Article 6 of the Paris Agreement. We also selected six EU policies: the EU Emissions Trading System (EU ETS), the Effort Sharing Regulation (ESR), the Renewable Energy Directive (RED), the Land Use, Land-Use Change and Forestry Regulation (LULUCF), the Common Agricultural Policy (CAP); and the Carbon Removal Certification Framework (CRCF). Finally, we also covered 11 national or subnational jurisdictions: Australia, California, Denmark, Finland, France, Germany, New Zealand, Sweden, Switzerland, the United Kingdom and the United States. Additional jurisdictions were considered (Singapore, Norway, Luxembourg and Kenya), but they were ultimately excluded due to lack of implemented policies.

Note that this paper does not represent a comprehensive geographic overview of all jurisdictions in which CDR policy is being implemented or developed. Other jurisdictions that were not reviewed are taking action, and many countries and sub-national authorities are developing CDR or CDR-relevant policies, for example, on carbon storage. The selected jurisdictions were chosen based on various factors, including the maturity and variety of CDR regulation (private sector initiatives were not considered), the visibility and importance of the policies as examples for other jurisdictions, identifying a spread of different jurisdictional levels (sub-national, national, regional or global), and the availability and accessibility of relevant materials.

**Weak foundations**

Based on our assessment, we conclude that all policy frameworks analysed are inadequate and require further development if they are to address CDR and achieve their climate goals. This is reflected in how only a few countries (France, Germany, Sweden, Switzerland and the UK) acknowledge the climate function of removals as supplementary to emissions reduction in their non-legally binding strategies.

None of the policy frameworks we analysed set comprehensive, separate and legally binding targets for CDR. The sole existing targets set in law refer to nature-based removals in the EU's LULUCF regulation, in the German climate law and in the current UK carbon budgets. Specific and separate targets for CDR were, however, identified by California and Switzerland in non-legally binding strategies. Note that separate targets do exist in non-reviewed jurisdictions, such as Portugal.

One worrying trend is how CDR is being utilised to supposedly offset emissions, or alleviate pressure on the need to reduce emissions. That is explicitly the case for CORSIA, CDM and Article 6 of the Paris Agreement. In addition, loopholes that lower emission reduction obligations through using land-based removals can be found in the EU's RED legislation and the flexibility mechanisms of its ESR. Fortunately, the EU ETS does not directly include removals, although this possibility is being discussed. Moreover, many of the national and subnational jurisdictions reviewed include removals in offsetting mechanisms or to reduce compliance obligations in emissions reduction policies (e.g. Australia, California, France, New Zealand, Switzerland) or intend to do so in the future (the UK), including cap-and-trade systems which, similar to the EU ETS, sets a ceiling on emissions but allows market players to freely trade their pollution allowances.

The EU's proposed Carbon Removals Certification Framework purposely avoids defining the valid end uses of certified removals units, leaving the door open for CRCF-certified units to be used for offsetting throughout national and EU-level climate policies, but also in voluntary carbon markets.

A sufficiently robust definition of CDR is missing from all the frameworks we assessed. A common problem is the inclusion of potentially very short-term and/or highly vulnerable carbon sequestration methods (such as carbon sequestered in soil or vegetation) in the definition of carbon removal, without any or sufficient differentiation between those more vulnerable carbon stores and any potentially more secure stores.

Finally, none of the frameworks contain robust, comprehensive accounting and MRV methodologies. The existing rules mainly refer to LULUCF or to specific aims, such as to certify removals being used for offsetting purposes.

**Key policy-relevant messages**

Based on the findings of this research, we recommend the establishment of dedicated and robust governance frameworks for carbon removals. These must make clear that carbon removals currently fulfil a secondary climate function, and that their role should be to supplement urgent and rapid emissions reduction. In the longer term, the framework should enable balancing out residual emissions from sectors or activities that are deemed too important to society to fully decarbonise, and finally lead to net-negative emissions.

Dedicated frameworks also need to introduce realistic legally binding targets for CDR that complement rather than substitute emissions reductions. Although the use of nature-based methods as removals can lead to a false equivalency between short-term storage and long-term emissions, if natural sinks are taken into account then separate targets for technological removals and natural carbon sinks should be set in such a way that reflects the different timescales, benefits and risks involved. Fixed and separated targets for nature-based CDR alongside targets with milestones for technological CDR would not only provide measurable indicators of progress, but also provide transparency on the amount of residual emissions that can be tolerated towards reaching climate neutrality and net-negative emissions.

To prevent misuse and to avoid other activities being misclassified as carbon removals, it is necessary for policymakers to clearly define CDR as a process that directly removes carbon dioxide from the atmosphere and permanently stores it for several centuries, with the amount of CO2 removed significantly exceeding the emissions involved in the removal process. Beyond accurately defining carbon removals, policymakers should implement robust accounting rules, methodologies, and sustainability requirements for CDR based on careful consideration of implications and impacts to ensure real, sustainable removals. This can also help address the risks of relying on vulnerable natural sinks by ensuring accurate accounting of both sequestered and (re-)released greenhouse gases.

The EU has the opportunity to become a pacesetter by implementing an air-tight definition of CDR, setting ground rules for its role and use, and starting the process of building robust MRV and accounting systems

in the CRCF. These criteria should be reflected in the EU's 2040 climate targets and linked policy architecture.

On the global level, the Paris Agreement Article 6.4 Supervisory Body also has the potential to positively influence the way CDR is treated internationally in both voluntary and compliance frameworks, if the recommendations it presents at COP28 in Dubai are robust and scientifically sound, and their implementation follows the same principles.

While reducing emissions must remain the absolute priority in the coming years and decades when addressing climate breakdown, carbon removals will become increasingly important over time. It is only relatively recently that countries and international or regional organisations have started designing and implementing removal policies, and many of the policies reviewed in this briefing are relatively young or still in their development or implementation phases. Furthermore, CDR policy developments are expected to broaden and pick up pace globally. There is, therefore, currently a window of opportunity for the design and implementation of robust carbon removal policies that will become a key part of wider climate policy frameworks.

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# Table of contents

# 1 Introduction

Political, scientific and corporate interest in carbon dioxide removals (CDR) methods and their potential is steadily increasing. The Intergovernmental Panel on Climate Change (IPCC) confirmed that carbon removals will be needed to counterbalance the limited leftover emissions that cannot be eliminated (so-called "hard-to-abate emissions") and to achieve net zero emissions by extracting from the atmosphere more carbon than we pump into it. In addition, many countries and companies are adopting net-zero or carbon-neutrality strategies that envision a role for carbon removals to supposedly offset emissions. Despite this interest, the deployment of CDR involves a multitude of risks, including the possibility that it will encourage moral hazard by discouraging polluters from cutting their emissions (known as "mitigation deterrence"). This could potentially be caused by optimistic perceptions of the (future) availability of carbon removals, leading to an overreliance on CDR that may never be deployed. This way, reliance on CDR actually risks greater emissions in the real world. In addition, the potential negative environmental and social impacts are significant, and deploying CDR at scale could further undermine planetary boundaries.

Considering the complexity of the topic and its implications, understanding how CDR is governed and treated under existing climate frameworks is critical when assessing the approaches pursued so far, identifying remaining gaps or shortcomings, and determining whether a dedicated policy and governance framework is necessary. With this in mind, we assess, in this paper, 20 policy frameworks at the global, EU and national levels against four environmental criteria.

In the next section on background and methodology, we explain the rationale for selecting the four assessment criteria and the policy frameworks. In the assessment section, we present case studies on each of the selected policy frameworks - giving an overview of existing rules and measures that directly and indirectly apply to CDR. The assessment section also analyses how policy frameworks score overall on the selected four criteria. After the individual assessments, we summarise the main findings at the global, EU and national levels.

In the last section of the briefing, we conclude and recommend principles that would enhance the environmental integrity of policy frameworks that include removals.

# 2 Background and methodology

It is scientifically proven that significant reductions in greenhouse gas emissions are urgently needed across all sectors to achieve the goals of the Paris Agreement, if dangerous overshooting of the relatively safe 1.5°C heating limit is to be avoided. The Intergovernmental Panel on Climate Change (IPCC) regards the deployment of CDR as necessary but complementary to emissions reductions. In this respect, carbon removals fulfil three different roles: lowering net-greenhouse gas emissions in the near term, counterbalancing 'hard-to-abate' residual emissions to help achieve net zero, and eventually achieving net negative emissions if deployed at levels exceeding remaining annual emissions.

This demonstrates how, as far as climate scientists are concerned, the hierarchy of climate action is crystal clear: driving emissions down to as close to zero as possible should be the absolute political, social and environmental priority. The main climate functions of carbon dioxide removal are to use them to balance the very last, unavoidable emissions and, thereafter, extract more CO2 from the atmosphere than emitted. In the shorter term, durable removals are currently being deployed at a small scale (approx. 1.8 million tonnes annually - 99% of which is Bio-Energy with CCS, BECCS). Durable removals are, therefore, currently insignificant when compared to present-day emissions - lowering net-greenhouse gas emissions in the near term will therefore need to be overwhelmingly done by reducing emissions.

Using carbon removals for offsetting atmosphere-heating greenhouse gas emissions that can and should be eliminated contradicts the IPCC's chair's key recommendation that immediate and deep emissions reductions across all sectors are necessary. Such an approach would exacerbate the climate crisis and potentially lead to catastrophic harm to biodiversity, ecosystems and human societies.

Treating CDR as a substitute for emissions reductions and conflating the two concepts under the same policy framework could result in so-called "mitigation deterrence". This occurs when emissions reductions are delayed or postponed because removals, or the perception of their potential availability in the future, are promoted as an alternative for effective climate actions. In addition, this kind of approach perpetuates the false equivalence between carbon removals and emissions reductions, which are, in reality, not interchangeable concepts. A tonne of carbon removed and a tonne of carbon emitted are not equivalent. According to the IPCC, a tonne removed may have 10% less impact on atmospheric CO2 concentrations than a tonne emitted, due to interactions with land and ocean carbon stocks. In addition, carbon removals can lead to leakages and reversals of storage, while fossil fuels that are not extracted and burned never enter the atmosphere.

A stand-alone CDR policy framework with dedicated, separate and legally defined targets is necessary to mitigate these risks and to provide predictability to project developers, ensure high environmental and sustainability standards, and benefit climate planning at multiple levels.

At the same time, carbon dioxide removal systems are resource-intensive and can have complex supply chains. Having a dedicated CDR policy framework that recognises the climate function of CDR is not sufficient to guarantee the generation of real removals and the actual reduction of greenhouse gas emissions in the atmosphere, leading to negative emissions. To ensure that CDR fulfils its intended climate role according to scientific guidelines, a comprehensive policy framework dedicated to CDR should include two other crucial elements: clear and robust definitions of when a removal can be considered as occurred, and an accurate yet conservative accounting framework that acknowledges uncertainties and potential reversals. This framework should include a robust system for monitoring, reporting and verification (MRV) and certification of removals, along with strong quality criteria and liability requirements.

For the purposes of this briefing, we adopt the definition of carbon dioxide removal suggested by Tanzer and Ramirez (2019). To be considered as generating removals, a removal process needs to extract carbon dioxide directly from the atmosphere and store it in a manner intended to be permanent, with the carbon taken out of the air outweighing the emissions linked to the removal process. 'Permanence' should last at

least several centuries, but ideally as long as the physical lifespan of CO2 in the atmosphere, i.e. from 300 to 1,000 years.

Regarding the accounting framework, it should contain rigorous accounting methodologies and rules on actors involved, to prevent double-counting and double-claiming, keep track of the removals certificates, and make sure that the certification happens at the actual end of the removal process.

The MRV system should be based on a strong quantification formula, which uses conservative estimates and takes into account direct and indirect greenhouse gas emissions flows both domestically and abroad. This would mean including indirect effects such as indirect land use change, activity shifting, and market and ecological leakage. Conservative estimates are needed due to potential uncertainties (especially with regard to longer-term and indirect effects) and to limit the potential for overestimation.

### *1. Environmental integrity criteria*

Based on the above, we identified four environmental integrity criteria to assess global, EU and national policy frameworks for CDR deployment:

1) **Clear vision of the climate function of removals as a supplement to emissions reduction**. The first essential element of a climate framework addressing CDR is the recognition that removals come on top of emissions reduction to balance out the hardest-to-abate emissions and lead to negative emissions. This criterion is translated into the following research question: Does the framework contain a clear vision for the role of carbon removals as supplementing, rather than replacing, emissions reductions?
2) **Separate CDR target set by law.** Dedicated and legally binding plans for the deployment of CDR should be outlined that go one step further towards preventing or minimising the potential for 'mitigation deterrence'. This criterion is translated into the following research question: Does the framework establish a firewall between removals and reductions, and is the separate CDR target enshrined in law?
3) **Robust definition of CDR.** All that sequesters carbon is not CDR. To avoid any boomerang effect on the climate, only those methods capable of capturing CO2 directly from the atmosphere and storing it permanently with a net-negative emissions balance in a sustainable manner should be considered. This criterion is translated into the following research question: Does the framework provide a robust definition of CDR and CDR processes?
4) **Robust accounting, MRV and certification rules.** Because of the complexity of CDR processes and supply chains, which can lead to undesired negative effects, a solid governance framework is necessary. This criterion is translated into the following research question: Does the framework set out rigorous accounting, MRV, certification and sustainability requirements?

### 2. *Selected sample*

For the assessment in this paper, we selected the key existing policies, regulatory frameworks and jurisdictions that are relevant to CDR, meaning that they directly or indirectly cover removals or could do so in the near future. These policies are presented in detailed jurisdiction-based case studies that can be found in the Annex.

At the global level, three mechanisms were analysed: the UN's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the Kyoto Protocol's Clean Development Mechanism (CDM), and Article 6 of the Paris Agreement. CDM, which started in 1997 and has a long history, has been the subject of in-depth research. CORSIA is a more incipient framework that kicked off in 2021 and will run until 2035. Article 6 of the Paris Agreement is not fully operational yet, though many of the rules have already been agreed upon, but guidelines for carbon removals are still in the pipeline. The UN framework for reducing emissions from deforestation and forest degradation (known as REDD+) was also assessed but found to be irrelevant for the purpose of this briefing as the REDD+ framework focuses on reducing emissions rather than removing emissions. It does not cover reforestation and afforestation activities, but aims at reducing emissions from deforestation and degradation.

At the EU level, the selected frameworks cover both emissions reduction and decarbonisation policies, such as the EU Emissions Trading System (EU ETS), the Effort Sharing Regulation (ESR) and the Renewable Energy Directive (RED), as well as land-use and agriculture policies like the Land Use, Land-Use Change and Forestry Regulation (LULUCF) and the Common Agricultural Policy (CAP). The rationale behind this selection was to assess whether and how removals were included in these non-dedicated frameworks, because they either cover CDR in some way or there has been a strong political push to do so in the future. In addition, one policy that is still under development was included: the Carbon Removal Certification Framework (CRCF). As this is, at the time of writing, still under negotiation in the co-legislative process, it is not possible to foretell what the final legislation will be like - we only assessed the European Commission's initial proposal.

The significant weight of EU policies in this research paper is due to two main factors. This is partly due to the so-called 'Brussels effect', whereby EU regulations have significant reach beyond the EU and provide impetus for regulatory developments in other jurisdictions and at the global level. In addition, the scope of the wider research project this paper is a part of (the Horizon 2020 NEGEM project) is focused on (but not limited to) CDR in the EU.

Lastly, at the national and subnational level, we focused on eleven jurisdictions: Australia, California, Denmark, Finland, France, Germany, New Zealand, Sweden, Switzerland, the United Kingdom and the United States.

Four additional jurisdictions were considered (Singapore, Norway, Luxembourg and Kenya). They were ultimately excluded due to the lack of significant developments and/or the existence of only proposals but no active legislation. Note that this paper does not represent a comprehensive geographic overview of all jurisdictions in which CDR policy is being implemented or developed. Other jurisdictions that were

not reviewed are taking action, and many countries and sub-national authorities are developing CDR or CDR-relevant policies, for example, on carbon storage.

The selected jurisdictions were chosen based on various factors, primarily the maturity and variety of CDR regulation (private sector initiatives were not considered) and secondarily the visibility and importance of the policies as examples for other jurisdictions. Furthermore, we attempted to identify a spread of different jurisdictional levels (sub-national, national, regional or global). The availability and accessibility of relevant materials (including language barriers) were a clear limiting factor in the selection of case studies.

The authors note and acknowledge that the focus remains on developed, richer and English-speaking jurisdictions where the CDR policy debate and implementation are further along. This represents a significant limitation of this analysis and a basis for further exploration in the future as removal policy processes become more widespread and lead to tangible measures across the globe over time. Other jurisdictions that could warrant analysis in the near future include Japan, Canada and China. This briefing does, however, provide a broad overview of existing policies and measures that are being implemented, efficiently or not, to deploy removals.

The following section presents an overall assessment for each of the three different types of case studies (global, EU, and national and subnational). These assessments present a high-level analysis across the various case studies within these types, highlighting common approaches and digging deeper into the key environmental criteria set out above.

# 3 Assessment of case studies

## 1. Global case studies

This briefing analysed three main global policy frameworks that are currently relevant to CDR: the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA); the Clean Development Mechanism (CDM) set up under the Kyoto Protocol; and Article 6 of the Paris Agreement. Of the three frameworks analysed, none can be considered compatible or well-designed for an environmentally robust deployment and/or incentivisation of CDR.

All three frameworks were put in place as mechanisms to use avoided emissions, emission reductions and/or removals (frequently of low environmental quality) to offset continued emissions. In line with that basic design tenant, the three schemes do not elaborate on the climate function of carbon removals to help reach climate neutrality and net negative emissions, nor do they envisage any separate target for removals (which could, for example, take the form of maximum amounts of residual emissions to be compensated with removals).

Similarly, the analysed frameworks do not provide robust definitions of removals. The CDM created ad hoc temporary credits to address carbon reversals in afforestation and reforestation projects, thereby differentiating them from every other credit based on emissions reduction projects. In essence, this approach had a positive outcome as it disincentivised entities to use those temporary credits to compensate for their emissions, as they were expected to replace any used temporary credits after they expired. However, both emissions reduction and removals would receive a "credit for emissions reduction" (CER or tCER and lCER) and this nomenclature could perpetuate the confusion between the two concepts.

The Article 6.4 mechanism has the potential to provide robust definitions of carbon removals to govern trading and use of removals. This will not regulate all removals used or traded at the international level, but could inspire knock-on effects on the voluntary carbon market, compliance markets and future national and EU legislation.

Finally, the CORSIA and CDM do have some requirements for accounting, MRV and certification of carbon removal projects creating credits, but the authors do not consider these sufficiently robust. In the case of CORSIA, the scheme requires all projects generating credits - be they for avoidance, emissions reduction or removal - to comply with eligibility criteria. While some of these criteria are welcome, for example, about the conservativeness of quantification and baselines, the key aspect of permanence is not defined at all. The CDM set up a comprehensive accounting, MRV and certification framework for removals achieved through afforestation and reforestation projects, but which was deeply flawed. Additionality, permanence, sustainability, and accurate quantification were often not respected, according to two analyses of Carbon Market Watch conducted in 2012 and 2018. An analysis of the Öko-Institut (2016) also suggests that projects and credits under the CDM were not providing real, measurable and additional emission reductions. The Supervisory Body of Article 6.4 is currently developing its methodologies for removal crediting.

Table 1. Assessment summary - Global

| Framework | Clear vision of the climate function of removals (supplement to ER) | Separate CDR target by law | Robust definition of CDR | Robust accounting, MRV and certification, sustainability |
|---|---|---|---|---|
| Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) | No. Carbon credits based on removal projects can be used to offset emissions in aviation. | No. The scheme does not regulate carbon removals and does not set any separate target. It allows for their use to offset emissions in aviation without specifying a maximum amount of emissions to be offset by removals specifically. | No. The scheme does not provide nor refer to any definition of carbon removals. | Not really. The scheme includes criteria for carbon credits to be eligible for use under CORSIA. However, these criteria are weak and apply to emissions reduction, avoidance and removals without differentiation. While permanence is required, no definition is provided. |
| Clean Development Mechanism (CDM) | No. Carbon credits based on removal projects can be used to offset emissions in many sectors and countries. | No. The mechanism does not regulate carbon removals and does not set any separate target. There was no limit to the use of land-based removals to compensate for emissions. | No. The mechanism did not provide nor refer to any definition of carbon removals. However, a distinction was made for temporary and long-term storage projects, thereby disincentivising the use of short-term storage credits. | Not really. The mechanism did put in place a system for accounting, monitoring, reporting and verification of removals delivered through Afforestation/Reforestation projects. However, this was flawed and issues related to carbon leakage, accounting, additionality, permanence and risks of reversals, and impacts on society and environment were not properly tackled. |
| Article 6 of the Paris Agreement | No. Both Article 6.2 and 6.4 mechanisms are centred on offsetting, and do not define the role of removals. | No. Article 6 of the Paris Agreement does not elaborate on a specific amount of residual emissions to be tackled by removals. | Not yet. Article 6.4 Supervisory Body is currently working on rules and requirements for carbon credits, including based on removals activities. The latest text put forward for negotiations contained a flawed definition of removals, but was not adopted in the end. | Not yet. However, the Article 6.4 Supervisory Body is supposed to work on accounting rules and methodologies for removals activities to be eligible under the mechanism. |

## 2. EU policy case studies

Six regulations were analysed at the EU level to assess whether and how removals were treated in each of them: the EU Emissions Trading System (EU ETS), the Effort Sharing Regulation (ESR), the Renewable Energy Directive (RED), the Land Use, Land-Use Change and Forestry Regulation (LULUCF), the Common Agricultural Policy (CAP), and the European Commission's proposal for a Regulation on a Carbon Removal Certification Framework (CRCF). All these policies are climate-related, but only the LULUCF Regulation and the CRCF have a strong focus on CDR - though even the latter is not CDR-dedicated as emission reductions are also included in this certification framework.

Carbon removals do not play major roles in the current EU ETS, ESR and RED frameworks, as all three are mainly aimed at reducing emissions in all sectors of the EU economy. However, they are still CDR-relevant. In the case of the EU ETS, its revenue has been used to fund a number of CDR projects through the Innovation Fund, or can be used at the member state level (at the member state's discretion) for the same purpose. In addition, the possibility of the direct inclusion of removals in the ETS (e.g. by granting ETS emissions allowances to companies generating CDR that can be sold and/or used) has been raised by many stakeholders, including key policy makers. This risks converting the EU ETS back into an offsetting mechanism, thereby undermining its price signal and the decarbonisation of the economic sectors it covers.

Similarly, in the ESR, so-called "flexibility mechanisms" allow member states to use LULUCF surpluses to comply with ESR targets. This perpetuates the wrongful assumption that removals and emissions reduction can be used interchangeably. In addition, MEP Polfjärd, the EU Parliamentarian in charge of the recent ESR review, has called for creating a new DACCS and BECCS 'flexibility' or loophole for member states to use for lowering their emission reduction obligations.

Finally, the RED includes provisions to lower the accounted carbon intensity of biofuels and bioliquids through so-called 'emissions savings' generated by improved agricultural practices (including increased soil carbon sequestration) and using BECCS. In addition, the RED sustainability criteria for bioenergy and its approach on treating biomass as zero carbon has negative implications for the accurate quantification of the impacts and actual net removals achieved through BECCS or other biomass-related CDR methods.

The LULUCF and CAP have more direct ramifications for land-based CDR deployment and sustainability, as the first sets EU- and country-level land-based removal targets into law, and the latter provides direct financial support for farmers implementing carbon sequestration practices. However, none of the five aforementioned policies comprehensively address CDR as a distinct concept, provide a robust definition nor put in place an MRV system dedicated to removals, with the exception of the LULUCF Regulation which has accounting rules in place for net removals and net emissions in the land sector - the latter considered by stakeholders fraught with large uncertainties.

Last but not least, the CRCF proposal is possibly the most problematic among the EU frameworks evaluated. The CRCF was set to become the first CDR-dedicated legislation in the EU, though it is highly likely that emission reductions in certain sectors will also be certified through it. Furthermore, the CRCF falls short of its potential to provide a clear understanding and definition of CDR and ensure the sustainable deployment of CDR methods in the EU. The proposed CRCF does not outline the climate function of removals, nor set a specific target for CDR. Its definition of removals is also flawed, as it

includes emissions reduction as well as methods leading to potentially very short-term carbon storage (carbon storage in products and certain carbon farming activities for example) without sufficiently distinguishing short-term storage from real permanent removals. The quality criteria proposals are also insufficient and often quite vague. The quantification formula is project-specific and takes net emissions into account. It does consider the “increase of GHG emissions” associated with the process, but fails to clearly define what these emissions are, and relies on business-as-usual with the use of the term “increase”.

Table 2. Assessment summary - EU policy case studies

| Framework | Clear vision of the climate function of removals (supplement to ER) | Separate CDR target by law | Robust definition of CDR | Robust accounting, MRV and certification, sustainability |
|---|---|---|---|---|
| LULUCF | No. The Regulation is aimed at ensuring that the gross sum of emissions and removals in the sector do not result in net emissions and furthermore aims to reach a net-removal target of -310 Mt CO2eq by 2030 | No. It sets a net land-based carbon removals target of -310 Mt of $CO_2$ eq - netting emissions and removals in this sector by 2030. The share and/or trajectory of emissions and removals in the LULUCF are not disentangled in the Regulation. | No. The Regulation does not define CDR per se, it refers to 'sinks' (defined as the process to remove greenhouse gases from the atmosphere) and carbon pools (defined as the storage place) which include a wide variety of very CDR methods with very different outcomes, such as soil organic carbon, forest ecosystems and harvested wood products. | Not really. The Regulation has comprehensive accounting rules only applicable to net removals and emissions in the LULUCF sector. However, some of the accounting methodologies in the framework are considered by stakeholders to be fraught with large uncertainties. The 2023 revision of the Regulation is meant to rectify that, including through the use of remote sensing. |
| RED | No. The RED allows some types of removals to offset emissions from the production and use of biofuels and bioliquids. | No. The Directive does not put in place a separate target for removals. | No. The Directive does not provide a definition of carbon removals. | No. A MRV system is put in place to certify 'emissions savings' (including soil carbon sequestration) achieved through improved agricultural practices. The system is based on very short term monitoring periods. |
| ETS | No. The ETS only has an emission reduction purpose and does not include removals at the time of writing. | No. The ETS does not put in place a separate target for removals. | No. The Directive does not provide a definition of carbon removals. | No. A comprehensive MRV framework is in place for emissions covered by the system. However, these rules do not specifically apply to removals. Secondary legislation does provide some accounting methodologies for technical removals to score projects for potential Innovation Fund funding. |
| ESR | No. The ESR only has an emission reduction purpose, though LULUCF Regulation removals can be used to offset emissions up to a limit. | No. A surplus (capped at a certain amount per member state) of net removals in the LULUCF can be used to replace parts of with the reduction obligations under the ESR. | No. The regulation does not define removals. | Not in place. |
| CAP | No. The CAP does not regulate removals, but does support practices that enhance carbon | No. A separate target for removals is not set. | No. The CAP does not define removals. | Not really. The CAP is assessed through its performance, monitoring and evaluation framework, which does not apply to removals. |

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| | sequestration in land. | | | |
| CRCF | No. The draft law does not cover the role or purpose of any certified removals. | No. The proposal does not suggest any target for carbon removals at the EU level that CRCF-certified removals could or should be counted towards, nor does it clarify the interactions with the existing LULUCF Regulation. | No. Permanence is not defined.<br><br>Very different CDR types are deemed equivalent (incl. soil carbon, carbon storage in products and geologic storage). Emissions reduction is included in the definition of removal. | No. Quality criteria are insufficiently strong and often vague. The main rules regarding the certification methodology and the operation of the certification schemes are proposed to be set in future delegated legislation. |

## 3. National and subnational case studies

Eleven national or subnational jurisdictions are assessed in this briefing: Australia, California, Denmark, Finland, France, Germany, New Zealand, Sweden, Switzerland, the United States and the United Kingdom. Note that these selected case studies do not represent a comprehensive geographic overview of all jurisdictions in which CDR policy is being implemented or developed.

Overall, the policy debate on CDR appears to be mostly advanced in California, Switzerland, the United States and the United Kingdom. In the rest of the countries selected, discussions so far have been either mainly focused on enhancing land sinks (this is the case of Australia, Finland, France and New Zealand) and on a mix of CCS and nature-based solutions without a comprehensive CDR strategy (like in Denmark and Sweden), or policies that are at the early stage of their development (such as in Germany).

Of the 11 jurisdictions assessed, six (California, France, Germany, Sweden, Switzerland and the United Kingdom) state that removals (often referred to as negative emissions) should be used to balance out hard-to-abate residual emissions in their long-term climate strategies.

None of the jurisdictions selected has an operational target for bringing CDR into law, with the exception of Germany which has so far only included a specific sequestration target for the LULUCF sector, though Germany has a stated plan to introduce targets for technical negative emissions for 2035, 2040 and 2045. In the UK, the government also committed to amending the Climate Change Act to enable engineered removals (examples they give include DACCS, BECCS, wood in construction, biochar and enhanced weathering) to contribute towards the next carbon budgets. In the United States, a bill presented in Congress, the *Federal Carbon Dioxide Removal Leadership Act*, introduces specific annual removals targets at the Federal level until 2035. California has included separate removal targets in its non-binding plan to achieve climate neutrality, amounting to 7 Mt by 2030 and 75 Mt by 2050. Switzerland projects 6.8 Mt of removals needed by 2050 in its long-term climate strategy.

Many countries, however, still conflate CDR with emissions reductions, and often include removals (in most cases land-based, short-term and vulnerable removals) as a way to comply with emission reduction obligations in offsetting schemes. This is the case in:

- Australia, with the Australian Carbon Credit Units (ACCUs) based on emissions reduction or carbon sequestration used in the national Safeguard Mechanism;
- California, with the State's cap-and-trade and Low-Carbon Fuel Standard programme;
- France, through the Label Bas-Carbone;
- New Zealand, where carbon sequestration in the forestry sector is included in the NZ Emissions Trading System as equivalent to emissions reductions;
- Switzerland, which allows fossil fuel producers to offset their emissions through carbon sequestration projects; and
- the UK, which has recently made public its intention to include engineering removals in the UK ETS, and will also explore the possibility of including those that are nature-based.

Currently, none of the countries analysed make use of a CDR definition that is as robust as that suggested by Tanzer and Ramirez (2019). They define CDR as a process that removes carbon dioxide directly from the atmosphere and stores it in a manner intended to be permanent, with carbon taken out of the air outweighing the emissions involved in the removal process.

The permanence requirement is mentioned by two countries. Switzerland defines it as storing carbon from several decades to centuries, and the UK does not define permanence at all. Two proposals of law now under discussion in California and at the Federal level in the United States could have positive implications related to the permanence of removals, as they would favour removals that can store carbon dioxide for 1,000 years or more.

Many countries still label very questionable methods such as storage in products (France, Finland, the UK and the US) and carbon sequestration in soils (France, Australia) as removal solutions, or keep subsidising removals projects linked to the production of fossil fuels (for example, enhanced oil recovery in the US).

The UK is the only country clearly stating that “case-by-case scrutiny” of the supply chains' carbon intensity and “long-term indirect emissions” of removal projects is necessary. Switzerland plans to deploy removals solutions “securely and sustainably”, without further detailing what those two concepts mean or would require from actors deploying those projects.

Finally, no comprehensive CDR-dedicated MRV system is currently in place in assessed countries. Since 2019 France has a national certification framework to incentivise land-based carbon sequestration. However, the system does not respect strong quality criteria, nor provide good definition of removal activities, and certifies both removal and reduction activities without differentiating the outcomes. Other countries have methodologies in place to credit land-based carbon sequestration (Australia and New Zealand) or to credit projects used for offsetting (California and Switzerland). Given the willingness to introduce removals in the UK ETS, the UK government plans to implement a “robust” MRV system and the management of “wider impacts” to ensure the quality of removals.

To conclude, California, Switzerland, the United States, and the United Kingdom are leading work on CDR at the time of writing, as their policy frameworks and proposals on the table generally have a more comprehensive understanding of CDR compared to other countries. The United States is also supporting both technological and nature-based removals activities through many different measures (existing or under development). However, the approach of all four countries has downsides regarding the four environmental integrity criteria we identified for this assessment. For example, removals in these jurisdictions are: included in offsetting mechanisms (California and Switzerland) or are planned to be included in the national ETS in the case of the UK; they are not well defined and include short-time storage or mixed with CCS; there is no MRV system actually in place dedicated to removals.

Table 3. Assessment summary - National

| Framework | Clear vision of the climate function of removals (supplement to ER) | Separate CDR target by law | Robust definition of CDR | Robust accounting, MRV and certification |
|---|---|---|---|---|
| Australia | No. Carbon sequestration activities in the land sector are used for offsetting in the national emissions trading scheme. | No. The country does not set any separate target for removals. On the contrary, it conflates removals with CCS. | No. There exists no official definition of CDR. Removals are often defined as carbon sequestration, without addressing the necessity of permanence. | Some methodologies exist to certify the Australian Carbon Credits - ACCUs. Those are, however, weak on critical environmental issues. For example, only 25 or 100 year permanence commitments can be chosen. |
| California | In theory, yes. The State has an emissions reduction target of 85% by 2050 in law, leaving 15% of residual emissions to be tackled with removals and CCUS, and specifies that reductions should be prioritised. However, removals are included as offsets in two key policies (cap-and-trade and LFCS) blurring the distinction. | Not really. The remaining 15% of emissions by 2050 in the climate crisis act need to be tackled by CDR and CCUS. A separate removal target is suggested in a legally non-binding government agency (CARB) act of 7 MT CO2eq by 2030 and 75 by 2050.<br><br>Removals are, however, included in the cap-and-trade and LCFS, which undermines the distinction between emissions reduction and CDR/CCUS envisaged in the targets for 2050. | Not really. Permanence is only intended to be 100 years. In addition, the LCFS does not take into account where the carbon ends up, and has been used to support enhanced oil recovery.<br><br>A new proposal, the Carbon Dioxide Removal Development Act, would introduce a definition of “durable” as being 1,000 years or more. | Accounting methodologies are in place for the LCFS. There are concerns in terms of environmental sustainability as the LCFS could be used for fossil fuels production. |
| Denmark | No. CDR is juxtaposed to CCS and CCU, and combined are expected to account at least 17% of the national emission reduction by 2030 | No. Measures that give negative emissions will be accounted for as emission reductions to meet emission reductions targets. | No. The conceptual definition and accounting practice of negative emissions is weak. Permanence is not addressed, CDR is juxtaposed to CCS and CCU to reach national emission reduction targets and no commitment to a continuation of CDR in case the removed carbon can be utilised more effectively. | Not in place. |
| Finland | No. But the gap between the Finnish Climate Change Act striving for net-zero emissions by 2035 and | No. But Finland aims to be climate neutral in 2035 and have emission reduction targets of -60% by 2030, -80% by 2040 and -90 % to -95% | No. There is no definition of carbon dioxide removals outside land-based sequestration as defined under the | Not in place. |

| Framework | Clear vision of the climate function of removals (supplement to ER) | Separate CDR target by law | Robust definition of CDR | Robust accounting, MRV and certification |
|---|---|---|---|---|
| | the emission reduction milestones for 2030, 2040 and 2050, indicates removals would be intended to balance for residual emissions. | by 2050. This means that removals could cover the remaining part of the target to become climate neutral. | LULUCF regulation. | |
| France | In theory, yes. In the non-binding national low-carbon strategy, "carbon sinks" are needed to compensate for "irreducible" emissions. | No. The national strategy conflates together CDR, CCS and CCU. | No. The definition included in the French long-term strategy mixes CDR, CCS and CCU and does not touch upon permanence. | No. *Label Bas-carbone*, the national certification system, is in place since 2019. The system uses modelling instead of actual soil samples, allows for the certification of projects with increased emissions (but decreased compared to 'business as usual'), favours the most intensive farms and covers both emissions reduction and removals. |
| Germany | Yes. In the German long-term strategy submitted to the UNFCCC in 2022, the government defined negative emissions as complementary to emissions reductions and necessary to offset unavoidable residual emissions. | Yes. Nature-based removal targets from the LULUCF are set in the revised climate law.<br><br>In a proposal to revise the climate action law presented in June 2023, the government suggests introducing targets for technical negative emissions. | No. Germany just refers to "natural sinks" which are needed to compensate for the remaining unavoidable emissions. | Not in place. |
| New Zealand | No. Carbon sequestration in the forestry sector is included in the NZ ETS as well as international offsets. Both measures are used to address the national emission reduction targets. | No. Carbon sequestration in the forestry sector is seen as equivalent to emissions reductions in the NZ ETS. | No. The NZ climate policy focuses on carbon sequestration in the forest sector and does not provide a definition of removals.<br><br>While not setting a real permanence requirement, for the purpose of the NZ ETS, credits based on forest carbon sequestration need to be replaced or | The accounting methodology for forest sequestration in place is weak and flawed. Carbon removals are accounted for by an "average approach" considering net-emissions/removals over a 100-year period whilst the Paris Agreement's target of keeping the global temperature rise to 1.5°C operates in a timespan of 30-45 years. This skews the actual balance in New Zealand hiding emissions which are currently taking place. |

| Framework | Clear vision of the climate function of removals (supplement to ER) | Separate CDR target by law | Robust definition of CDR | Robust accounting, MRV and certification |
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| | | | paid back if the forest is felled. | |
| Sweden | Yes. The enhancement of forests' carbon sink and negative emissions technologies are part of the "supplementary measures" to address "hard-to-abate" emissions. | No. Separate targets for "supplementary measures" are set in the non -binding long-term strategy, but those also include emissions reduction from investments in other countries in addition to removals. | No. A definition of removals is not provided in the Swedish climate framework, which only refers to carbon sinks and negative emissions technologies (BECCS). | Not in place. |
| Switzerland | Yes. Cutting emissions to a minimum is seen as a priority in the Swiss long-term strategy. CDR and CCS will be needed to balance or reduce residual emissions. | No. Separate targets for emissions reduction and CDR are set in the non-legally binding long-term strategy and roadmap for CCS and NETs, not into law.<br><br>In addition, the country allows for the use of carbon sequestration projects to offset fossil fuel producers' emissions. | No. Removals should be "permanent" (meaning for several decades to centuries) and must store carbon "securely and sustainably" (these terms are not clarified). | There is an MRV system in place for offsetting projects by fossil fuel producers under the CO2 Act.<br><br>The government plans to further define "quality criteria and standards for permanent and sustainable sinks". |
| United Kingdom | In theory, yes. The non-binding Net-Zero strategy clearly states that Greenhouse Gas Removals (GGR) are needed to balance residual emissions for sectors that are unlikely to achieve full decarbonisation by 2050, and that should not substitute emissions reductions. | No. Currently set carbon budgets include removals from the LULUCF. The government also plans to include GGR in the 2028-2032 and 2033-2037 periods.<br><br>However, the risk of mitigation deterrence is prevalent. The UK ETS Authority intends to incorporate engineered GGR in the scheme and explore the possibility of also including those that are nature-based. | No. Storage in wood products (which is unlikely to be long term) is included among removals solutions. While the government states that removals need to be "permanent and verifiable", and should result in a "permanent net reduction in atmospheric carbon", permanence is not defined. | A "case-by-case scrutiny" of the supply chains' carbon intensity and "long-term indirect emissions" of GGR projects is needed according to the government. To do that, a robust approach to the Monitoring, Reporting and Verification (MRV) is planned to be put in place. |
| United States | No. While various measures to support CDR are in place, the country does not specify the climate function of removals. | No. The long-term strategy to become net-zero by 2050 implies that both technological and nature-based removals will play a large role, with all scenarios envisioning around 1 billion tCO2 in CDR. US measures to enhance CDR also support CCS, and include subsidies for CCU or enhanced oil recovery (EOR). | No. The definition of removals used by the government most of the time includes carbon storage in undefined "value-added" products which is unlikely to mean long term storage. | Not in place. |

| Framework | Clear vision of the climate function of removals (supplement to ER) | Separate CDR target by law | Robust definition of CDR | Robust accounting, MRV and certification |
|---|---|---|---|---|
| | | A new proposal, the CDR Leadership Act, suggests a target for removals. | A new proposal, the CREST Act, would introduce a reverse auction system which would favour removals which can store carbon for more than 1,000 years. | |

# 4 Conclusions and recommendations

The assessment of selected existing climate frameworks against four environmental integrity criteria for the deployment of CDR shows an evident lack of comprehensive and robust governance approaches to the topic. The (often indirect) treatment reserved for CDR varies widely among the different policy frameworks, with many unsuitable to ensure that removals play the important, supplementary role that has been prescribed in climate science - most notably by the IPCC. The only CDR dedicated policy is the EU CRCF, which falls short of reaching its potential and doesn't avoid the pitfalls related to CDR inclusion in climate frameworks.

Only a few countries acknowledge the climate function of removals in their non-legally binding strategies: France, Germany, Sweden, Switzerland and the UK. California is the only jurisdiction assessed that clearly enshrines the principle of prioritising emissions reduction in law, but then doesn't go a step further in defining the exact role that CDR should play.

None of the policy frameworks analysed set comprehensive, separate and legally-binding targets for CDR. The sole existing targets set in law refer to LULUCF removals, as is the case in the EU's LULUCF regulation, German climate law and current UK carbon budgets. The UK plans to set targets for technological removals in law, and in the United States the recently proposed CDR Leadership Act has set Federal CDR targets. Germany has set a target for nature-based CDR and also plans to set a separate target for technological CDR which would provide both measurable indicators of progress and speed as well as give clear indication of the amount of residual emissions that can be tolerated in reaching a net-zero trajectory. Specific and separate targets for CDR were, however, outset by California and Switzerland in non-legally binding strategies.

One approach does repeat time and again: the particular concern of using CDR to offset emissions. All three global frameworks assessed (CORSIA, CDM and Article 6) are currently focused on offsetting continued emissions with removals, while loopholes to reduce emission reduction obligations through the use of land-based removals can be found in the EU RED and the flexibility mechanisms of the ESR. The EU ETS for the moment does not directly include removals, but this possibility is being actively discussed. The proposed CRCF purposely avoids covering the end use of certified removals units and leaves the door open for CRCF-certified units to be used for offsetting.

Many jurisdictions also include removals in offsetting mechanisms or to reduce compliance obligations in emission reduction policies including cap-and-trade systems. This is the case for Australia, California, New Zealand and Switzerland, whereas the UK has signalled an intent to include engineered removals, and potentially nature-based ones too, in its national ETS.

A robust definition of CDR is also missing from all of the frameworks assessed. A common negative trait is the inclusion of potentially very short-term carbon sequestration methods in the definition of carbon removal (such as storage in products and soil organic carbon), equating those with longer-term or permanent removals, and the omission of strong permanence requirements. This is also the case for the EU CRCF proposal. The Article 6.4 Supervisory Body has discussed this topic throughout 2023, and is planning to suggest recommendations by COP28, which however will not have legally binding implications for countries and companies. Some positive proposals regarding permanence have been introduced and

are currently under consideration in California and the United States. No robust and comprehensive accounting to enable a successful MRV framework was identified. The existing rules mainly refer to LULUCF or to specific aims, such as to certify removals being used for offsetting purposes (for example in the case of the methodologies to account for 'emissions savings' of biofuels under the EU RED).

The only certification process for carbon sequestration in the land sector among the analysed frameworks is the French Label Bas-Carbone, which is in itself inadequate as it doesn't differentiate in use between emissions reductions and removals and does not respect good quality standards. Only a few of its certification methodologies are based on actual sampling. Some aim at optimising, not reducing, the emissions linked to the production thereby favouring more intensive farms with higher absolute emissions; the agricultural methods emissions are considered reduced as soon as they decrease compared to the business-as-usual scenario, even if they are still increasing. Also, no environmental, biodiversity or animal welfare considerations are made binding in the Label. The CRCF was meant to fulfil this role in the EU, but the Commission proposed vague, insufficient and weak quality criteria, and will only commence work on specific methodologies once the CRCF has been formally adopted.

*Key policy recommendations*

Considering the above, we recommend the establishment of a dedicated, robust governance framework with legally binding targets and requirements for CDR based on the four criteria identified in this assessment. The new framework should:

1. Clarify that currently, carbon removals have a secondary climate function and that their role is to supplement - not substitute - urgently needed emissions reduction, in the longer term balance out residual emissions from sectors or activities that are deemed too expensive or impactful to fully decarbonise, and finally lead to net-negative emissions. To do this, it is crucial to define "residual emissions" in a realistic and dynamic way; what is known as 'hard-to-abate' today might not be in a few years or decades as new technologies or practices and behavioural changes take hold.

2. Introduce specific legally binding targets for CDR, in parallel with more prevalent current targets for emissions reduction. If nature-based methods are included in the definition of CDR, separate targets for technological removals and LULUCF sinks should also be set, as natural carbon sinks cannot guarantee the permanence of the carbon stored, yet are valuable for other so-called 'co-benefits'. Offsetting emissions with removals must be explicitly ruled out, ensuring that CDR is developed as a supplement, not substitute, to emission reductions.

3. Incorporate a robust definition of CDR, which delineates a removal as a process that removes carbon dioxide directly from the atmosphere and stores it permanently for at least several centuries, with the emissions taken out of the air outweighing the emissions involved in the removal process.

4. Launch robust accounting rules, MRV methodologies, sustainability requirements and liability criteria that truly take into account the several implications and impacts of CDR methods and ensure the generation of real, sustainable removals. More specifically, accounting methodologies

and rules on actors involved in the removal processes should be rigorous to prevent double-counting and double-claiming, keep track of the removals certificates, and make sure that the certification happens at the actual end of the removal process. The MRV system should be based on a strong quantification formula, using conservative estimates and considering direct and indirect greenhouse gas emissions flows both domestically and abroad. Processes generating removals should be socially and environmentally sustainable. In the case of removals based on biomass or land use specifically, such as BECCS, those activities must have a positive impact on the environment and biodiversity.

The EU has the potential to adopt many of these recommendations in the short-term and provide a leading example at the global level. The CRCF legislative process currently being developed should implement a strong definition of CDR, set the ground rules for its role and use, and start the process of building robust MRV and accounting systems.

In addition, the EU is in the initial stages of the 2040 target-setting process, which gives a unique possibility to establish separate targets for removals and emissions in the EU in the context of the post-2030 climate framework. The EU, as a privileged region with a significant historic responsibility for the climate crisis should play a leadership role for ambitious climate action by developing and financing difficult and/or expensive but good quality CDR options that could serve as an example for removals policy in other jurisdictions and at the international level. In parallel, the ongoing work on Article 6 of the Paris Agreement also has the potential to shape discussions on removals. Under the Article 6.4 market rigorous rules meant to govern the quality of carbon credits, including environmental and social safeguards, could have knock-on effects on the voluntary carbon market, compliance markets and future legislation such as the European Commission's proposed Carbon Removal Certification Framework. Those rules are planned to be recommended by the Article 6.4 Supervisory Body at the next COP28.

# 5 Annex 1: Global case studies

## 5.1 CORSIA

### 5.1.1 Overview

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) aims to achieve carbon-neutral growth in the global aviation sector. Established in 2016 by the International Civil Aviation Organisation (ICAO), it currently applies to routes between countries that are participating voluntarily. From 2027 to 2035, it will become mandatory for most countries, with the exception of the least developed nations and small island or landlocked developing states as well as countries that do not represent a significant share of global aviation traffic. CORSIA has been branded 'totally ineffective' for reducing aviation emissions.

The scheme obliges most airlines[1] to monitor and report their emissions from 2019 and to compensate for any growth in the sector's CO2 after 2020. The intent was to create a unified climate policy framework for international aviation to avoid uneven competition amongst the sector by having "a patchwork of state and regional market-based measures", as the ICAO puts it. To comply with CORSIA and compensate for its emissions, the international aviation sector can choose between lowering emissions (through the use of sustainable aviation fuel (SAF); improving ground operations, air traffic management and infrastructure and/or deploying more fuel-efficient aircraft, or purchasing and using eligible carbon credits.

To be eligible for CORSIA, carbon offsetting programmes must generate credits that represent emissions reductions, avoidance or removals. It is currently not possible to determine to what degree carbon removals will be part of CORSIA, as no credits have yet been sold. Since CORSIA only covers the growth in emissions from the sector above the baseline set at 85% of 2019 emissions, there has not been a need to offset any emissions yet, as the sector has not yet fully recovered from the dip following the COVID-19 pandemic.

According to ICAO's emissions unit eligibility criteria for CORSIA, offsetting programmes should deliver credits that represent either emissions reductions, emission avoidance, or sequestration of carbon. These credits should be additional, meaning they exceed what is already required by law, regulation or legally binding mandates, or what would occur in a conservative, business-as-usual scenario. Credits must also be based on realistic, credible and conservative emissions baselines; and be quantified in a transparent and conservative manner, with monitoring, reporting and verification carried out by an accredited third party.

These credits should also have a clear and transparent chain of custody visible through tracked identification numbers; be permanent (without specifying what permanence means). Note that afforestation and reforestation projects are included in CORSIA's list of eligible units. Credits must assess and compensate for some potential indirect effects, including increased emissions elsewhere brought

[1] The air operators covered are those that connect countries participating in the pilot or first phase of the scheme internationally, whose flights result in more than 10,000 tonnes of CO2 emissions annually, operate for more than three years, and whose aircraft weigh more than 5.7 tonnes on takeoff.

about by the displacement of activities, for example reforestation of agricultural land leading to deforestation elsewhere to maintain agricultural production. Moreover, the emissions reductions represented by these carbon credits should only be counted once towards a mitigation obligation. Finally, they should comply with social and environmental safeguards that ensure that their benefits outweigh their harm.

### *5.1.2 Assessment*

While not specifically regulating carbon removals, CORSIA allows the use of carbon credits based on removals to offset aviation emissions. In this way, the scheme conflates emissions reductions with carbon removals, which has a significant potential to deter climate mitigation in the sector as land-based removals (such as reforestation) are likely to be significantly cheaper than reducing aviation emissions.

CDR is not addressed specifically, and the scheme does not include any definition of carbon removals or key concepts, such as permanence of storage. Instead, it sets eligibility criteria that apply to emissions reduction, avoidance or "sequestration projects" indiscriminately.

Some of these criteria are reasonable requirements, such as regarding the conservativeness of the quantification and baselines. When it comes to permanence, the criteria definition is that carbon offset credits must represent emissions reductions, avoidance, or carbon sequestration that are permanent. If there is risk of reductions or removals being reversed, then such credits are either not eligible or measures must be put in place to monitor, mitigate, and compensate for any material incidence of non-permanence. However, a major shortcoming to this definition is that there is no appropriate definition of the timeframe of permanence in CORSIA's eligibility criteria. Practically, that means that the end of CORSIA's implementation period (2037) is the *de facto* horizon for permanence. Safeguards and systems are clearly needed to ensure storage of carbon far beyond that deadline, as offsetting credits based on carbon removal projects are meant, under the scheme, to compensate for greenhouse gas emissions that will remain in the atmosphere for centuries to millennia.

The CORSIA registries are, meanwhile, notorious for allowing dubious methodologies into the scheme, including ones with problematic approaches to permanence. According to CORSIA's Technical Advisory Body's (TAB) 2020 recommendations on the scheme's eligible units, in some cases the timeframe for which activities are required to monitor and compensate for reversals can cover as little as five to ten years, and is therefore too limited. The TAB recommends these programmes revise their procedures to provide for monitoring and compensation for a period of time that at the very least exceeds the period of time between when the programmes were assessed (2019) and the end of CORSIA's implementation period (2037).

While the recommendations represent an acknowledgement of the ineffectiveness of current rules regarding permanence and monitoring, they would only require that projects guarantee carbon storage until the end of CORSIA's implementation period in 2037, which is still a very low bar for permanence.

Forcing carbon removal units to compete on price with other offset units favours the cheapest crediting and removals projects. The weak permanence requirement potentially allows low-quality and short-term

storage projects to be included in the scheme. Buyers are likely to favour these credits as they are cheaper than high-quality removals such as direct air capture with carbon storage (DACCS).

CORSIA is supposed to be a self-regulating mechanism for neutralising the aviation sector's climate impact, but this is happening only on paper. Offsetting allows companies to seemingly comply with their climate obligations (which are already very weak in CORSIA's case) while not actually reducing their emissions, and often increasing them. CORSIA comes across, at best, as half-hearted. The scheme merely aspires to carbon-neutral growth at a time when the sector needs to half its actual emissions by 2030. It also fails to tackle the significant non-CO2 emissions, which are responsible for about two-thirds of the climate impact of aviation. The price of offset units is kept low, which means that finance will, in any case, not flow into high-quality removals.

## *5.2 Clean Development Mechanism (CDM)*

### *5.2.1 Overview*

The Clean Development Mechanism (CDM) was set up under the 1997 Kyoto Protocol to allow developed countries to buy emissions reductions or carbon removals from developing countries in the form of carbon credits. These certified emissions reductions (CERs) correspond to one tonne of CO2 equivalent. The objectives of the CDM were to help developed countries achieve their climate commitment under the Protocol and to assist developing countries in achieving sustainable development. The 2015 Paris Agreement established a revised post-2020 framework for global climate action. This included a new mechanism understood as the heir of the CDM: the Article 6.4 mechanism. Today, the CDM can no longer accept requests for registration, for crediting period renewals, or for issuance of CERs relating to emission reductions from after 31 December 2020, but some of its activities are eligible to transition to the Article 6.4 mechanism if they meet certain requirements.

The CDM was used for two decades to certify afforestation and reforestation projects (A/R), the only activities that qualify as removing carbon from the atmosphere under that scheme. In fact, while agriculture falls within the scope of the CDM, carbon sequestration in agricultural crops and soils was not eligible under the CDM in the first commitment period 2008-2012. According to the UNFCCC registry, projects registered in agriculture were meant to reduce emissions (for example, methane avoidance). A/R projects were also considered eligible during the second commitment period of the Kyoto Protocol (from 2012 to 2020). To be eligible to sell credits projects needed to respect certain requirements. This included demonstrating that they achieve real, measurable, verifiable and additional emissions reductions or removals.

Furthermore, for A/R projects specifically needed to provide proof that the land being used was not forested for at least 50 years (afforestation) or was converted to other uses before 1989 (reforestation). To quantify a project's net greenhouse gas removals, a baseline was calculated, interpreted as the sum of changes in the carbon stocks within the project boundary that would have occurred without the project. The baseline and any leakage that occurred (i.e. any increase in greenhouse gas emissions elsewhere that were measurable and attributable to the project) were then subtracted from the actual net greenhouse gas removal.

The quantified removals resulted in two types of credits, which were created to take into account the risk of the forests releasing back carbon into the atmosphere: temporary emissions reductions credits (tCERs) and long-term emissions reductions credits (lCERs). Temporary credits would expire at the end of the Kyoto Protocol's commitment period in which they were issued. The holder would then be required to replace them in the following commitment period to ensure continuing carbon storage. This type of credit was generally cheap, but the project operator did not need to pay back if carbon was lost to natural or human disturbances.

In contrast, long-term credits expire at the end of the project's crediting period (i.e. the period of time during which the removals achieved were eligible for issuance of credits and the project should be monitored), which could last from 20 to 60 years. These credits tended to be more expensive and the holder needed to replace any that had been lost due to premature carbon release. The validity of both types of certificates was reflected on the certifying documents.

The CDM required projects to go through validation, verification and certification processes conducted by an independent designated operational entity. Validation happened prior to registration to evaluate the proposed project's activities against the CDM prerequisites, while rules, verification and certification were carried out afterwards, to review and give a written stamp of approval of the actual removals achieved. The project owner was in charge of monitoring the carbon stocks in the carbon pools and could choose to start doing that at any time. After the first monitoring report, carbon pools needed to be monitored, re-verified and recertified every five years until the end of the crediting period of the project activity. Today, 67 A/R projects appear on the CDM registry, with the latest carried out in 2019, out of which 53 have issued tCERs or lCERs.

Looking forward, Article 6 allows CDM projects to transition to the 6.4 mechanism if it is approved by the country where the project is located and if the project meets the new rules, with the exception of rules on methodologies. Projects can continue to use the same old CDM methodologies until 31 December 2025, or the end of their current crediting period, whichever comes first. From 2026, they must be fully compliant with Article 6. However, tCERs and lCERs cannot transition for use towards NDCs.

### *5.2.2 Assessment*

In addition to helping developing countries achieve sustainable development while contributing to climate change mitigation and adaptation, the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) regarded A/R carbon crediting projects as an opportunity for the private and public sectors in developing countries to increase land productivity (by controlling soil erosion, improving soil fertility, combating desertification) while earning revenue for the carbon sequestered by their forests.

The performance of the CDM is, at best, mixed. In a 2012 analysis, Carbon Market Watch found many flaws related to the crediting of A/R projects under the mechanism. These were related to the complexity of quantifying the carbon stored; the incentive given to monoculture tree plantations; the impossibility of accurately accounting for carbon leakage due to indirect land use change; permanence issues, such as the risk of reversal of CO2 storage is high in forests; and conflicts over land tenure. More recently, in 2018, Carbon Market Watch concluded that it was doubtful that the CDM had reached its climate objective of producing high-quality credits which could be used to compensate for a country's emissions. Most CDM

credits are based on projects which would probably have happened anyway, and the scheme itself has failed to adopt sufficiently stringent environmental and social safeguards, especially towards indigenous communities. For example, Carbon Market Watch exposed how a private company had blocked access to land vital for the livelihoods of local communities in Uganda in order to claim credits for planting forests in that area for an A/R project.

In general terms, a 2016 analysis by Öko-Institut suggests that the CDM still has fundamental flaws in terms of overall environmental integrity and that it is likely that the vast majority of the projects registered and CERs issued under the CDM were not providing real, measurable and additional emissions reductions.

In terms of definitions, the distinction between emissions reductions and removals was not very clear under the mechanism. A robust definition of carbon removal was not present, and neither were strong sustainability criteria required for removals to comply with.

To conclude, the CDM is a market-based offsetting mechanism which the authors do not deem to incentivise deployment and use of carbon removals in line with the environmental criteria used throughout this analysis. However, as already stressed by Carbon Market Watch, the CDM approach to addressing carbon reversals in A/R projects by differentiating between temporary and long-term crediting is an interesting concept which underlines the temporary nature of the benefit achieved by the activity. However, this approach is incompatible with an "offsetting" model (whether it is for countries or the private sector), because it is not realistic to expect a buyer of carbon credits to continuously replace credits that have been purchased for generations to come. It is even less realistic to expect that any governance system, or external observers, will be able to monitor whether and how expired credits have been replaced - operationalising the necessary liability needs globally over the longer term. Temporary credits would be a useful asset under a financial contribution model, but are a climate liability when it comes to offsetting.

## *5.3 Article 6*

### *5.3.1 Overview*

Article 6 of the Paris Agreement establishes two new markets for countries to achieve their climate commitments through trading emissions reductions and removals. The role and functioning of these two markets are set out in Article 6.2 and Article 6.4 of the Agreement, and have been discussed by the negotiators since 2016. In 2021 at COP26, countries agreed to the overall rulebook. In the years ahead there is a need to negotiate further implementation requirements and design elements, including detailed rules on carbon removals definition and crediting.

Article 6.2 establishes a carbon market which allows countries to buy or sell to one another any extra emission reductions or removals they have achieved relative to their climate target (NDC), known as internationally transferred mitigation outcomes (ITMOs). These bilateral or multilateral trade agreements are called "cooperative approaches". Without an independent body responsible for enforcement power over the implementation of the 6.2 market, countries could in theory keep information regarding the quality of their reductions or removals confidential. This means that the quality of emissions reductions or removals transferred will not be easily measured or even potentially verifiable in some cases. Countries

can self-define “environmental integrity”, social safeguards, and other core criteria for the credits exchanged, and even claim whether or not a project would have happened anyway. While a review team composed of UN technical experts will analyse countries’ ITMO trade agreements, they are not asked to assess the robustness of the environmental and social safeguards in place. Moreover, countries are not required to implement the review team’s recommendations.

Article 6.4 resembles the Clean Development Mechanism, except that it will not be restricted to projects implemented in developing countries. In this market, project developers will reduce or remove emissions through specific actions in a country, and sell these emissions reductions or removals to another country, company or person. The process will be administered by a “Supervisory Body” tasked with establishing detailed rules and requirements that projects and credits must comply with in order to be eligible. They will also have the final say over registering individual projects, issuing credits, and renewing crediting periods. From the perspective of the removals community, negotiations on Article 6.4 will be interesting as detailed rules on removals, including on their definitions and crediting, will be at some point adopted by the Supervisory Body and may influence the way removals are treated in the voluntary carbon market or national and regional jurisdictions, potentially including the Article 6.2 market.

Since 2022, the Supervisory Body has started working on whether and how carbon removal projects would be permitted and credited in Article 6.4. A first draft of recommendations on carbon removals was presented by the Supervisory Body during COP27 in November 2022, but the Parties did not adopt it, postponing the discussion to COP28. This first draft included carbon capture and storage (CCS), carbon capture and utilisation (CCU) and products that have no permanence limitations in the definition of removals. In addition, the Supervisory Body did not provide detail on the definition of durable storage, and plans to address permanence and reversals at a later stage. The draft recommendations also propose to leave the assessment of environmental and social considerations to the national level, as it is considered a responsibility of the host party. These topics have been under discussion by the Supervisory Body throughout 2023, which aims to finalise a new set of recommendations on removals at COP28. The Supervisory Body is also undertaking important parallel work on methodological requirements (e.g. additionality) for emission reductions and removals activities to be eligible and become credited under the system.

Besides, countries have already agreed on rules to avoid double-counting under Article 6 by applying what are called “corresponding adjustments” to country-to-country trades, country-to-airline trades under CORSIA, and country-to-company trades in certain cases. This means that “host countries”, where an emission reduction/removal project takes place, must deduct any achieved reductions or removals from its national greenhouse gas accounting, should it have sold them to another country for the purpose of counting them towards its own national climate target. In addition, at COP27, countries also agreed to establish a new kind of carbon credit in the Article 6.4 market, called a “mitigation contribution unit” (with mitigation including both reducing emissions and sinks enhancement in the UN context). It does not require a “corresponding adjustment” and encourages countries to consider means other than offsetting. Since the host country can count the unit towards its climate target after the sale, the same unit should not also be counted by the company, e.g. for offsetting, carbon-neutrality claims or towards its own corporate climate target.

### *5.3.2 Assessment*

As negotiations on Article 6 are ongoing, it is difficult to assess the robustness of its rules concerning correct definition and use of carbon removals. The agreement reached on avoiding double-counting through "corresponding adjustments" and including the opportunity to use credits based on "contribution units" instead of offsetting under the Article 6.4 market is helpful if correctly applied to the use of removals. However, the fungibility of emission reductions and removals-based credits is not something that is clearly ruled out under the Article 6 mechanisms. The possibility of using removals to offset emissions and also comply with a country or a company's climate commitments would be inappropriate as these operate on fundamentally different and distinct timescales: emissions stay in the atmosphere for millennia, while in certain cases the carbon removed could re-enter the atmosphere after a few years. This could be solved if countries clearly separated emission reductions from removals as part of their nationally determined contributions. This is unlikely to happen under the auspices of the UNFCCC, but some countries, including in the EU, should take the lead and voluntarily set separate targets in their NDCs.

At the very least the Supervisory Body should adopt a robust definition that forbids crediting of temporary storage if this is used for offsetting purposes. Article 6 will not prescribe how countries and companies have to consider and use carbon removals in their climate frameworks and commitments. However, introducing rigorous rules under the Article 6.4 market to govern the quality of carbon credits, including environmental and social safeguards, could have knock-on effects to the voluntary carbon market, compliance markets and future legislation such as the European Commission's proposed Carbon Removal Certification Framework.

# 6 Annex 2: EU policy case studies

## 6.1 EU Emissions Trading System

### 6.1.1 Overview

#### 6.1.1.1 Background of the EU ETS

The EU Emissions Trading System (EU ETS)[2] was developed in 2005 as a "cap-and-trade" system to reduce greenhouse gas emissions. It covers approximately 40% of the EU's GHG emissions, mainly from electricity and heat generation installations, manufacturing industries, shipping and intra-European flights. The system sets a cap on the total amount of greenhouse gases that can be emitted in the sectors covered by the ETS. The cap decreases annually to bring the covered sectors in line with longer-term climate targets. Companies receive or buy emission allowances which they can trade as needed. All industries covered by the ETS are required to keep monitoring plans that are checked annually.

In theory this is supposed to decarbonise the economy in the most cost-effective way. However, the EU ETS has from the outset included a series of measures with the intent of protecting industry from the carbon price, including allowing for the use of international carbon credits (a.o. from the CDM) for compliance. These measures have contributed to an oversupply of emission allowances, depressed carbon prices and limited emission reductions. Over the past 10 years, steps have been taken to fix these problems. The Market Stability Reserve has been put in place to limit oversupply by reducing the amount of allowances auctioned, depending on the scale of current oversupply. A more ambitious 2030 climate target was also set in 2023 resulting in the annual cap shrinking faster. The EU ETS now aims to decrease emissions by 62% in 2030 relative to 2005 levels, and by issuing no new emission allowances after 2039. As a result prices of allowances have risen to around €100 per tonne CO2eq as of 2023.

#### 6.1.1.2 CDR in the EU ETS

The stated goal of the EU ETS is to reduce GHG emissions. Removals are not currently within the scope of the EU ETS. However, the EU ETS can fund CDR initiatives. Most ETS revenues are channelled back to the member states which, starting in 2024, must use 100% of this income for climate- and energy-related purposes. The member states have the flexibility to decide what they wish to fund from a list that includes both land-based sequestration (in forests or soils) and innovative technological carbon removal methods such as DACCS.

A smaller share of EU ETS revenue is channelled to supplementary programmes including the Innovation Fund, which supports innovation within Europe that leads to significant emission reductions. The Innovation Fund contains approximately 530 million ETS allowances - valued at about €40 billion to be used between 2030 and 2040 (calculated using a carbon price of €75/tonne of $CO_2$).

[2] This section will focus on the EU ETS that covers the industrial, electricity and heat generation, and intra-EU aviation and international shipping sectors which is also known as ETS1. ETS2 in contrast is a recent policy that is yet to become operational and covers the buildings, road transport and some smaller sectors not covered by the ETS1. ETS2 currently has no clear link to removals, but this could change as the policy develops in the coming years and decades.

While the Innovation Fund has an overall focus on emission reductions in the industrial, power and transport sectors, and not removals, a number of CDR projects have received support from the Innovation Fund. These projects must adhere to CCS methodologies and be evaluated in the CCS category as no dedicated methodology for removal projects exists. One such project is the Bio Energy Carbon Capture and Storage project by Stockholm Exergi's that was granted €180 million by the Innovation Fund. It projects a removal of 7 Mt CO2 over its first ten years of operation by adding a carbon capture installation to the existing biomass fueled heat and power plant in Stockholm, and from 2026 capture and store CO2 permanently. The EU ETS can therefore indirectly support CDR deployment through both the central Innovation Fund and by member states using ETS revenues.

Since 2022 European Union policy makers have called for direct inclusion of removals in the ETS. One such proposal called for companies that generate CDR through geologic storage of atmospheric carbon (DACCS or BECCS are often mentioned as concrete examples) to be granted ETS emission allowances per tonne removed. Those companies could then sell or use those allowances to cover their own ETS obligations.

Two key arguments have been used. First, removals will be needed once the ETS cap hits zero because not all emissions will have been eliminated by then. Therefore removals should be used to offset the remaining emissions. Second, by extending the pricing of emissions to removals the ETS would be a funding instrument to help grow the technical CDR sector in the EU.

Both arguments suggest that inclusion of CDR in the EU ETS would convert it to an offsetting mechanism, and would therefore be a retrograde step for the EU ETS that stopped the use of international offset units for compliance from the CDM in 2021. That was stopped due to a lack of environmental integrity of imported units amongst the almost 1.6 billion units brought into the ETS between 2013 and 2020. Nonetheless, the proposal to include CDR in the ETS was dismissed only with a compromise that the European Commission would be mandated to publish a report by mid-2026 on how possible integration of CDR from greenhouse gases removed from the atmosphere and permanently stored could be accounted for and covered by emissions trading. The question of including CDR in the ETS is still a live issue although postponed for some years.

### *6.1.2 Assessment*

Progress on the EU ETS has been gradual over the past 20 years and although prices have not yet reached levels compatible with the Paris Agreement, and a risk of oversupply remains, there is reason for optimism that the system can succeed in reducing emissions. Revenues from the EU ETS can provide much-needed financial support for the energy transition or the development of removal technologies.

However, direct inclusion of removals in the EU ETS would signal a step backwards by incentivising mitigation deterrence and rejustifying offsetting.

The idea to introduce removal into the EU ETS is heavily influenced by a perceived need to limit the cost of compliance as much as possible, instead of achieving cost-effective decarbonisation of ETS sectors and activities. Therefore a major risk is that lower quality and cheap removals (e.g. soils or forests) would be prioritised over higher quality removals that are more expensive (e.g. DACCS).

Including CDR in the EU ETS further risks undermining the overall mitigation efforts of industry by allowing more sectors to claim their emissions as "residual" although they might not be. Over the longer term inclusion of CDR in the EU ETS could undermine the EU's ability to reach deep and sustained net-negative emissions by 2050.

## *6.2 The LULUCF Regulation*

### *6.2.1 Overview*

The Land Use, Land Use Change and Forestry sector (LULUCF) has a major impact on the global carbon cycle and emissions from this sector are among the highest in the world (20-25% of the global emissions). In the EU, emissions and removals from these sectors are managed by the LULUCF Regulation. The regulatory framework is also described as a third pillar of EU climate policy next to the EU ETS and the ESR.

The LULUCF regulatory framework was adopted in 2018 to include emissions and removals from the sectors in the 2030 climate target framework. It aimed at enhancing the LULUCF sink through improved protection and management of EU land and forests, ensuring that greenhouse gas emissions from the sector were offset by at least an equivalent removal of $CO_2$ from the atmosphere in the period 2021 to 2030 (the "no debit rule"). A revised version of the Regulation entered into force in 2023, which increases the Union net removal target from the LULUCF sector from the previous -225Mt CO2eq to -310Mt by 2030. The new Regulation will operate in two phases: a first phase until 2025 during which each member state is obliged to balance emissions and removals, keeping the current "no debit" approach in place; and a second phase from 2026 to 2030 when member states' targets for net removals will contribute to the increased ambition of -310 Mt. In addition to national targets, which range significantly across the EU (from 2000 tonnes of $CO_2$ for Malta to nearly 6.7 million tonnes for France by 2030), each member state should commit to further net greenhouse gas emissions and removals between 2026-2029.

It is important to note that the EU Climate Law set a maximum contribution for LULUCF removals to the EU as a 55% emission reduction target of -225Mt CO2eq, which actually equates to -57% net-emissions by 2030 compared to 1990 levels.

#### 6.2.1.1 CDR in the LULUCF Regulation

The Regulation does not define CDR per se, but refers to 'sink' as "any process, activity or mechanism that removes a greenhouse gas, an aerosol, or a precursor to a greenhouse gas from the atmosphere". Removed greenhouse gas ends up in a 'carbon pool' and covers greenhouse gas emissions and removals from the management of land, forests and biomass and includes the land use categories: forest land, cropland, grassland, wetlands, settlements, and other land. It comprises emissions and removals from the carbon pools: living biomass, deadwood, dead organic matter, litter, mineral and organic soils and harvested wood products.

The LULUCF Regulation has comprehensive accounting rules for the sector with different benchmarks and reference years for the different land types. Accurate assessment of emissions and removals from land-use and forestry is challenging due to the complex and decentralised nature of the sector so is not done

annually but through multi-year accounting. The regulation introduces two accounting periods, the first from 2021-2025 and the second from 2026 to 2030. The balance between emissions and removals are calculated for each period and each country must average their greenhouse gases compared to a national reference level, which are benchmarks to calculate the sum of greenhouse gas removals and emissions from existing forests in each member state, and in the second period greenhouse gases are compared to a linear trajectory towards a 2030 target. The revision of the Regulation in 2023 also aims to improve the monitoring, reporting and verification of emissions and removals through the use of remote sensing.

Accounting principles of land use categories follow the logic that sequestered CO2 is recorded as a removal, whereas removal of biomass, organic matter or interference in the ecosystems releasing captured emissions is accounted as emissions. This logic, however, does not apply when it comes to accounting for harvested wood if used as products.

Harvested wood products has its own category and is accounted as part of the LULUCF-sector's carbon stock. Products are sub-classified into paper, wood panels, and sawn wood, and each of these is assigned a different decay factor. The decay factor determines how long products can remain as part of the LULUCF-sector's carbon stock before automatically accounted as emissions. The decay factor can be set at up to 35 years although there is no control over the actual life cycle of the wood products.

Flexibility mechanisms are included should a member state overcomply and produce surplus net removals in either of the two periods, or if they don't reach their targets. In the case of overcompliance LULUCF credits are created and can either be banked from the first accounting period to the second, be traded between member states that are not complying with their target (as long as the -310Mt target is met across the EU) or be used to a limited extent under the ESR flexibility mechanism (see ESR section). If a member state does not reach their target they must either buy LULUCF credits from other member states, or compensate with additional emission reductions in the ESR sectors (including agriculture, buildings, road transport and waste).

#### 6.2.1.2 Assessment

Some of the accounting rules in the framework have been criticised for being fraught with major uncertainties, especially with regard to emissions and reductions from cropland, grassland, wetland and soil carbon where it is difficult to assess the actual amount of emissions or removals and the permanence. Furthermore, there are shortcomings in that harvested wood products are included in the carbon stock for up to 35 years although there is no control over the actual life cycle of the wood products or realistic potential to monitor the stock of these wood products. Lastly, natural disturbances causing loss in carbon stock, such as deforestation caused by storms or forest fires, are exempt from accounting. These different methodological uncertainties are concerning in a situation where removals are supposed to be offsetting emissions, but in reality they do not exist.

The LULUCF regulatory framework has its strengths but many stakeholders have raised concerns about how it functions. Recognising the LULUCF sector as a separate pillar in EU climate policy architecture is undoubtedly positive due to the high activity of the sector and the objective of increasing carbon stocks across the EU.

However, the flexibility mechanisms included in the framework are concerning. They are problematic as they allow offsetting of fossil fuel emissions in ESR sectors through forestry or land use sinks, at the risk of decreasing incentives for emission reductions in the LULUCF and ESR sectors. Furthermore, the mechanisms equate emission reduction with removals, setting a dangerous precedent that is scientifically disproven as emission reductions and removals cannot be equated. Equalising emissions and removals has the potential to undermine the EU's overall climate policy objective of deep and sustained emission reductions across all its sectors. While the LULUCF Regulation covers emissions and removals that are all biogenic in nature, they are used to offset fossil emissions under the ESR target. To compound that there is still a large degree of uncertainty surrounding measurements under the LULUCF Regulation.

## *6.3 The Effort Sharing Regulation*

### *6.3.1 Overview*

#### 6.3.1.1 Background of the ESR

The Effort Sharing Regulation (ESR) aims to reduce emissions from all sectors not covered by the main EU ETS (also known as ETS1 which covers industry, electricity and heat generation, and intra-EU aviation and international shipping). The ESR covers road transport, buildings, waste management, agriculture and small-sized industry. Collectively these sectors accounted for approximately 60% of the EU's GHG emissions in 2021.

A methodology was developed to distribute differentiated emission reduction targets amongst member states for non-ETS emissions based on GDP per capita, with higher targets set for wealthier member states than less wealthy member states. Emission reductions were differentiated by a maximum range increase of +20% for the lowest GDP per capita member states to -20% for member states with the highest GDP per capita. The non-ETS sectors achieved an average emission reduction of -10% in 2020 compared to 2005. The ESR was revised in 2018 and more recently in 2023, and its current target is to reach an overall emission reduction of -40% by 2030 relative to 2005 EU emission levels. The range of emission reductions is between -10% to -50% respectively for member states with the lowest GDP per capita and those of the highest GDP per capita. The ambition may have increased but flexibility provisions have been introduced, simultaneously lowering the effort needed by member states to reach their targets.

#### 6.3.1.2 Flexibilities in the ESR - a loophole for CDR

A range of different flexibilities exist, but from a CDR perspective linking ESR Targets with the LULUCF is directly relevant as it allows member states to use potential overachievement of their LULUCF sector target to fill any gaps towards achieving the ESR target. A cap of 262 million tonnes of CO2 has been set between 2021-2030, and is split evenly so that a maximum of 131 million credits may be used each 5 year period. All member states can use this, but there is a larger flexibility granted to countries that have a greater share of their emissions in agriculture due to the lower potential to mitigate agricultural sector emissions. These LULUCF credits must be produced nationally and can only be considered if a member state would otherwise be unable to reach their emission reduction target. The LULUCF flexibility is problematic because it creates an inappropriate precedent that allows land based carbon sinks to be exchanged with emission reductions.

Other ESR flexibilities include banking and borrowing emission allocation from year to year. Countries can bank surplus emissions in years where emissions are lower than their annual allocations and borrow from the following year if the country has run short. This allows for annual fluctuations in emissions caused by weather or economic conditions. Member states can also sell or buy up to 10% of their annual allowances with other member states.

Furthermore, country specific flexibilities have been introduced to the EU ETS allowing nine high-income countries (Belgium, Denmark, Ireland, Luxembourg, Malta, the Netherlands, Austria, Finland, and Sweden) to use a share of their EU ETS auctioning allowances to reach ESR targets. This means that ETS installations across these member states are allowed to pollute less in order to make up for a shortfall in climate action. A flexibility for lower income member states is also included through a safety reserve of 105 million tons of extra CO2 that is to be distributed to member states that do not surpass their annual emission allowance limit in 2032.

During the ESR negotiations the European Parliament rapporteur proposed an additional CDR loophole, whereby removals could offset emission reduction obligations under the ESR. The rapporteur proposed that member states could use certified carbon capture removals from their own territory to comply with up to 5% of their annual emission allowance commitments. If in the future such an amendment was adopted it would jeopardise EU's target of net-negative emissions by 2050.

#### *6.3.2 Assessment*

The various different flexibilities weaken the ESR and put at risk the transition of relevant sectors as lack of progress can be easily hidden on paper. A strong precedent has been created to not reach set emission reduction targets. The most worrying flexibility from an environmental integrity perspective is the LULUCF flexibility that equates emission reductions with removals, although they can not be equated. Including the LULUCF flexibility effectively introduces offsetting of permanent emissions with temporary nature based removals. Under the Effort Sharing Decision from 2013-2020 LULUCF sector removals were deliberately not included due to fears that it would undermine real reduction of emissions. As the risk of undermining reductions is unlikely to be reduced significantly, including removals into the ESR would be problematic.

This risk also applies to the inclusion of CDR in the ESR as proposed by MEP Polfjärd (the European Parliament rapporteur on this file during the recent Fit-for 55 revision process). The modest 10% emission reduction achieved over the first period of the ESR suggests that deep emission reduction needs will likely be met by additional demands for loopholes. Including CDR in the ESR would be an extremely harmful type of mitigation deterrence by rewarding countries that are not achieving their targets with an easy route out of non-compliance.

### *6.4 Renewable Energy Directive*

#### *6.4.1 Overview*

The Renewable Energy Directive (RED) is the legal framework for incentivising renewable energy uptake in the EU. The current version - Directive 2018/2001/EU, also known as RED II - entered into force in 2021 setting an overarching EU renewable energy target, with targets and rules for the use of renewables in

heating and cooling and in the transport sector, and sustainability criteria for bioenergy and the use of biomass. In July 2021, as one of the initiatives included in the so-called "Fit for 55" package to help the EU achieve 55% emission reductions by 2030 compared to 1990 levels, the Commission proposed another revision of the Directive, mainly to raise its targets. At the time of writing, an agreement was reached between the EU Council, Parliament and the Commission to raise the overall binding target for 2030 from 32% to a minimum of 42.5% whilst aiming for 45%, to increase the targets in heating and cooling and transport sectors, and for the first time to include a target for the industry and strengthen the sustainability criteria for the use of forest biomass. The provisional agreement still requires formal adoption by the Institutions before it is published in the Official Journal of the EU and becomes law.

#### 6.4.1.1 Carbon sequestration and carbon intensity of bioenergy

In line with its purpose, the RED does not regulate removals. However, carbon sequestration in soils and carbon capture and storage or utilisation is considered in rules that calculate the contribution of biofuels and bioliquids towards renewable energy targets. More specifically, RED II establishes the methodology to calculate the total greenhouse gas emissions impact of biofuels, bioliquids and biomass fuels and consequently the emissions savings that they should achieve compared to conventional fossil fuels. In this calculation, carbon sequestered through "soil carbon accumulation" (via improved agricultural management of the raw materials that become biofuels), carbon capture and geological storage and so-called carbon capture and 'replacement' (i.e. CCU) can be deducted from the total emissions from the use of the fuel and count as emissions savings.

Regarding soil carbon accumulation, the EU refers to some examples of improved practices, such as shifting to reduced or zero-tillage, improved crop rotation, the use of cover crops, crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation, digestate, biochar, etc.). According to the Directive, emissions savings from improved agriculture management shall be taken into account for the purposes of quantifying the total climate impact of biofuels only if "solid and verifiable" evidence is provided that soil carbon has increased or that it is "reasonable to expect to have increased" over the period in which the raw materials (i.e. biomass) for the relevant biofuels were cultivated. The calculation should also consider emissions that may occur from increased fertiliser and herbicide use.

An addendum to the law specifies that measurements of soil carbon should happen at the farm before establishing a baseline. The carbon stock should be measured at regular intervals, no later than 5 years apart. After the baseline is measured, the increase in soil carbon can be estimated yearly on the basis of representative experiments or soil models. From the second measurement onwards, measurements must be based on the actual values, thus accurately determining the existence of an actual increase in soil carbon and its magnitude.

For these greenhouse gas savings to be claimed, the farmer or the economic operator must commit to continuing to apply the improved management practices "long-term", meaning at least for 10 years, implemented as a 5-year renewable commitment. Improved agricultural practices must be applied continuously for at least three successive years if the economic operator would like to account for the emissions savings. This means that it is not allowed to switch management practices every year when emissions savings are claimed. If this criterion is not respected, savings can not be claimed and will instead

be considered as emissions to be added to the total climate impact of the fuel. Even when all requirements are respected the total amount of emissions savings which can be claimed is capped at 45g CO2eq/MJ of biofuel, or for bioliquid using biochar during the process at 25g CO2eq/MJ. The emissions savings should be verified by certification bodies and finally certified by an independent authority called Voluntary Scheme, which the Commission must approve.

In addition to savings for soil carbon sequestration, RED II allows for the use of emission savings derived from CO2 capture and geological storage, if not already accounted for in the processing phase, to lower the total carbon intensity of the final biofuel and bioliquid products. The savings can be claimed only if the captured carbon is stored in compliance with the CCS Directive and is directly related to the emissions that occur during the extraction, transport, processing and distribution of the fuel. Such actions generally lead to avoided emissions and thus CCS. However, if the captured carbon is biogenic (for example the one captured during the processing phase of biofuels that are based on the fermentation of the biomass raw material) and it is permanently stored, we could talk about CDR. The provision is therefore of interest to CDR and could lead to double claiming.

Finally, emission savings from the capture of biogenic carbon during the production of biofuels or bioliquids and its use to replace fossil-based CO2 in the production of commercial products and services can also be accounted for and deducted from the total emissions of biofuels. This does not, however, represent CDR.

#### 6.4.1.2 Sustainability criteria for bioenergy and other implications for BECCS

The RED II also defines a range of sustainability criteria for bioliquids, solid and gaseous biomass fuels that must be complied with in order to be appraised for the renewable energy target. This could mean that without a dedicated framework for removals accounting in the EU (now suggested by the European Commission as the Carbon Removal Certification Framework), the RED II would also regulate the sustainability of biomass used for bioenergy with carbon capture and storage (BECCS). However, sustainability and greenhouse gas criteria do not currently apply to biomass fuels used in installations producing electricity, heating and cooling or fuels with a total rated thermal input lower than 20 MW for solid biomass fuels and 2 MW for gaseous biomass fuels. The agreement for the RED II revision lowers the threshold for solid biomass to 7.5 MW.

The Directive treats biomass as zero-carbon at the point of combustion, an approach that also underpins the EU Emission Trading System (ETS) and Effort Sharing Regulation. As explained in a 2022 report by the NGO BirdLife, this classification is based on two assumptions. The first is that biomass emissions are viewed as being part of a natural cycle in which the carbon emitted by burning biomass will be directly re-absorbed by forest or plant growth. The problem with this assumption is that the initial increase in carbon emissions due to harvesting and burning of biomass creates a 'carbon debt' that depending on the feedstock takes decades to centuries to pay back (the time needed for recovery of the vegetation and start carbon absorption to the same level). The carbon debt for slower growing biomass might not be repaid in time to be relevant for the current climate crisis and the objectives of the Paris Agreement.

The second assumption derives from greenhouse gas reporting and accounting frameworks established under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, in which

emissions from biomass are only reported under the land-use sector when they are harvested and not in the energy sector when they are burned to avoid double-counting. This poses a challenge especially when the biomass feedstock is produced in one country and exported for energy use in another. But, as stressed by Nehler and Fridhal (2022) this also means that in the case of BECCS deployed to remove and store carbon from zero-rated biomass, the stored emissions would be directly reported as negative. However, from a system perspective, the climate benefit of BECCS would be undermined by unsustainably sourced biomass, and full, robust life-cycle assessments would be necessary to calculate how much, and when, net-negative emissions are really being created.

### *6.4.2 Assessment*

By definition, the Renewable Energy Directive is focused on the use of renewable energy in the EU and should have nothing to do with carbon removals. In fact, the Directive does not cover nor define removals, and it is not meant to create a framework for their deployment. However, the Directive could directly or indirectly regulate a number of key CDR-relevant aspects of biomass and soil carbon sequestration.

The emissions avoided through the use of improved agricultural practices when harvesting raw materials for biofuels (practices which could belong to the wide category of carbon farming) and through carbon capture and storage (such as BECCS based on bioethanol) are in fact allowed to count as emissions savings and be deducted from the total amount of emissions linked to the fuel production and use. This possibility would overlap with using removals from BECCS to achieve separate or net-zero targets and increase the risk of double-claiming, or the intention to create carbon credits from carbon farming.

Simultaneously this approach allows for the use of very short term carbon storage, such as soil organic carbon (SOC), to downgrade the carbon intensity of biofuels and bioliquids used, as is the case for example in aviation and thus artificially present permanent emissions as offsets. The ISCC system, one of the approved certification schemes under the RED II, stresses that it reserves the right to reject certain improved agricultural practices if scientific evidence shows that these practices will not sequester the SOC in the "long run".

Also, as the Directive regulates the use of biomass for bioenergy, it would constitute (as mentioned in recital 15 of the Carbon Removal Certification Framework proposal) a referral to the EU legal instrument used to assess the sustainability of biomass based removals solutions such as BECCS, in the absence of a robust accounting system for removals in the EU. While new sustainability provisions have been introduced in the revision of RED II, and almost concluded at the time of writing, they are considered not strong enough by WWF Europe. In a similar way, treating biomass as zero carbon could have problematic implications for the actual quantification of removals from BECCS, which could be overestimated if direct and indirect emissions linked to biomass are not taken into account, e.g. due to the harvesting and processing of the biomass. In addition, this ignores the carbon debt and time dimension regarding the regrowth of biomass, which is considered critical in light of the climate crisis.

## *6.5 Common Agricultural Policy (CAP)*

### *6.5.1 Overview*

Launched in 1962, the Common Agricultural Policy (CAP) is the oldest European Union policy still in operation and in 2021 accounted for 33.1% of the total EU-27 budget. The initial purpose of the CAP was

to increase agricultural production and secure food supply in Europe. This was done through financial support for the agricultural sector and by guaranteeing farmers a minimum price for the sale of their products.

It has since undergone several reforms, the most recent adopted in December 2021, to align the CAP with the EU's overall goals. Following the European Green Deal, the CAP has integrated more environmental ambitions and climate actions than before. These must be reflected in CAP strategic plans, which set out how EU member states intend to implement CAP objectives in their territory for the period 2023-2027. The plans are developed nationally and approved by the Commission.

The performance of the CAP is continuously evaluated through the common monitoring and evaluation framework (CMEF). Following a review of its 2014-2020 performance a new set of common indicators will apply to assess progress of EU countries in achieving the latest environmental ambitions and climate actions added to the CAP strategic plan. This will be monitored through annual performance reports and a biannual review of the performance of CAP Strategic Plans.

At least 25% of the 2023-2027 CAP budget for direct payments is allocated to so-called "eco-schemes". These are developed nationally to address local climate and/or environmental issues and are included in CAP strategic plans. According to the Commission, eco-schemes can provide stronger support for climate and environment-friendly practices, such as organic farming, agro-ecology and "carbon farming". The latter is defined by the Commission as a "green business model" that rewards the land sector actors should they take up improved land management practices that result in carbon sequestration of living biomass, dead organic matter and soils by enhancing carbon capture and/or reducing the release of carbon to the atmosphere. According to the Commission, carbon farming activities include afforestation and reforestation, agroforestry, use of catch crops, cover crops and conservation tillage enhancing soil organic carbon, and restoration of peatlands and wetlands. Several Member States have adopted eco-schemes that address such practices in their CAP strategic plans, including Croatia, Cyprus, Denmark, Germany, Lithuania, Netherlands, Poland and Spain.

Apart from eco-schemes, the CAP strategic plans can allocate funding from various other parts of the CAP to support natural sinks, such as The Rural Development Programmes, where at least 35% of CAP funds are allocated. This also focuses on the priority area to foster carbon conservation and sequestration in agriculture and forestry.

The intention of promoting carbon sequestration in the CAP in the future (so beyond the current 2023-2027 period) was also articulated in the Communication on Sustainable Carbon Cycles adopted by the Commission in 2021, in which they set out short to medium-term actions to support "carbon farming". The declared aim of the communication is that carbon farming initiatives should contribute 42Mt of CO2eq of the land sink that is required to meet the objective of 310 Mt CO2eq net removals by 2030 as required in the LULUCF Regulation.

### *6.5.2 Assessment*

The integration of environmental ambitions and climate actions into the CAP is appropriate as the agricultural sector is known to cause large-scale environmental degradation and contribute substantial

greenhouse gas emissions. The activities included by the Commission under the umbrella of "carbon farming" can have positive effects on the environment, creating better soil health, increasing biodiversity, protecting water systems and more. However, there is a risk involved in promoting practices such as carbon removals, because the permanence of these practices is not reliable. Human interference, natural disturbances and climate change can lead to the re-emission of sequestered carbon, and in some cases over very short time periods.

The integration of many of the "carbon farming" practices in the CAP is positive as farmers are incentivised to introduce changes that are generally beneficial for the environment and biodiversity. However, it is problematic if a precedence is created that acknowledges soil carbon sequestration as a carbon removal. It is especially troublesome if member states that adopt eco-schemes, and thereby overachieve their LULUCF targets, use those carbon farming results to offset emission reductions under their ESR obligations. The lack of permanence in carbon removals from agricultural practices means that if presented as a substitution for emission reduction they risk damaging the integrity of the EU's climate targets with empty removal commitments that are easily reversible by humans, unforeseeable weather events or other natural disturbances.

## *6.6 Carbon Removal Certification Framework*

### *6.6.1 Overview*

On 30 November 2022, the European Commission published its proposal for a Carbon Removal Certification Framework (CRCF) to establish the groundwork for a voluntary system to certify, monitor and account for carbon removals in the EU. This case study on the CRCF is the only case study to be based fully on a proposed but not yet implemented or operational policy. The overview and assessment are based on the European Commission draft law, and not on various changes that have been proposed by policy makers as the final outcome of the legislative process is unclear. Likewise, the date by which the final text will be agreed upon is also unclear, but likely due some time in 2024.

The draft law does not cover the role or purpose of any certified removals, nor does it suggest any target for carbon removals at the EU level or clarify how it interacts with the existing Land Use, Land Use Change and Forestry (LULUCF) Regulation. Instead it provides definitions of carbon removals, gives indications of eligibility by deciding quality criteria for activities, and establishes basic rules for the functioning of the certification process.

In terms of definition carbon removals are understood as either the storage of atmospheric or biogenic carbon into geological or biogenic carbon pools, "long-lasting" products (with no reference to durability) and the marine environment. Regrettably, the definition of removals also includes the reduction of emissions from a biogenic carbon pool to the atmosphere. Three activity groups covering a wide range of activities are included in this definition:

1. Carbon removal with geological storage (DACCS and BECCS for example).
2. Carbon farming, which covers anything that stores carbon in soils or vegetation and also includes emissions reductions.

3. Carbon storage in products without clarity of necessary timelines or which types of products would be considered. Therefore in policy discussions a wide variety of products have been proposed by various stakeholders, including biochar, bio-fuels, bio-plastics, bio-chemicals and wooden construction elements.

To become certified, carbon removal activities need to comply with four quality criteria. The first is quantification: activities should provide a quantifiable net carbon removal benefit, i.e. more carbon removed than increased during the implementation of the activity. The use of 'increased' emissions indicates that relying on business-as-usual processes that cause high emissions (such as clear-cutting forests for biomass) would not hinder certification. To make this calculation the European Commission suggests fixing a baseline corresponding to the standard carbon removal performance of comparable activities in similar social, economic, environmental and technological circumstances within the geographical context.

The second quality criterion is additionality: activities need to demonstrate that the removal goes "beyond Union and national statutory requirements" (no clarity is given on what this means in practice) and that the activity only takes place due to the incentive effect of the certification.

The third criterion is on "long-term" storage, which those operating carbon removal activities must demonstrate to "aim" towards. There is a lack of testing on how this "aim" can be achieved, and as a result there are widespread concerns that by suggesting an aim rather than target e it will allow for low-quality removals implemented by bad actors to be certified. To ensure this is not the case, the Commission states that operators should monitor any risk of carbon release during the "monitoring period" or otherwise be subject to "appropriate liability mechanisms". Neither the monitoring period nor the appropriate liability mechanisms are defined in the CRCF proposal but are meant to be developed in separate, delegated acts to be prepared by the Commission in the future. One additional specification is made for carbon farming and carbon storage in products, in which the carbon stored should be considered released to the atmosphere at the end of the monitoring period.

The last criterion for activities to be eligible for certification under the CRCF is related to sustainability. The draft law states that a carbon removal activity must have a neutral impact on or generate co-benefits for six sustainability objectives: climate change mitigation and adaptation, sustainable use of water, circular economy, pollution prevention, protection, and restoration of biodiversity. These broad objectives are not explained in detail, and there is no indication of how they will be assessed, and with which indicators.

The proposed CRCF also gives some indication on the functioning of and actors involved in the process to certify carbon removals. However, the main details of the certification methodology and how so-called certification schemes will verify compliance with the criteria are planned to be published in future delegated acts.

In line with the suggested definition in Article 2 of the proposed CRCF, all certificated carbon removal would receive a "carbon removal unit" corresponding to one tonne of certified net carbon removal benefit generated by a carbon removal activity and registered by a certification scheme. No differentiation is proposed in terms of units, certificates or use of outcomes related to the wide ranging activity groups

included in the definition (carbon removal and geological storage, carbon farming - which includes emissions reductions, and carbon storage in products).

### *6.6.2 Assessment*

The European Commission's proposal to create a certification system for carbon removals in the EU should have been, in principle, a necessary first step to determine what actually constitutes valid carbon dioxide removals, to understand the related environmental and social impacts, and to help ensure the sustainable deployment of these methods in Europe. At the same time, an EU certification framework for removals could potentially harmonise rules among EU member states in this field while serving as a leading example for removals policy in other jurisdictions and at the international level (for example, under Article 6 of the Paris Agreement). Disappointingly, as explained by Carbon Market Watch, the European Commission's proposed Carbon Removal Certification Framework (CRCF) falls short of this potential.

First of all, the CRCF purposely stays clear of outlining the climate function of certified removals. The hierarchy of climate action, resolves that removals should be used to balance the very last, unavoidable emissions and reach net-negative emissions, yet the purpose of removals supplementing and not substituting emission reductions is not mentioned in legally binding parts of the proposed law. At the same time, the proposed certification system does not make explicit what the carbon removal units will be used for and leaves the door wide open for them to be used as offsets. The proposed CRCF does not exclude the possibility of using these units in EU compliance policy frameworks for reducing emissions, such as the EU Emission Trading System (ETS) and the Effort Sharing Regulation, or in voluntary carbon markets.

The definition confuses emissions reduction and carbon removals by lumping together a broad range of activities, including emission reduction from natural carbon sinks. It is concerning that carbon farming and carbon storage products are included in the framework but not distinguished from real removals with permanent storage, and also define what is meant by "long-lasting" is not clearly defined. Each of these stores carbon for very different durations, are difficult to monitor, run very different risks of reversals, and some will not lead to removals at all. The broad definition also ignores the very diverse effects on the climate and ecosystems of each of these methods. For example, in the case of carbon farming, there are major differences in climate impact between carbon stored in trees, soil or peatlands: this proposal ignores those differences.

Quality criteria are often not strong enough and vague. In the quantification, the Commission is unclear on how each activity actually causes "direct and indirect emissions increase". Additionality in relation to other "Union and national statutory requirements" is confusing, and failing to define the "appropriate liability mechanism" in the primary legislation potentially breaches the Treaty on the Functioning of the EU (TFEU) as "essential elements" of a legislative act must be decided by the co-legislators and not through delegated acts.

Last but not least, land or biomass-based activities, such as bioenergy with carbon capture and storage (BECCS), should aspire to provide a positive and not only neutral impact on sustainability objectives, ensuring positive environmental and biodiversity impacts beyond the status quo.

# 7 Annex 3: National and subnational case studies

## 7.1 Australia

### 7.1.1 Overview

#### 7.1.1.1 CDR targets

In Australia's current Nationally Determined Contribution, the country has pledged to achieve a 43% emission reduction below 2005 levels by 2030 and reach net zero greenhouse gas emissions by 2050. The previous government proposed a technology-led plan to realise these targets, explained in Australia's Long-Term Emissions Reduction Plan (LTS). It is mentioned that the country relies on the development of low-emission technologies, Carbon Capture and Storage (CCS) technology and renewable energy. To "close the gap towards net zero" the LTS models suggest that CDR from the land sector and offsets, could produce up to 63Mt $CO_2$-e of accredited carbon offsets from carbon farming projects each year by 2050. At the time of writing no dedicated policy framework or specific targets for carbon removals exists. Removals are mentioned interchangeably with emission reduction, which could raise concerns that a continued conflation of concepts could be used as a means to further delay emissions reductions.

#### 7.1.1.2 Offsetting measures in the land sector

The term carbon dioxide removal is not used widely in the Australian climate framework, where different governmental sources often refer to it alongside the concept of carbon sequestration. For example, the Australian Climate Change Authority defines carbon sequestration as "the storage of carbon in geological, biological, mineral and ocean reservoirs, which was captured by either 1) removing CO2 from the atmosphere, referred to as carbon dioxide removal (CDR), often referred to as negative emissions technologies (NETs); or 2) separating CO2 at point of origin and storing it to prevent it entering the atmosphere, commonly known as carbon capture and storage (CCS)", while the local government of South Australia views it as "the process of removal and storage of carbon dioxide from the atmosphere in carbon sinks (such as forests, woody plants, or soils)".

The country has had policies promoting carbon sequestration since 2011. In that year, the Carbon Farming Initiative (CFI) was established, aimed at incentivising farmers, land-owners and indigenous communities to manage their lands in a way that would increase carbon sequestration in soil or plants. In 2014, the CFI was fully integrated with the Emission Reduction Fund (ERF). The latter, today referred to as the ACCU Scheme, allows participants to earn ACCUs (Australian Carbon Credit Units), each of which represents a tonne of carbon dioxide equivalent (tCO2eq) avoided or sequestered through their activity. A number of activities can be eligible under the scheme to earn ACCUs, including in the industry sector (CCS, energy efficiency, waste treatment, transport etc.) and, in line with the former CFI, in the land sector (agriculture, fire and vegetation management). ACCUs earned by project developers can be sold to generate revenue. There are three main buyers of ACCUs. First, the Australian government, which purchases the credits through reverse auctions to comply with the country's climate commitments. Second, ACCUs are bought by Australia's largest polluters to offset their emissions and stay below the cap of 100,000 tonnes of CO2eq imposed on them by the Safeguard Mechanism. Finally, there is demand for the credits by all other private companies and individuals which voluntarily decide to purchase credits to offset their emissions.

The Clean Energy Regulator is in the process of developing an Australia Carbon Exchange to make the trading of ACCUs approved though the ACCU scheme simpler among individuals and businesses. A large share of the ACCUs are generated in carbon farming projects. Since the carbon farming initiative began in 2011 over 1,300 carbon farming projects have enrolled creating almost 80 million ACCU's.

Extensive methodologies exist for the different activities in the land sector, but common amongst them is that they are required by the Clean Energy Regulator to choose a permanence period of either 25 or 100 years. Once they have chosen a permanence period this timeline is fixed to the project and affects the number of credits received per project. In fact, the number of ACCUs received per project reflects the amount of tonnes of CO2eq net abatement[3] achieved over the reporting period, and in the case of sequestration offsets projects it is reduced by a risk of reversal buffer (currently 5%). Furthermore, if the project has a permanence period of 25 years the number is further reduced by 20%, or another percentage specified in the legislative rules applicable to the project at the start of its crediting period, to cover the potential cost to the government of replacing carbon stores after the project ends. In practice this means that a project committed to a 25-year period only receives 75% ACCU. Therefore carbon farmers committing to 100 years- earn more because they receive 95% ACCU's, only requiring them to deduct the 5% reversal buffer. Of the registered carbon farming projects about 70% committed to a 25-year permanence period whilst the remaining 30% committed to a 100-year permanence period.

#### 7.1.1.3 Recent and emerging policies

In May 2022 a new government was formed which has led to the emergence of new policy initiatives. Most significant is a reform of the Safeguard Mechanism that came into effect in July 2023, introducing declining emission baselines for different industries as an incentive for companies to lower their emissions. With this reform, an absolute cap was added on the amount of offsets that can be used to meet the Safeguard Mechanism.

Recently an Indo-Pacific offsets scheme has been announced. Partnering with neighbouring countries in the Indo-Pacific, Australia plans to develop offsetting projects that in reducing, avoiding or removing emissions would count as Australian emission reductions. Fiji and Papua New Guinea are the first countries to be involved in the scheme.

### *7.1.2 Assessment*

The Australian climate framework has been the subject of strong criticism for not putting adequate focus towards actual emission reductions. There is extensive use of offsetting -, including through very short-term carbon sequestration methods - and even more in the pipeline following the announced Indo-Pacific offsets scheme. This prevalence of offsetting mechanisms, where carbon sequestration projects are regarded as fungible with emission reductions, is likely to slow down reducing emissions at source and have a boomerang effect on the fight against climate change. Even though recent reform of the Safeguard Mechanism introduced declining emission baselines and an absolute cap for offsets, dubious carbon

[3] The net abatement is calculated by setting a baseline based on the average carbon stock before the project and subtracting the total change of carbon stock over the reporting period.

farming projects are still widespread, the definition and role of carbon removal remains vague, and there is a clear risk of mitigation deterrence.

In particular, the integrity of several methods included in the ACCU scheme has recently been questioned. The general critique is that the governance of the offset scheme is weak and that several methods are questionable as to whether they can in fact deliver "*real and additional greenhouse abatement*". On this basis questions have been raised on the eligibility of credits generated by projects due to misinterpretation of methods. Credits have been allocated to forest regeneration projects that have not occurred, as well as for regeneration that would have occurred anyway due to natural events. Furthermore, credits have been allocated to land owners for agreeing not to clear forests, many of which may not have been cleared to begin with. The same critics hold concerns with methodologies covering plantations and measured soil carbon and are calling for an integrity evaluation.

In addition to these critiques, another key and detrimental shortcoming is that there is no official definition of what it means to remove carbon, and that existing definitions of carbon sequestration are inconsistent and do not address the necessity of permanence.

Finally, the ACCUs risk of reversal buffer set at 5% is too low and puts project participants in a precarious situation in the event of a natural disturbance such as flooding, wildfires, drought, disease etc. If such an event occurs emission removals will ultimately fail to deliver their intended climate benefits and project participants can be made to pay back revenues from their participation. The minor difference in the amount of ACCUs received between 25 or 100 year based projects is also highly problematic because it incentivises carbon sequestration with much shorter-term timeframes.

## *7.2 California*

### *7.2.1 Overview*

#### 7.2.1.1 CDR targets

The State of California has a carbon neutrality target enshrined into law by the California Climate Crisis Act (Assembly Bill 1279) adopted in September 2022. The law requires the state to achieve net zero greenhouse gas emissions as soon as possible, but no later than 2045, and achieve and maintain net negative greenhouse gas emissions after that. Specifically, California has to reduce greenhouse gas emissions to at least 85% below 1990 levels by 2045, leaving up to 15% of emissions to be addressed through carbon dioxide removal solutions and carbon capture, utilisation and storage technologies.

The 2022 Scoping Plan for Achieving Carbon Neutrality prepared by the California Air Resources Board (CARB) - the state agency responsible for monitoring and regulating greenhouse gas emissions - explains in a legally non-binding text the government's carbon removal and sequestration strategies. In its definitions, CARB makes an effort to distinguish between Carbon Capture and Storage (CCS) from a facility - necessary to reach the 85% reduction target, which mainly addresses emissions from electricity generation, cement production and refineries - and Carbon Dioxide Removal (CDR) from ambient air, which is necessary to address residual emissions and reach carbon neutrality.

However, CARB is less clear when considering targets, as they mention a grouped "removal and capture" target of 100 million tonnes in 2045. This is clarified later in the text when the strategy states it aims to

deliver 7 million tonnes of CO2eq in 2030 from CDR, including DACCS, BECCS and "Natural and Working Lands" (NWL), which can ensure both long-term storage and an overall net increase in carbon stocks over time, i.e. California's urban forests and grasslands. However, there are no specific durability or permanence requirements in the plan, and from using these solutions the removal target increases to 75 million tonnes of CO2eq by 2045. Sequestration from urban forests is estimated to reach an average of 1.5 million tonnes per year between 2025 and 2045.

In parallel, the government recommends climate-smart actions on all NWLs, which should be prioritised to decrease emissions and support healthy and resilient lands. However, NWL management alone is not estimated to be a significant carbon removal path in the near term. On the other hand, the "mechanical" CDR is considered an opportunity to remove legacy GHG emissions from the atmosphere.

#### 7.2.1.2 CDR inclusion in market-based policies for emissions reduction

California includes removals from the forestry sector in its Cap-and-Trade Program through its Compliance Offset Program, although most of the credits are generated by avoided harvests. Launched in 2013, the Californian Cap-and-Trade establishes a declining cap on approximately 80% of the State GHG emissions, covering electricity generators, large industrial facilities, and distributors of transportation, natural gas, and other fuels. Entities covered by the programme can use compliance offset credits based on projects that represent verified greenhouse gas emissions reductions or removal enhancements (including from the forestry and urban forestry sectors) to satisfy a percentage of their overall compliance obligation: that is 8% of their compliance obligation for emissions through 2020; 4% for emissions from 2021-2025; and 6% for emissions from 2026-2030. From 2021, a minimum of half of the offsets used for compliance by each covered entity must be sourced from projects that provide direct environmental benefit in the state. The revenues of the Cap-and-Trade are channelled into the Greenhouse Gas Reduction Fund and then into California's climate investments, to fund, among others, projects focused on increasing soil organic carbon in wetlands and watershed, improving carbon sequestration in agricultural soils and stabilising carbon storage in forests.

The environmental integrity of the program is, however, insecure. According to a peer-reviewed and corroborated[4] analysis by Californian non-profit organisation CarbonPlan published in April 2021, a large percentage of the credits in the program do not reflect real climate benefits. Of the 102 million credits analysed (corresponding to two-thirds of all forest offsets and approximately one-half of California's entire offsets program), 29% of the offsets were over-credited. In addition, the credits set aside to cover carbon losses from wildfire, known as the buffer pool, are likely to have been fully depleted by the 2020 and 2021 wildfire seasons losses, according to CarbonPlan. In addition, while California law requires all carbon offsets to be "permanent", it does not define this term, which CARB interprets as requiring a minimum storage duration of 100 years.

[4] For further information, please see: https://onlinelibrary.wiley.com/doi/10.1111/gcb.15943; https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.16380; https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/eap.2817; https://www.frontiersin.org/articles/10.3389/ffgc.2023.958879/full.

Similarly, the Low Carbon Fuel Standard (LCFS) amended in 2018, allows certain types of CDR projects to generate credits that support compliance with carbon intensity benchmarks on transport fuels. Provided they meet the requirements specified in the CCS Protocol - including storing the CO2 for at least 100 years (which CARB defines as permanence) and delivering net greenhouse gas emissions reduction after accounting for all emissions associated with the capture, storage and land use change of the project - developers of Direct Air Capture (DAC) which either store it in a dedicated geological site or for use in enhanced oil recovery and other CCS applications' (e.g. ethanol production with CCS) projects can sell credits to fuel providers who need to meet their yearly carbon intensity reduction obligations. According to Global CCS Institute, in the case of DAC, projects located anywhere in the world can generate credits by opting into the LCFS. As for ethanol production with CCS, projects can also be situated globally but credits can only be claimed for the proportion of transport fuel sold into the Californian market. To ensure the environmental integrity of the LCFS, projects seeking to generate credits under the programme must contribute a percentage of their credits to the Buffer Account reserve, to be used should CO2 leakage occur. However, It is important to note that while the LCFS generally uses lifecycle assessment to credit net climate benefits it does not consider where the carbon ends up. This means that the protocol gives the same amount of credits to a project that injects CO2 into a saline aquifer as one that injects it into an oil and gas field for oil and gas production. At the time of writing only out-of-state projects, which can be credited under the LCFS, can still inject into oil and gas wells for enhanced oil recovery.

#### 7.2.1.3 Proposal for a CDR-dedicated market

In May 2023, the California Senate passed a bill proposed by Senator Becker called the Carbon Dioxide Removal Market Development Act, which is now currently being considered in the California Assembly. If approved by both bodies, the law would demand by 2027 for CARB to adopt a regulation requiring companies subject to the California cap-and-trade system, those emitting 25,000Mt mt of greenhouse gases or more per year, to purchase negative emissions credits equal to a specified quantity that is relative to of their emissions. This percentage would be 1% in 2030, 8% in 2035, 35% in 2040, and 100% in 2045. Purchased credits should be based on "durable" removals (i.e., with an expected storage time frame of at least 1,000 years and a project guarantee of at least 100 years) or temporary (i.e. anything below 1,000 years) if combined with a legally binding commitment to replace it with a permanent solution. However, credits purchased by a company using this "two-phase" approach may not exceed 50%. Also by 2027, the bill requires CARB to establish rules and processes for certifying carbon removal processes that may be used to create negative emissions credits. The text states that negative emissions resulting from the use of these credits should be included in the calculation of the state's net emissions, even if the removals happened elsewhere in the world. This raises the potential for double-counting where the same tonne of CO2 removed might be accounted for in different jurisdictions.

### *7.2.2 Assessment*

By identifying the climate function of carbon dioxide removals as only supplementing emissions reduction and by implementing a 2045 target, California has set a high standard for robust CDR policy. However, the State has no official CDR policy, and existing CDR targets are part of a non-binding planning document, which does not model the cost or energy use associated with CDR. Rather than a distinct definition and target for CDR and CCS, the CARB plan collectively confuses and conflates them as "carbon removal and sequestration". The CARB interpretation of permanence is also unambitious, referring only to 100 years.

Also, while the LCFS provides some basis for a removals certification system for removals through its CCS Protocol, it ignores enhanced oil recovery and is only open to underground CO2 storage, meaning it can't be used for processes other than DACS/BECCS.

The inclusion of both nature-based carbon sequestration in the cap-and-trade system and technological CDR in the LCFS allows removals to be used for offsetting (even non-permanent in the case of the cap-and-trade), and is controversial for several reasons. Firstly, such an approach risks suggesting an equivalence between emissions with permanent atmospheric consequences and temporary storage of carbon, whilst not effectively preventing reversals. Secondly, it causes mitigation deterrence, giving polluters the possibility to compensate for their continued emissions instead of reducing them. Thirdly, at present high-quality removals are at present a scarce resource, and using them to comply with emissions reduction targets risks undermining the state's removals targets in the long run.

On a more positive note, Senator Becker's proposal for a CDR market is a step in the right direction requiring private polluting companies to buy removals that contribute towards the state's climate targets, on top of their commitments under the California cap-and-trade system. Although the proposal raises the possibility of double-counting outside of California, it does a good job of separating CDR procurement from CO2 mitigation. The proposal sets a predictable path for CDR purchasing and for the establishment of a robust certification system for removals. The idea of a two-phase approach to redress the lack of permanent removals in the short term is interesting. However, while setting a high bar with meaningful requirements for the permanence of storage, the possibility for covered companies to initially use temporary removals credits as a way to comply with part of their obligations could introduce a dangerous loophole especially on the issue of liability. While positive this proposal is not yet law and the risks of it not being adopted or being severely watered down are high.

## *7.3 Denmark*

### *7.3.1 Overview*

#### 7.3.1.1 CDR targets

In 2020, Denmark adopted a climate act with the purpose of reducing Denmark's greenhouse gas emissions by net-70% in 2030 compared to 1990 and reaching climate neutrality by 2050. The national strategies that have followed since suggest that these emission reductions will be largely met through use of various technological means. Power-to-X (PtX) and CCS are in this regard expected to account for 41,5-72,1% of the emission reduction. Measures that result in negative emissions will be accounted as emission reductions to meet climate targets, under the argument that negative emissions will soon be recognised internationally (implicitly meaning recognised as an emission reduction) due to the IPCC underlining the necessity of negative emissions. This is a fundamentally flawed argument that undermines the effective use of limited removals as a supplement to emission reductions.

Each year the government must present a National Climate Programme, and assess the status of national development towards reaching the goals of the Climate Act. The assessment of the National Climate Programme in 2022 included three negative emissions initiatives: negative emission through carbon capture and storage (NECCS), biochar and afforestation.

A key EU-level demand of the current Danish government is the inclusion of CDR in the EU ETS - which would lead to mitigation deterrence and implementation of a false equivalency between emissions and removals.

#### 7.3.1.2 Negative emission through carbon capture and storage (NECCS)

Shortly after adopting the climate act in 2020 the Danish government signalled support for the development and implementation of CCS through a "Climate Agreement for Energy and Industry",, the specific details of which will be elaborated in a CCS strategy at a later date. The CCS strategy aims to reduce fossil emissions, create negative emissions when capturing biogenic CO2 or to utilise the captured CO2.

CCS, CCU and NECCS are expected to account for at least 17% of the national emission reduction by 2030. The Danish government has budgeted approximately DKK40 billion (€5.37 billion) until 2030 to promote the development of CCS, NECCS and CCU, including the establishment of an integrated value chain for the capture, transport and storage of CO2. A part of the CCS strategy aims specifically at delivering negative emissions under a relatively small NECCS pool: from 2021 only DKK2.6 billion (€349 million) was apportioned to CDR. The NECCS pool is supposed to deliver 0.5 mio/t CO2e of removals per year from 2025 until 2033. The remaining €5 billion is distributed between a CCUS pool and a CCS pool.

The CCUS pool amounts to DKK16.6 billion (€2.2 billion) and aims to produce 0.4 mio/ton CO2e emission reductions or removals per year from 2025 and 0.9 mio/t CO2e per year from 2030. The CCS pool amounts DKK19.5 billion (€2.6 billion) envisioning emission reduction of at least 0,5 mio/t CO2e per year from 2030.

Both the CCUS and the CCS pools are tendered to projects that can deliver cost-effective greenhouse gas reductions and can contribute to the realisation of the national climate goal. The pools are market-based and therefore CDR projects as well as CCS projects can be selected. The first project under the CCUS pool has recently been allocated to a BECCS project by Danish energy company Ørsted. NECCS funding on the other hand focuses on establishing value chains for negative emissions from biogenic emitters and is only set to operate with a support period of 8 years, with the intention of ensuring that the cheapest biogenic sources is not committed to storage purposes long-term, but can be utilised. This could be troublesome for the development of CDR in Denmark, and suggests that the real ambition for Danish carbon capture is to utilise the carbon in their PtX strategy.

#### 7.3.1.3 Biochar measures

As part of Denmark's effort to reduce GHG emissions in the agricultural sector, the government budgeted DKK396 million (€53.2 million) from the EU Just Transition Fund to the development of 'brown biorefineries' - a term that mainly covers pyrolysis, a thermal process where biomass is converted to biochar and an intermediate liquid or gas that can be refined. The biochar produced in the brown biorefineries can be added to farm soils where it is suggested to have a beneficial effect for the soil as well as to store CO2, with the latter enabling it to be categorised as a removal. The aim of developing brown biorefineries is to reduce GHG emissions of the agricultural sector without reducing production, and is envisioned to "compensate" 2 mio/ton CO2e per year in 2030 through biochar storage - the largest amount of emission reductions in the agricultural sector.

#### 7.3.1.4 Afforestation measures

Afforestation is the final policy Denmark is pursuing that includes negative emissions. This is part of Denmark's effort to offset GHG emissions in the agricultural sector, which is possible due to a flexibility mechanism under the ESR allowing Denmark to make use of LULUCF credits in order to meet ESR targets (see ESR section).

As part of the agreement to transition the agricultural sector, from 2021, the government has budgeted DKK613 million (€82.2 million) for afforestation. The forests are expected to be raised by private owners of agricultural land, i.e. farmers, companies, foundations or associations that can apply for money for afforestation. This is estimated to create negative emissions of 0.2 mio/ton CO2e in 2030[5].

### *7.3.2 Assessment*

Denmark is developing a dangerous policy framework that is confusing emissions reductions and carbon removals. Significant amounts of national emission reductions are to be met through either a reliance on technological innovation or replaced by carbon removals. The legislative actions that support the national CCS strategy, and thus the national CDR strategy, are biased to favour CCU due to efforts to align the CCS strategy with the PtX strategy[6]. The NECCS pool is only set to operate with a support period of 8 years, which suggests a weak conceptual definition and accounting practice of negative emissions, and no real strategy for actual CDR.

A progressive effect of the CCS strategy can be noticed in resulting legislative actions. In 2022 Denmark took the first steps to realise its national CCS strategy by legalising injection of CO2 into the underground. At the same time the Minister of Climate, Energy and Supply was granted authority to make agreements with other countries on the export/import of CO2 with the purpose of storage under the seabed, as geological circumstances in Denmark are favourable for storing CO2 unlike many neighbouring countries. This legislation can pave the road for cooperation on carbon removals and shared responsibility of storage.

A major shortcoming of measures to support the biochar initiative is that there is no actual plan or strategy to realise the potential of brown biorefineries, or a clear idea of where the biochar will end up. However, despite hopeful rhetoric on biochar, it is in fact still uncertain how permanent different fractions of biochar really are and what the long-term effects might entail

Furthermore biochar is defined as both an emission reduction and as a carbon removal adding to previously explained shortcomings of there being a lack of a conceptual definition and accounting practice for negative emissions. Furthermore, the estimation of -2 mio/ton of CO2 removed annually is highly uncertain according to a report published by The Danish Energy Agency on technical emission reduction potentials.

[5] Besides this, the new government from December 2022 has also announced that it would present a forest plan during 2023 with a goal of establishing 250,000 hectares of new forest in Denmark.

[6] Carbon is a necessary component in many PtX products

Finally, the ambition to increase afforestation can have a positive ecological impact. However, shortcomings mentioned in the above-mentioned cases persist where negative emissions and emission reductions are not clearly separated and short term sequestration in the land sink may be used to counterbalance fossil emissions.

## *7.4 Finland*

### *7.4.1 Overview*

#### 7.4.1.1 CDR targets

In July 2022 Finland amended its Climate Change Act to introduce a legally binding carbon neutral target by 2035 and to consider sinks from the LULUCF sector. In addition to this, the country set emission reduction targets relative to 1990 to -60% by 2030, -80% by 2040 and -90% (but aiming for -95%) by 2050. Whilst there are no specific targets for CDR the gap between the emission reduction targets and the 2035 carbon neutral goal indicates that a role is imagined for removals to balance residual emissions. The Climate Act suggests that these removals will be nature-based, as it calls for strengthening carbon sinks in the LULUCF sector. Finland's focus on carbon sinks must be understood in the context that more than 75% of Finland's land area is covered by forests, making Finland the most forested country in Europe in relative terms. A high-level demand of Finland's current government regarding carbon removals, outlined during a meeting of EU environment ministers on the Carbon Removals Certification Framework (CRCF), is to acknowledge the role of carbon farming in both removing carbon and reducing emissions in the land sector.[7] These demands align closely with both the National Energy and Climate Plan (NECP) and the National Strategy towards 2035 of Finland, where emission reductions and negative emissions reached through land-use activities are indicated as pathways to a successful outcome for the climate policy. Besides the strong focus on nature based removals in the LULUCF sector, which have decreased to almost zero in recent years, the new government has stated in their government Programme that from June 2023 that they also plan to promote "technological sinks" in Finland, and that they will already set a target for their use already during this decade.

#### 7.4.1.2 Measures to enhance removals in the land use sector

The Climate Plan for the Land Use Sector, adopted by the government in July 2022, specifies how the land use sector can contribute to Finland's carbon neutrality target by 2035. A government report presents various measures that aim to promote climate resilience in land use, forestry and agriculture, to reduce emissions and to strengthen removals by carbon sinks. These are planned to be implemented through a wide variety of new or existing policy instruments, including under the EU's Common Agricultural Policy and deforestation legislation, national legislation and subsidies programmes, and market-based instruments. Many of the measures are aimed at preventing deforestation (for example, through land use guidance and planning, a land use change fee or an authorisation requirement for clearing), supporting afforestation (by introducing economic incentives for the afforestation of wasteland, low-yield fields and

[7] This is based on Carbon Market Watch's interpretation of the Finnish Minister for the Environment's intervention during the EU ENVI Council meeting of 16 March 2023, available at *https://video.consilium.europa.eu/event/en/26709* at 11:29:20

shallow peatland fields), peatland restoration and carbon sequestration and carbon stocks in fields through carbon farming practices. In addition, the emergence of voluntary carbon markets related to carbon sequestration and storage and the reduction of emissions in the land use sector and agriculture is also promoted, with the objective to develop rules and prepare pilot projects for carbon markets in the period 2022-2024.

In the period 2025-2027, the government also intends to continue the Catch the Carbon research and innovation programme, originally planned for the years 2021-2024 to investigate the impact of climate actions in the land use sector. Particular attention will be given to promoting emissions reduction, carbon sequestration and storage, climate change adaptation and the development of carbon markets in the land use sector. In addition, funded projects will also focus on strengthening biodiversity, water resource management, economic, social and regional sustainability, and food supply. Finally, the Plan also aims to promote carbon stocks in long-lived wood products. This will be done by encouraging increased use of wood products in construction (such as infrastructure, tourism, agriculture, structures related to outdoor activities, and repair), furniture and surface materials while, in parallel, continuing to develop and promote tools that assess the amount of carbon sequestered and the carbon footprint of those products.

The total net climate impact (i.e. the net increase in carbon sinks, considering both emissions reduction and carbon sequestrations) of the additional measures included in the Climate Plan for the Land Use Sector is projected to be only about 2 million tonnes of CO2eq annually by 2030 and a little over 3 million tonnes annually by 2035. The overall carbon sink from the LULUCF sector is forecasted to be between 18 million tonnes of CO2eq (baseline scenario) to 23.7 million tonnes (with additional measures) in 2035. Feedback received from a public consultation on the plan suggests that the 3 million tonnes target of net impact should be more ambitious, particularly due to uncertainty factors in land use carbon sequestration. However, in recent years the LULUCF sink has decreased heavily, collapsing to almost zero due to increased harvests and reduced forest growth rates. This underscores the need for additional measures if Finland is to reach net zero emissions by 2035. The government of former Prime Minister Sanna Marin acknowledged in its Climate Plan for the Land Use Sector that assessing emissions and removals in the land use sector is particularly difficult, reporting a great degree of uncertainty over soil information. For example, it stated that because carbon dioxide stored in land sinks can be released "fairly quickly" into the atmosphere due to anthropogenic or natural causes this causes uncertainty over the permanence of land sinks and their ability to achieve climate objectives. For this reason, the Plan found it important to preserve and increase ecosystems' long-term carbon stocks, such as peat in mires. The document also warns about the possible saturation of the land sink, which could at some stage lead to net emissions.

Moreover, according to the government funded HIISI study (2022) on the measures and impacts of the Finnish climate and energy policies, the target of strengthening the carbon sink of the land use sector by 3 million tonnes has at least some overlap with the emissions reduction target of 29% in agriculture, as it is also largely concerned with land and field use. The measures in the Plan, as assessed in the 'Environmental report of the Climate Plan for the Land Use Sector' found to have more positive than negative impacts on both the environment and people, with the greatest negative impacts associated to the utilisation of natural resources. The measures with the most negative potential environmental impacts were the nitrogen fertilisation of coniferous forests and usage of long-lived wood products. However, It

is important to note that the results of the mentioned study could be outdated due to the dramatic change in LULUCF sink in 2021.

In a paragraph related to the EU's CRCF proposal, the government's report states that the EU certification framework "must include a sound and reliable definition of carbon removals providing guarantees in terms of environmental integrity". In addition, the CRCF should ensure that identified solutions "unambiguously remove carbon from the atmosphere in a sustainable manner".

#### 7.4.1.3 The role of technological removals

The national energy and climate strategy for 2035 only mentions Bioenergy with Carbon Capture and Storage (BECCS) as a possible way to significantly lower industrial emissions. Similarly, Direct Air Capture (DAC) is referred to theoretically as a possible future option to capture CO2 for the production of e-fuels. No reference is made to either technology as a solution for carbon dioxide removals. The government appears much more interested in Carbon Capture and Storage (CCS) at the point source in industrial facilities and for Carbon Capture and Utilisation (CCU). However, this might all change with the programme of the newly elected government (June 2023) stating that they intend to set a significant target for the use of technological sinks during the 2020s, and that they will introduce a reverse auction of negative emissions or a similar mechanism to encourage the capture of carbon dioxide. The programme suggests that a market-based measure such as a voluntary carbon sequestration market should be used to fund the mechanism.

### *7.4.2 Assessment*

Overall, Finnish CDR-related policies have mainly been related to the LULUCF sector, and are articulated as measures to increase Finland's carbon sinks. This approach is in line with what was expressed by the Finnish Environment Minister during an EU Council meeting in March 2023 regarding the need to include carbon farming with emission reduction in the land use sector in the EU Carbon Removal Certification Framework. The measures have the potential to increase natural carbon stocks in Finland and improve ecological conditions. The government believes that by combining these measures with their emissions reduction target of -80% by 2040 and -90% to -95% by 2050 Finland will achieve its national target of carbon neutrality by 2035 while reducing reliance on removals to meet future climate goals.

However, the absence of a clear distinction between emissions reduction and carbon removals, especially in the land use and agriculture sector, may cause mitigation deterrence. Moreover, beyond land-based sequestration, a proper definition of carbon dioxide removals and related impacts and benefits is not provided. That said, Finland may be in the process of redeveloping their approach as the newly elected Petteri Orpo government (June 2023) may increasingly focus on technical solutions, such as BECCS.

It is also not clear whether a separate type of monitoring, report and verification system is to be implemented by the government for carbon sequestration in the land use sector. Until now, the removals are only reported according to UNFCCC inventory rules. This is particularly worrying as their land-use management approach raises concerns related to permanence and additionality if the removals are to balance residual emissions. The permanence concern is especially relevant when considering the recent

development of the GHG emission balance of the LULUCF sector in Finland where the sinks have collapsed to close to zero due to increased harvests and reduced forest growth rates. The Climate Plan for the Land Use Sector also includes carbon storage in wooden products as a removal which is problematic because it is very difficult to monitor the carbon storage medium, and by extension, its permanence.

Additionality is another concern because it is difficult to measure actual additional sequestration in the land-based sector. It must also be highlighted that feedback received by the government in a public consultation on the Climate Plan for the Land Use Sector warns against the fact that the additionality of the measures was unclear and overlaps with other policy instruments, including the CAP plan.

According to a report by the Finnish research institute VTT, the Finnish Environment Institute and Tyrsky Consulting, Finland requires a separate strategy for carbon dioxide use and removals, recognising CDR targets in the Climate Act and establishing a stakeholders roundtable on the topic. Stronger national guidance, a clearer regulatory environment and measures to ensure sustainability are especially needed for solutions to be deployed. The Finnish approach to the land use sector also brought together Greenpeace and the Finnish Union for the Conservation of Nature to file Finland's first climate case in November 2022. In particular, the applicants argue that the government has not adopted sufficiently robust additional measures in response to the dramatic collapse of Finland's forest carbon sink, putting in jeopardy the achievement of the country's 2035 carbon neutrality target.

## *7.5 France*

### *7.5.1 Overview*

#### 7.5.1.1 CDR targets

France has a carbon neutrality target enshrined in the Energy and Climate law of 8 November 2019. By 2050, the country must balance anthropogenic emissions with removals of greenhouse gases, without relying upon offsetting with international credits. The French climate law requires the country to reach at least 83.3% emission reductions by the middle of this century - implicitly leaving space for removals to bridge the gap between those 83.3% emission reductions and climate neutrality. It also mentions the contribution of bio-sourced materials and the preservation of natural resources to store carbon.

The National Low Carbon Strategy (*Stratégie National Bas-Carbone*) of March 2020 relies on "carbon sinks" (defined as the capacity of the territory to store carbon in the forest, in soils, in wood products or via industrial processes) to achieve the net zero emissions goal by 2050, specifically to compensate for so-called "irreducible" emissions. The strategy defines "anthropogenic removals" as the quantities of greenhouse gases absorbed in natural environments managed by man (forests, grasslands, agricultural soils, wetlands, etc.) and some industrial processes (carbon capture and storage or reuse). With this definition, the strategy blends the concepts of carbon removals, carbon storage (sinks) and avoided emissions (CCU and CCS). There are three types of carbon sinks identified: human-managed ecosystems (forests, farmland, etc.); products and materials from the bio-economy based on plant matter (wood, straw, etc.) and carbon capture and use or storage of carbon (CCU and CCS) from industrial processes.

The three sinks have different roles according to the strategy's scenario. In fact, the estimated total sink in the land sector (forest and agricultural land) at "optimal and sustainable performance", when added to

an estimated capture and storage sink (which we interpret in this example to mean carbon capture and storage from industrial facilities), would only allow the balancing of residual non-energy emissions and the residual emissions from fossil fuels retained for part of the transport sector.

Biomass combustion's contribution with carbon capture and storage (BECCS) is estimated to generate about 10MtCO2 of negative emissions per year for France. The strategy also finds that in addition to storage, use (or reuse) processes for captured CO2 could act as a "lever for mitigation". The role of capturing CO2 directly from the atmosphere is also recognised, with the admission however that the technology is at a primitive development stage. Finally, the strategy addresses the issue of the geological CO2 storage potential of France and declares storage at sea more feasible. A government decree of April 2020 formally adopted the Low Carbon Strategy and sets legally binding annual carbon greenhouse gas emissions budgets for three periods from 2019 to 2033 (2019-2023, 2024-2028, 2029-2033) that also cover removals in the LULUCF sector. The French National Common Agricultural Policy Strategic Plan suggests using the land sector to store CO2. The country aims to commit approximately 26% of its utilised agricultural area to store carbon in soils and biomass from 2023 onwards, covering a variety of practices (such as agroforestry, crop rotation, direct seeding and soil cover) and types of land (woody landscape features, arable land, permanent grassland, permanent crops). While likely targeting a significant land area, no indication is included in the Plan regarding its corresponding carbon sequestration potential.

#### 7.5.1.2 Label Bas-Carbone

France has also been one of the first countries in the EU to establish a national certification framework to incentivise land-based carbon sequestration. The framework, called Label Bas-Carbone ("Low-Carbon Label"), was created by the French Ministry for Ecological Transition in 2019 to achieve the objectives of the Low-Carbon Strategy. It certifies national projects that are able to reduce emissions, either by avoiding them through changing practices in sectors such as buildings, transport waste and agriculture or by improving carbon sequestration in forests and soils. Currently, 55% of the projects belong to the agricultural sector. The framework has been criticised as a possible greenwashing tool allowing private companies to claim carbon neutrality while financing projects that have a negative impact on the environment or cause an increase in greenhouse gas emissions.

First, according to RAC France, those who fund emissions reduction or carbon sequestration projects under the certification framework in exchange for carbon credits (hereby "funders") can use those credits to offset their emissions without an obligation to adopt a credible decarbonisation strategy that complies with the Paris Agreement 1.5 target. In addition, the label does not distinguish between emissions reduction and carbon sequestration in the land sink.

A lack of rigour has been found in certifying project methodologies, with a reliable verification framework often missing. For instance, only three methods require actual field checks while the "Field Crop" method has surrendered its initial plan for evaluation based on soil samples and now uses a modelling tool based on declared data. Moreover, some methods approved by the French Ministry of Ecological Transition and used to certify agricultural practices under the label are deemed to be based on distorted indicators, which lead to the promotion of production intensification practices. For example, the carbon intensity metric "CARBON AGRI", counting the amount of greenhouse gases per production volume (i.e. teqCO2 per litre of milk rather than teqCO2 per hectare), makes it possible to certify projects optimising their emissions

linked to the production without necessarily reducing the total quantities of greenhouse gases emitted, thus favouring the most intensive farms. At the same time, the label does not make it binding to take into account any environmental, biodiversity or animal welfare considerations.

Furthermore, the agricultural methods used under the label make it possible to certify projects where emissions are increasing, as emissions are considered reduced as soon as they decrease compared to the business-as-usual scenario. Also, the methods used to measure emissions reduction and carbon sequestration ("CARBON AGRI", "Field Crop" and "Orchard Planting") allow for projects to compensate for their emissions through carbon sequestrations and be certified as having reduced their net emissions.

Last but not least, the label does not seem to be very farmer- (especially small-scale, already implementing good practices) friendly. This is because the label not only rewards the optimised but most intensive practices, it also better supports those farmers who have a lot of progress to make in reducing their carbon footprint, at the expense of early adopters who had already implemented environmental or biodiversity-friendly practices. Similarly, the complicated functioning of the framework makes it difficult for project owners not to depend on intermediaries, which, by the end of the process, may only earn up to 40% of the total value of the practice-based carbon credit sold to the funders.

#### 7.5.1.3 Assessment

While both the French climate law and the national low carbon strategy allude to the contribution of the country's carbon sinks to reach climate neutrality and negative emissions, France does not seem to have a structured and long-term vision on carbon removals. On the contrary, the concept of CDR itself is not well defined and removals are interpreted as the absorption of greenhouse gas emissions by human-managed carbon sinks. As a consequence, the policy and the legislation currently in place do not elaborate on the requirements, implications and impacts of different removal (and non-removal) solutions with different storage timeframes (e.g. removals in the LULUCF sector, carbon storage in wood products, DACCS and BECCS). The only distinction is made for BECCS, which the French policy framework seems to recognise as the sole technology capable of leading the country towards negative emissions. However, no consideration is made of the possible environmental and social impacts of BECCS, besides the recognition of the "uncertainty regarding the availability and reliability" of these technologies, which makes it necessary to develop them "with caution and incrementally". The role of DACCS is shortly acknowledged, without a real plan to back their deployment.

To make matters even worse, the French climate framework does not provide a credible firewall between carbon removals and emissions reduced/avoided. One can sense this is already lacking in the national strategy, where Carbon Capture and Use (CCU) is addressed in the same section as Carbon Capture and Storage (CCS) and is recognised as having an important mitigation role despite potentially only delaying emissions. But this confusion between emissions reduction and removals in the French approach is more evident in the Label Bas-Carbone, originally introduced by the Ministry for Ecological Transition to reduce emissions, not to support removals. Although the country is one of the few EU member states establishing a system to certify carbon sequestration in the land sector, the label is not designed to respect strong quality criteria and does not provide thorough definitions of removal activities. It is also aimed at creating

credits to be used for offsetting emissions that otherwise could have been abated, ensuring that any credit created will undermine emission reductions efforts.

## *7.6 Germany*

### *7.6.1 A. Overview*

#### 7.6.1.1 CDR targets

The CDR policy space is rapidly changing in Germany, moving away from a strong reluctance when the German climate policy framework (The Federal Climate Change Act) was developed in 2019 to current efforts to redevelop its position on CDR. The long-term goal back in 2019 was to reach greenhouse gas neutrality by 2050, and removals were not explicitly included in the law. Widespread caution existed at the time that CDR would obstruct mitigation attempts and lower overall climate ambitions. Political discussions have since been evolving swiftly and under a revision of the Climate Change Act in 2021 Germany shifted their long-term goal to reach greenhouse gas neutrality by 2045 and a net-negative emissions balance by 2050. In 2022, the German government submitted a new long-term strategy to the United Nations Framework Convention on Climate Change (UNFCCC) which highlights that negative emissions are necessary for the climate targets to be achieved as a complement to and not substitute for emissions reductions.

The long-term strategy also stipulates that "technical negative emissions will be necessary to offset unavoidable residual emissions". The revised climate change act increased emission reduction ambitions, setting milestones of a minimum 65% CO2 reductions by 2030 and a minimum 88% CO2 reductions by 2040. Alongside this, separate nature-based removal targets were also included, and the German government has started the process of establishing a carbon management strategy in parallel with a long-term strategy on how to deal with residual emissions.

In June 2023, the German government proposed to revise the Climate Change Act. As part of this revision, the government suggested introducing removal targets for technical negative emissions by 2035, 2040 and 2045 (such as direct air capture and carbon storage – DACCS).

#### 7.6.1.2 Measures to enhance removals in the land use sector

The nature-based removal targets included in the revised climate action law in 2021 require at least -40Mt CO2eq to be sequestrated annually by 2045 with milestones of at least -25Mt CO2eq by 2030 and at least -35Mt CO2eq by 2040. It is important to note that these are separate from the emission reduction targets, but represent the minimum contribution of LULUCF removals required for Germany to attain climate neutrality. This means there is no cap to the contribution of LULUCF removals, unlike in the EU climate neutrality target. Should Germany exceed its LULUCF target, its emission reduction target may be watered down, effectively deterring emission cuts.

In March 2023 the government presented a Federal Action Plan on Nature-based Solutions for Climate and Biodiversity ring-fencing €4 billion until 2026 to initiate projects that help reach the sequestration targets. The plan funds an array of projects in different fields including afforestation and peatland and soil restoration.

40Mt will only account for about 3% of the emissions from 1990, whilst modelling studies investigating decarbonisation pathways for Germany suggest that at least 5% removals are needed to eliminate unavoidable residual emissions. This suggests that additional measures must be taken for Germany to make The Climate Change Act a reality.

#### 7.6.1.3 Strategies for managing carbon and residual emissions

These additional measures may be included in the Carbon Management Strategy that is due to be presented later in 2023, in which the government is expected to realign their official stance on technical removals as well as CCS. The government has expressed willingness to update laws on the geologic storage of $CO_2$, which is currently forbidden in Germany. In a June 2023 draft revision of the Climate Change Act, it is suggested that technological storage targets be set with the possibility of including the quantities at a later date once capacity is assessed.

The carbon management strategy will most probably focus on CCS and CCU. A second strategy, specifically on negative emissions, is also being prepared and is expected to be ready in 2024 though very little information is currently available.

As it stands, the German government has only set up research funding for CDR.

### *7.6.2 Assessment*

The development of Germany's climate framework with the inclusion of a net-zero target and removal goals has reoriented Germany's position on CDR. Germany is one of the few countries assessed in this paper that has set separate targets for emission reductions and emission removals, with milestone goals for removals in 2030 and 2040. Currently, only nature-based removals are included in the climate framework, but a revision of the Climate Change Act is anticipated, in which elevated removal targets are expected. These might be addressed in the Carbon Management Strategy or the second long-term strategy for negative emissions that is being developed at the time of writing. Although not yet published, including milestone goals for removals in the proposals would break new ground in CDR policymaking and could serve as inspiration to legislators across the EU.

Fixed and separated targets for nature-based CDR alongside targets with milestone goals for technological CDR would not only provide measurable indicators of progress but also provide transparency on the amount of residual emissions that can be tolerated in reaching a net-zero trajectory. For investors, fixed targets would offer a reliable indication of future development and reduce investment risks.

Germany’s carbon management strategy risks strengthening a narrative that mixes the concepts of CCS, CCU and CDR together, as the term ‘carbon management’ is increasingly being used to lump these three distinct terms together with insufficient differentiation between them. While CCS and CCU may have a role to play in a net-zero strategy it is important that separate and ambitious targets are set for technological CDR to counterbalance residual emissions, and so that CCS/CCU and CDR are not conflated and confused.

## *7.7 New Zealand*

### *7.7.1 Overview*

#### 7.7.1.1 a. Carbon removal targets

New Zealand has set a net-zero emissions target by 2050, with an intermediate target to reduce net greenhouse gas emissions to 50% below gross 2005 levels by 2030. In gross emissions terms, this equates to a 22% decrease as the 2030 target includes removals ('net) while the 2005 baseline does not ('gross'). To reach this target, 149Mt CO2e abatement or sequestration will be needed for the period 2021-2030 according to the updated NDC from 2021. No concrete CDR targets have yet been proposed. The main policies to enable these carbon removals are through the New Zealand Emission Trading Scheme (NZ ETS), afforestation outside of the NZ ETS, and international offsets.

#### 7.7.1.2 Measures to enhance removals through the NZ ETS

The NZ ETS was introduced in 2008 requiring all sectors of the New Zealand economy to report on their emissions and to purchase and surrender carbon credits to the government with the exception of biological emissions from the agricultural sectors and industries that receive free allocation of units. As one of the few ETS' in the world they included emissions and sequestration in the forestry sector to reflect the targets of the Kyoto Protocol, where emissions reductions are accounted as net. CO2 sequestration is treated as fully equivalent to CO2 reductions and is used to reach New Zealand's emission reduction targets. In practice it meant that owners of forests planted after 1990 could account for the trees as carbon sinks, creating carbon credits to be sold in the NZ ETS. The participation of forestry in the NZ ETS is voluntary and owners may enter and leave the NZ ETS as long as they pay back credits earned. Inclusion of the forestry sector accounted for a large share of the NZ ETS cap, averaging 40% of gross GHG emissions annually between 1990–2017 (-29MtCO2e yearly). The share is high not solely as a consequence of the inclusion of forestry into the NZ ETS, but also due to coinciding conditions. 1990 was the base year that countries decided for their emission reduction targets to be measured against under the Kyoto Protocol and concurrently the economic circumstances for farmers changed in the early 1990's. They were incentivised to convert agriculture to forestry and between 1990 and 2005 over 500.000 hectares of new monoculture pine forests were planted, which are exotic species to New Zealand but are fast growing. According to The Ministry for the Environment's own evaluation of the ETS, only 30,4Mt of the 179,7Mt forestry credits could actually be attributed to the ETS whilst the rest were due to the new pine plantations.

New Zealand's reliance on removal-credits generated through forestry in past years to reach their emission reduction targets, meant that they have been building up a carbon debt. Forests that were planted in the 1990s are now reaching an age when they will be felled, and when that happens credits generated through forestry are supposed to be paid back.

If the government was to repay the carbon debt built up since creating an ETS with non-permanent forest removals it would be very difficult to reach the NDC. Their solution to avoid this problem was to alter the accounting rules for forestry reporting in the ETS so carbon stored in some forests (i.e. production forests that have a 25-30 year cycle of growth, harvest and replanting) is now accounted for by an "average

approach", representing the average amount of carbon stored in the forest over a 100-year period. This controversial manoeuvre wiped out a large part of the generated carbon debt when rules were changed, and has been the subject of legal action in the High Court of New Zealand. Accounting sequestered carbon over a 100-year period is inconsistent with the Paris Agreement's target of restricting global temperature rise to 1.5°C in a timespan of 30-45 years, and this methodology will likely result in net emissions rather than CDR.

The NZ ETS has long had a reputation for underperforming, and the government has recently outlined its intention to amend it by launching two consultation processes. One proposal is to reform the NZ ETS and create separate markets for emissions reductions and carbon removals to redress the general over-reliance on forestry removals. However, a reform that leads to a reduced reliance on forestry could have a negative social impact affecting forest owners that have invested in forestry to earn money from carbon credits. Indigenous Māori own a large share of forestry assets, and changing the rules is a potential rights violation. Māori foresters have contested the government's proposals in court and to the UN.

#### 7.7.1.3 Afforestation measures outside the NZ ETS

Besides afforestation through the NZ ETS, various other afforestation projects exist. The four main projects are: The One Billion Trees Fund (1BT), The Crown Forestry joint ventures, the Hill Country Erosion Programme and the Erosion Control Funding Programme (ECFP). These afforestation projects have a wider purpose than to only remove CO2 including: enhancing indigenous forest regeneration; treating environmental challenges such as land erosion; improving soil and water quality; providing habitats for native species; and regenerating natural landscapes. It is estimated that together these projects will remove and store around 46Mt CO2-e over the period from 2022–35. However, there are no real permanence criteria for these forests. Landowners or organisations that commit to maintaining the planting project for a period of typically ten years can receive funding. Removals and emissions from the forests not included in the NZ ETS are monitored and accounted for in New Zealand's UNFCCC reporting, and follow the accounting rules for the LULUCF sector.

#### 7.7.1.4 International offsets

Offsetting has been an integral part of New Zealand's climate action over the past two decades. Besides offsetting emissions in the national context, New Zealand also relies on offset credits generated abroad to meet its net zero target, for example by financing carbon removals through forests and other land-use activities abroad. According to New Zealand's Climate Economic and Fiscal Assessment 2023, New Zealand will need to purchase 99.2 million tonnes of offsets for the period 2021-2030 to meet its NDC target.

### *7.7.2 Assessment*

Due to asymmetrical interactions with land and ocean carbon stocks, let alone the reliance on vulnerable and temporary storage in biomass stocks, it is a major shortcoming of the NZ ETS to treat a tonne of CO2 removed from the atmosphere as equivalent to a ton of CO2 not emitted.

The inclusion of forest credits into the NZ ETS serves as a great illustration of the dangers in relying on non-permanent removals to reach net-zero emissions targets. Whilst on paper, New Zealand's recently updated NDC is almost consistent with limiting warming to below 2°C, hardly any actual emission reduction has been achieved since the NZ ETS was introduced.

The additional afforestation projects are developed purposefully to enhance the ecological benefits of planting trees as a co-benefit with carbon removals. This is a healthy way of pursuing projects, as in such cases the ecological benefits often outweigh the removal value. However, it is problematic if removals from the LULUCF sector are relied upon to reach the national net emission reduction target if there are no requirements for these removals to be permanent.

New Zealand also uses offsetting as part of its climate action, which includes the morally questionable practice of substituting their domestic emission reductions by imposing responsibility for that pollution to other countries (typically in developing countries). The effectiveness of offset projects is often criticised due to the issue of additionality, the risk of double counting, lack of transparency and inadequate monitoring and verification mechanisms.

Overall, the incentive to include carbon removals into the NZ ETS and thus into New Zealand's climate strategy has been driven by a price-based, least-cost approach to mitigation, which has largely failed to address actual emissions reductions. In addition, this enacts a false equivalence between emissions and removals. The government's proposal to reform the NZ ETS has been met by resistance from forest owners which could make it difficult to implement such reforms. Even after a major reform of the NZ ETS that creates separate markets for emission reductions and carbon removals, there is still a serious attitude shift required that commits to deep emission reductions and abandons a reliance on national and international offsetting.

## *7.8 Sweden*

### *7.8.1 Overview*

#### 7.8.1.1 CDR targets

Sweden aims to reach net-zero GHG emissions no later than 2045 and net-negative thereafter. The policy framework was adopted in 2017, setting milestone targets and introducing a climate policy council to make yearly evaluations of national efforts to reach climate-positivity. Besides introducing national emissions reduction targets, Sweden included 'supplementary measures' in their Long-Term-Strategy (LTS) to address so-called 'hard-to-abate emissions' (specifically referencing the agriculture sector). These supplementary measures essentially enhance sinks/removals or offset Swedish emissions in other countries and are described as: 1. increased net removal of carbon dioxide in forests and land, 2. emission reductions from investments in other countries and 3. negative emission technologies such as capture and storage of biogenic carbon dioxide (BECCS). Sweden was thus an early mover in terms of integrating CDR into their long-term strategy.

In Sweden's long-term strategy a maximum target has been set for how many emission reductions may be compensated through supplementary measures, yet how each of these measures will contribute

individually is not quantified. Milestones have been set, aiming at a net-63% emissions reduction target by 2030, in which a maximum of 8% may be achieved through supplementary measures. By 2040, these targets become at least net-75% with a maximum of 2% made through supplementary measures, and by no later than 2045, Sweden must have net-zero emissions and at least 85% lower emissions than in 1990, meaning that the remaining 15% of reductions could come from supplementary measures. From the year net-zero is realised, supplementary measures must continue to increase for Sweden to reach net-negative emissions.

The CDR potentials of the supplementary measures were assessed in a Swedish government report with input from an expert group of stakeholders (Vägen till en klimatpositiv framtid). It was suggested that the greatest CDR potential was to be found in the deployment of BECCS as well as increasing carbon sinks in forest and land - the former having a removal potential of 3-10 MtCO2eq/yr by 2045, and the latter 2.7MtCO2eq/yr, by 2045. Other CDR measures were not quantified due to uncertainty.

#### 7.8.1.2 Reverse auction system for BECCS

In 2021, the Swedish Energy Agency suggested using the state budget to finance a reversed carbon auction system that would develop and support a BECCS industry. This was proposed after a larger assessment of different finance models and of different bio-based CDRs (including support of biochar). Eventually, the reversed carbon auction system received financial support. It established a market in which actors suggest prices on how they can produce and deliver geologically stored biogenic CO2. The best value-for-money bids win tenders. The Swedish Energy Agency expects bids from the pulp and paper industry or combined heat and power plants in the district heating sector, at an expected cost in the first bidding rounds of SEK1,100–2,000 (approximately €95-170) per tonne of carbon dioxide for 15-year contracts. Sweden is the first country to introduce reverse auctions for BECCS, obtaining price discovery and generating only the most cost-effective removals. Companies winning the auction gain the security of fixed long-term revenue. The first auction was supposed to take place at the end of 2022 but has been postponed to 2023 because the Swedish Energy Agency lacked the prerequisites to launch the scheme.

#### 7.8.1.3 Measures to enhance removals in the land use sector

In the report (Vägen till en klimatpositiv framtid), it is suggested that regrowing forests on abandoned agricultural land, agroforestry, rewetting peatlands, and planting more catch, cover and energy crops have great potential for CDR in Sweden. Although it is an objective in Sweden's LTS to increase carbon sinks in forests and land, it remains unclear what policy measures are supposed to encourage this. Sweden's national forestry programme is production-oriented rather than climate-focused and states that active, sustainable forestry can better contribute to climate change than a temporary increase in the storage of carbon in forest land. The Swedish Forestry Act is likewise preoccupied by supporting forest production and sustaining carbon sinks rather than increasing carbon sequestration. The few measures in the Forestry Act that could increase the carbon sinks in the Swedish forests include encouraging the protection of old-growth forests and promoting the use of forests for recreation and tourism rather than wood production.

### *7.8.2 Assessment*

The Swedish climate framework, aiming to emit net zero greenhouse gases in the atmosphere no later than 2045, relies on supplementary measures (land-based and some technological removals and emissions reductions from investments abroad) in addition to emissions reduction. Supplementary measures may only contribute 15% of emissions in order to reach the 2045 net-zero target. While it is positive that emissions reduction and "supplementary measures" have separate targets to reach net zero, one cannot unequivocally state that the Swedish framework provides a specific and separate target for removals, as the supplementary measures include emissions reduction from investments abroad and are described in a document which is not legally binding.

Sweden's effort to promote BECCS through a reversed auctioning system is innovative and, in theory, should allow the government to support quality CDR at the cheapest available price. Furthermore, by financing it, they can control the pace of technological development and can set expectations and obligations to the actors that win the auction. However, the system still has to prove that it can work in practice. Valid concerns have been raised in a report by the Swedish Energy Agency on the design of the reversed auction system because the bar to enter the auction could be set too high, which risks reducing competition and disadvantaging smaller players. The risk of this is for insider trading or for cartels to form, which can lead to price inflation and overcompensation for the BECCS industry. Furthermore, there is the risk that cost is prioritised over quality, leading to lower standard removal services if social, environmental or MRV aspects are secondary to value pricing. One suggestion of the Swedish Energy Authorities is that it should be possible for BECCS companies to sell removal credits on voluntary carbon markets as contribution claims to reach Sweden's climate goals, but this has not yet been approved.

With regard to the Swedish objective to increase carbon sinks in forests and land, existing policies to support such a development are weak. Whilst on paper it is written that there should be a balance between production and environmental protection, many observers criticise Sweden's forest management for favouring industrial interests over environmental protection and that forest harvesting practices drive deforestation, biodiversity loss, and increased carbon emissions.

## *7.9 Switzerland*

### *7.9.1 Overview*

#### 7.9.1.1 CDR targets

In a June 2023 referendum, Swiss voters approved the government's new climate and innovation law, which commits the country to climate neutrality by 2050 and net negativity thereafter. It also clarifies the role of the so-called negative emission technologies (NETs), stating that Switzerland should reduce emissions as far as possible by the midpoint of this century and compensate for residual emissions through domestic and international use of NETs. It also sets intermediate emissions reduction targets before 2050, which are at least on average -64% for the years 2031-2040, at least -75% by 2040 and at least -89% for the years 2041-2050. Specific reduction targets are also set for the building, transport and industry sectors, with the first two to be completely decarbonised and the latter to reduce emissions by 90%.

The Federal Council (i.e. the Swiss government) adopted a long-term climate strategy in 2021, which defines NETs and their usage. Switzerland prioritises reducing the use of fossil fuels to a minimum, cutting its greenhouse gas emissions as far as possible and only balancing residual emissions through NETs and carbon capture and storage (CCS). Residual emissions mainly exist in agriculture, waste, cement production and the use of solvents and are defined as those that are "technically unavoidable", meaning there is no alternative to avoid or reduce them.

Because of constraints on NET deployment in Switzerland (such as limited domestic CO2 storage potential, the required transport of removed CO2 over long distances, the current high costs, potential risks, public acceptance and uncertainty over further technological development of these technologies), the strategy is explicit that NETs should only be used to compensate for emissions that are difficult to avoid. This is the justification for government calls to establish "suitable framework conditions" for the deployment of NETs both at home and abroad.

The strategy provides a comprehensive definition of CDR methods, ranging from technical, which are based on chemical processes (i.e. direct air carbon capture and storage, or DACCS, and enhanced weathering) to natural, based on photosynthesis (i.e. afforestation, reforestation, wood utilisation and soil management). A key requirement for all NET methods is for the removed CO2 to be permanently stored, "as far as possible for several decades, ideally centuries". According to the document, permanence cannot be guaranteed for natural approaches, which are seen as requiring continuous, targeted management and, even then, have a high risk of reversals from biomass. The Council also acknowledges that natural sinks can reach saturation within a few decades. In addition to permanence, NETs should remove carbon "securely and sustainably", but the strategy does not elaborate further on these terms.

It is projected that a total amount of 6.8 million tonnes of CO2 residual emissions (mainly the 4.6 million tonnes in agriculture) be compensated using NETs by 2050, 2 million tonnes of which are to be conducted in Switzerland (primarily BECCS, including from waste incineration) and 4.8 million tonnes abroad (primarily DACCS). CCS also plays a major strategic role in reducing emissions, i.e. 5.1 million tonnes in 2050, mainly from cement production and fossil-based waste incineration.

In May 2022, the Federal Council adopted a roadmap on how carbon capture and storage (CCS) and NETs can gradually contribute to the long-term climate target. They state that CCS and NETs should be deployed in a way that is "socially acceptable, economically viable and environmentally sound". The roadmap envisages rolling out both technologies in two phases: From 2022 to 2030, a pioneering phase with a target of storing around 500,000 tonnes of either fossil (CCS) or atmospheric and biogenic (NETs) CO2 in Switzerland and/or abroad; and a targeted scaling phase from 2031 to 2050. The Council then suggests an action plan based on five priorities, which include the need to: have separate climate targets for "ambitious" reductions and, "where relevant", negative emissions; define quality criteria and standards for permanent and sustainable sinks; create economic incentives and markets for private actors, including the national emission trading system and voluntary carbon markets; develop infrastructure for CO2 transport and storage; and promote innovation in both technical application, and policy design for business models and social issues.

#### 7.9.1.2 Removals in relevant climate frameworks and other measures

The CO2 Act and the CO2 Ordinance have been the main pieces of legislation setting the legal framework of Switzerland's climate policy before the adoption of the 2023 climate and innovation law. Both pieces of legislation set a number of targets, policy instruments and strategies to address climate change via emissions reductions in Switzerland, including establishing the Swiss Emission Trading System (ETS). Neither act elaborates on removals; the CO2 act only states that wood used as building construction material can be considered a carbon sink, without further explanation.

At the time of writing the inclusion of removals in the Swiss ETS is not foreseen. Swiss voters rejected a 2021 government proposal to revise the CO2 Act, so that negative emissions obtained by the capture and storage of biogenic emissions of installations under the Swiss ETS would be accounted separately from this system. This would mean they could not be included as allowance credits to be used by installations. An updated proposal currently under Parliament review, which is in line with the previous rejected version and the EU regulation, excludes the direct inclusion of negative emissions in the Swiss ETS, but states that it will be possible to calculate negative emissions obtained in installations covered by the Swiss ETS in the context of offsetting projects.

The CO2 Act also requires fossil fuel producers and importers to offset from 5% to 40% of the emissions resulting from fuel use by submitting attestations from emissions reduction and carbon storage projects. Those projects need to meet a number of core requirements (including conservativeness of the calculation, additionality, no double counting and permanence of at least 30 years in the case of carbon storage). A system and rules for the project's validation, verification and monitoring are also envisaged. If undertaken abroad, these projects can only be carried out in countries that have a bilateral agreement with Switzerland, of which there are currently 12[8] under Art. 6.2 of the Paris Agreement. In addition, Switzerland also signed two international agreements on CCS and NETs, with Iceland and the Netherlands.

Finally, the Environment Research Master Plan 2021-2024 includes negative emissions among its research priorities, including research questions related to: their potential and cost-benefit assessment; the environmental and societal risks; the constraints for a large-scale deployment; how to ensure a positive climate impact of reversible carbon sinks such as soils, wood and woody biomass; the role of NETs in the Swiss climate policy.

### *7.9.2 Assessment*

The debate on CDR (always referred to as negative emission technologies in the Swiss context) is gaining momentum in Switzerland. The recently adopted climate and innovation law clarifies the role of carbon removals as a strategy to achieve the climate neutrality target and forecasts a specific amount of residual emissions to be compensated by negative emission technologies. However, at the time of writing there is no specific CDR-dedicated target enshrined into law. Concurrently, the country stresses the need to prioritise emissions reductions and turn to NETs only where emissions are deemed truly unavoidable because of several constraints NETs bring with them regarding social acceptance, costs and risks, domestic storage potential and transport. The separation between CCS and NETs and their respective role in

[8] Peru, Ghana, Senegal, Georgia, Vanuatu, Dominica, Thailand, Ukraine, Morocco, Malawi, Uruguay and Chile.

tackling the country's residual emissions is also defined in the country's long-term climate strategy and the more focused CCS and NETs roadmap. Switzerland is also advanced compared to other countries when it comes to defining negative emission technologies and identifying their main constraints. Both technical and natural processes are mentioned, and while permanence is meant to be a key requirement for all NET methods, the impossibility of guaranteeing the permanent storage of carbon for natural solutions is acknowledged. That said, the definition of permanence itself is not very robust and is a key weakness of Switzerland's long-term strategy, as it can mean storing carbon for only several decades. The Swiss framework also permits offsetting permanent fossil emissions with temporary carbon storage projects. To comply with obligations under the CO2 Act, fossil fuel suppliers can compensate for part of the emissions from fuel use with carbon storage projects in biological or geological sinks requiring a storage guarantee of only 30 years. In terms of additionality, avoiding double counting and conservativeness other positive requirements are in place to validate such offsetting projects. Switzerland also seems very proactive when supporting research and development in the field of NETs, both domestically and abroad.

All in all, there are some positive standpoints in Switzerland regarding negative emission technologies' role and their deployment. Nevertheless, the country's position on permanence and the possibility of offsetting is worrying and undermines the true climate role of removals.

## *7.10 United Kingdom*

### *7.10.1 Overview*

#### 7.10.1.1 CDR targets

By 2030 the UK is committed to reducing its emissions by 68%, and 70% by 2035 compared to 1990 levels. The country focuses on what the government calls Greenhouse Gas Removals (GGR), as opposed to Carbon Dioxide Removal (CDR), to potentially include removals of non-CO2 greenhouse gases. However, carbon dioxide is also the key focus for removal policy in the UK. The main UK climate legislation, the Climate Change Act, requires the government to fix, with an advance of 12 years, five-year caps on total greenhouse gas emissions produced in the country (also known as carbon budgets) from 2008 to 2050. While removals are implied in the net zero target - requiring that by 2050 emissions should be at least equal or less than GGR - none of the five carbon budgets set in law so far and covering the period from 2008 to 2032, entailed a specific, separate target for GGR.

The Climate Change Act currently only considers removals from the land-use, land-use change, and forestry (LULUCF) sector, where they are coupled with emissions reduction. However, in the 2021 "Net Zero Strategy: Build Back Greener", the government clarifies that both nature and technology-based removals will be needed to complement decarbonisation and commits to amending the Climate Change Act to enable 'engineered removals' (examples this document gives include Direct Air Carbon Capture and Storage, Bioenergy with Carbon Capture and Storage, wood in construction, biochar and enhanced weathering) to contribute to UK carbon budgets. In the Carbon Budget Delivery Plan published by the government in March 2023, the Fifth (2028-2032) and Sixth (2033-2037) Carbon Budgets are expected to need 6.4Mt CO2 and 23.4Mt CO2 of removals a year on average.

The 2021 Strategy clearly states that the purpose of GGR is to balance residual emissions for sectors that are unlikely to achieve full decarbonisation by 2050 and that in order to avoid mitigation deterrence GGRs

must not substitute “ambitious mitigation”. In addition, the government stresses in the document the need to ensure that GGRs result in a permanent net reduction of atmospheric carbon, which would require “case-by-case scrutiny” of the supply chains' carbon intensity and “long-term indirect emissions” of GGR projects. To do that, the government suggests that a robust approach to the Monitoring, Reporting and Verification (MRV) of GGRs is essential to ensure their deployment at scale. Moreover, the Strategy underlines that future markets for GGRs, whether voluntary or not, need to be regulated carefully to ensure investments into “permanent and verifiable” carbon removal. The government does not, however, define permanence in this Strategy. The most recent Net Zero Growth Plan, published in April 2023, reiterates that GGRs should be used to mitigate remaining GHG emissions that are unavoidable, and acknowledges that the various types of engineered GGR methods have different levels of sustainability.

#### 7.10.1.2 A strong push for engineered removals

In the 2021 Strategy, the government is confident about the need for and potential of engineered removal solutions in the UK. In particular, it stresses that GGR (DACCS are mentioned specifically) will have to be developed or scaled up significantly over the decade to contribute effectively to future carbon budgets, the UK zero target and to build evidence and experience in the sector. The strategy aims to deploy at least 5Mt CO2/year of engineered removals by 2030. Engineered removals are then expected to deploy around 23 Mt CO2 by 2035. It also anticipates that, by 2050, between 75 and 81Mt CO2 of negative emissions from engineered GGRs will be needed annually to compensate for residual emissions and reach the net zero target. At the time of writing, no engineered removal or even carbon capture and storage are currently operating in the UK. To achieve the goals for engineered removals, the government pledges to deliver £100 million for “DACCS and other GGRs” to assist these technologies to reach commercial viability. The funding includes the Direct Air Capture and GGR Innovation Competition, phase 2 of which was announced in July 2022, with over £54 million of government funding awarded across 15 demonstration projects.

In July 2022, the government launched a public consultation on Business Models for Engineered Greenhouse Gas Removals, aimed at accelerating investment in the sector. More specifically, the government sought to gather views on the design of a business model that could attract private investment and enable GGR projects to be deployed at scale over the next decade. In its response to the consultation published in the summer of 2023, summarising stakeholders’s views and outlining its position, the government confirmed its intention to move forward with the development of a GGR business model that will be based on a ‘contract for difference’ structure, where the subsidy will be determined by the difference between a ‘strike price’, reflecting the cost of producing negative emissions, and a ‘reference price’, reflecting the market value.

#### 7.10.1.3 The integration of removals in the UK ETS

In parallel, the government is seeking to develop markets and incentives for investment in GGRs, including exploring the potential for GGR inclusion in the UK Emissions Trading Scheme (ETS). In a 2021 document summarising responses to a call for evidence on GGR launched the previous year, the government already took a position in favour of using the UK ETS as a possible market-based solution for stimulating investment in GRR, to ensure the building of a “single, integrated compliance market for carbon”. According to the government, negative emissions could “support liquidity as the ETS allowance cap falls

over time". In their view, GGR credits could be used in the UK ETS to allow polluting sectors to meet their obligations through the procurement of negative emissions alongside conventional abatement options. In 2022, the government launched a broad public consultation on developing the UK ETS, which included a section on its role as a long-term market for GGR technologies.

The main government response, published in July 2023 by the UK ETS Authority[9] confirmed the intention to include engineered GGRs meeting "robust standards" in the UK ETS, to overcome the lack of predictable revenue streams towards these technologies. The inclusion would be subject to further consultation, a robust MRV system and the management of "wider impacts". The Authority will also explore the inclusion of "high-quality" nature-based removals, after consideration of issues related to permanence, costs and land management impacts and examples from government-endorsed voluntary carbon standards, such as the Woodland Carbon Code. Concerning biomass GGRs, the government published the Biomass Strategy in August 2023. This commits to developing a cross-sectoral common sustainability framework (subject to consultation) and recommends in the long term for biomass uses that can produce negative emissions. Alongside the Strategy, the government published a report on the ability of BECCS to generate negative emissions. The report does not identify any "insurmountable scientific barriers" to the net removal of CO2 via BECCS when carried out in compliance with existing sustainability criteria and via sustainable supply chains. Current technologies are considered competent enough to robustly and reliably monitor forest biomass, even though existing regulation/certification practices need to be carefully evaluated.

The ETS Authority intends to create a new "credible" tradeable GGR allowance, that takes into account the permanence of the carbon stored. This would entail, according to the Authority, the creation of "robust" MRV requirements so the removals can be quantified and to clarify the rights and liabilities of trading a GGR allowance. The Authority will then consider how these new allowances will be integrated into the ETS in a way that always prioritises decarbonisation but stresses that the risk of mitigation deterrence is expected to be limited in the early years of GGR integration in the UK ETS. According to the Authority, this is because engineered GGR will not be deployed at scale until the 2030s, and it will take time before certain nature-based solutions sequester a high amount of carbon relative to the UK ETS. The UK government is planning a further consultation on the development of the UK ETS, with the inclusion of engineered and nature-based GGRs in the UK ETS being a key part of that consultation, specifically addressing the market design, eligibility requirements and timeframe for the inclusion.

#### 7.10.1.4 Other measures to support nature-based removals

In 2021, the UK government launched the Nature for Climate Fund, providing over £760 million towards woodland creation and management and peatland restoration. The Nature for Climate Peatland Grant Scheme runs until 2025 and is specifically designed to restore and reduce emissions from peatlands in England while providing wider benefits such as improved ecosystems and biodiversity. In March 2023, the UK government also launched its Nature Markets Framework, setting out plans to mobilise private investment into nature through selling units of ecosystem services, including nature-based carbon

[9] The UK ETS Authority consists of the UK government, Scottish government, Welsh government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland.

removals. After leaving the EU and thus terminating its cooperation with the Common Agricultural Policy, the UK government plans to phase out direct payments to farmers based on land ownership and tenure and pay them to provide environmental goods and services alongside food production instead. To do that, they have announced the rollout and funding of the UK Environmental Land Management schemes, which include the Sustainable Farming Incentive, Countryside Stewardship and Landscape Recovery. The schemes aim at incentivising farmers and land managers to create and restore ecosystems, improve water quality, increase resilience to flooding and drought, create more new woodlands, reduce carbon emissions and store carbon. The results of these schemes are uncertain though, with experts questioning if they will be sufficient to reach the UK's targets.

### *7.10.2 Assessment*

There is a clear interest in supporting the deployment removals in the UK, with a clear preference for technical removals. Removals play an important role in the UK Net Zero Strategy and future carbon budgets. The definition of GGR as essential to compensate for residual emissions arising from the most hard-to-abate sectors is also a good indicator of the role of removals in the country's climate policy. In the different available policy documents and action plans, the UK government often reiterates the need to prioritise emissions reduction and avoid mitigation deterrence. Nevertheless, the potential contribution of removing non-CO2 greenhouse gases remains unclear.

However, the risk of mitigation deterrence is prevalent. The UK ETS Authority's intention to incorporate engineered GGR in the scheme and explore the possibility of also including those that are nature-based is worrying. At the time of writing, it is not clear how this will be done. The Authority has not taken a decision yet on how it will integrate GGR with the functioning of the UK ETS, but the dangerous possibility of making negative emissions and emissions reduction allowances fully fungible for use by polluters to achieve their compliance obligations has not been rejected either. The Net Zero Growth Plan and the government response to the GGR Business Model Consultation indicate that work on assessing UK ETS integration options is ongoing and that it is the preferred way forward for incentivising removals.

The UK does seem willing to put in place a robust MRV system to ensure the quality of removals, as stressed in the government responses to the UK ETS consultation, the Carbon Budget Delivery Plan and the GGR Business Model Consultation. The 2021 Strategy itself also underlines the need for removals to result in a permanent net reduction in atmospheric carbon, thus requiring a robust assessment of the carbon intensity of their supply chains and long-term indirect emissions of GGR projects.

Notwithstanding the UK government's plans on engineered removals, the 2023 Progress Report to Parliament of the country's Climate Change Committee (CCC) - the independent body established by the Climate Change Act 2008 with the purpose of advising the UK government and reporting progress towards reducing greenhouse gas emissions and adapting to climate change to Parliament - describes a lack of progress on the development and delivery of detailed policies to support these aims. This means that, according to the CCC, there are insufficient plans to meet the government's 5 MtCO2/year removals target by 2030.

## *7.11 The United States*

### *7.11.1 A. Overview*

#### 7.11.1.1 CDR targets

The United States has not developed a dedicated carbon dioxide removals policy at the federal level, nor has it set a binding target at the time of writing. However, the ambition of the US Long-Term Strategy is to become net zero by 2050 and implies a significant role for both technological and nature-based removals, with all scenarios envisioning around one billion tCO2 in CDR (approximately half in the land sector and half from technology-based applications). The US has also been directly or indirectly supporting CDR through different measures.

#### 7.11.1.2 Incentives for CDR

In November 2021 the Department of Energy (DOE) released its first CDR-dedicated R&D programme in the context of the Energy Earthshots, named Carbon Negative Shot. The initiative aimed to support CDR pathways that can remove, at gigatonne scale, CO2 directly from the atmosphere and store it in geological, biobased or ocean reservoirs or value-added products at less than $100 per tonne of CO2. Technologies should also ensure robust accounting of full lifecycle emissions and secure “high-quality, durable” storage with costs demonstrated for monitoring, reporting and verification for at least a century. The supported approaches include Direct Air Capture with Storage, Biomass Carbon Removal and Storage, enhanced weathering, soil carbon sequestration, ocean-based CDR, afforestation and reforestation).

In parallel, section 45Q of the US Internal Revenue Code provides a tax credit for each ton of CO2 captured both at point source or directly from the atmosphere and injected for sequestration, enhanced oil recovery or other uses. First introduced in 2008 and then enhanced in 2018 to include Direct Air Capture for the first time, section 45Q was further expanded with the approval of the Inflation Reduction Act (IRA) in August 2022. The tax credit was increased for carbon captured both at point source (from the previous $35 to $60 per tonne if the carbon is used - for example, in enhanced oil recovery - and from $50 to $85 if it is stored permanently) and directly from the atmosphere (from $50 to $130 per tonne if used, from $50 to $180 if stored).

The carbon captured at the point source could also include removals types such as bioenergy with carbon capture and storage (BECCS), for example, in ethanol production facilities. In addition, the 2022 changes reduce the removal capacity requirements for eligible projects by reducing the threshold of the annual amounts of CO2 captured, making it easier for smaller plants to receive the credit. In particular, the capture threshold decreases from 500,000 tonnes of CO2 emitted per year to 18,750 tonnes for power generation facilities; from 100,000 tonnes per year to 12,500 tonnes for industrial facilities; from 100,000 tonnes of CO2 captured per year to 1,000 for DAC facilities. Important to note is that the tax credit is for carbon injection specifically and does not use a lifecycle assessment or require climate considerations. This means that the tax credit is not based on the net climate benefit in terms of CO2 outcomes.

Section 45Q provides a federal tax credit that supplements and can be combined with state and local clean energy incentives, including the California Low Carbon Fuel Standard CCS protocol. However, several differences between the eligibility requirements for 45Q and the LCFS could prevent some operators in

the US from claiming both credits. The 45Q credit does not stipulate requirements regarding the possibility for projects to participate in the voluntary carbon market.

The IRA also unlocked investments in "the nation's lands and waters" to, among other aims, improve soil carbon and sequester carbon dioxide.

In addition to that, the Bipartisan Infrastructure Law (BIL, also referred to as Infrastructure Investment and Jobs Act - IIJA) enacted at the end of 2021, while largely focused on CCS and transport and storage infrastructure for CO2, includes $3.5 billion for building four regional DAC hubs across the country and $115 million for the DAC Technology Prize Competition. The first two of these hubs were awarded $1.2 billion in August 2023. One of those hubs will be run by Occidental Petroleum, a fossil fuel company, whose CEO has publicly stated that DACS is a way to continue fossil fuel extraction. The DAC hub funding does not preclude how produced CDR can or should be used, even in ways that cancel out its climate benefit. This presents a clear risk of mitigation deterrence.

The objective of the DAC hubs is to create an integrated network of projects active in the direct removal, processing, transport, storage and/or conversion to "valuable products[10]" of CO2. Subsidised projects may include the storage of CO2 coupled with fossil fuel extraction. While preference is given to applicants with the greatest long-term potential, projects only need to demonstrate that captured CO2 will be stored in a secure, domestic CO2 storage facility that has sufficient capacity to store CO2 supporting at least 12 years of DAC Hub operation. Other technologies, such as biochar, biomass burial, direct ocean capture, soil carbon sequestration, and afforestation/reforestation may be included in the hub without being eligible for funding. Additionally, the BIL unlocks funding streams for nature restoration and land management projects for carbon management, which can also lead to carbon removals.

#### 7.11.1.3 Proposals for a fixed CDR target and a reverse auction system

Two proposals have also been submitted at the Federal level by lawmakers. They have been included in this analysis because they present interesting approaches on how to incentivise CDR, though it is unclear how likely both bills will actually become law in the near future.

Firstly, the *Federal Carbon Dioxide Removal Leadership Act* (the CDR Leadership Act) was presented in Congress in 2022 as a bill to leverage federal procurement of CDR. To do so, the proposal introduces specific removals targets per year at the federal level until 2035 by requiring the US Secretary of Energy to remove from the atmosphere 50 thousand tons of CO2 in 2025, 500 thousand for each fiscal year in the period 2026-2028, 5 million in 2029-2034 and 10 million by 2035. The bill also sets a price cap per ton of CO2 removed that lowers over time from $550 in 2025 to $150 in 2035. The obligation would only refer to carbon directly removed from the ambient air or seawater and stored permanently in "geologic formation or in materials, including building and mineralised carbon materials, or other permanent

[10] The US Department of Energy defines "valuable" a product which demonstrates a reduction in life cycle GHG emissions when compared to the equivalent incumbent product following a life cycle analysis of the carbon utilisation or conversion pathway. Source: DOE, Funding Opportunity Announcement, DE-FOA-0002735, available at https://www.fedconnect.net/FedConnect/default.aspx

storage methods". It would exclude nature-based solutions or technologies related to fossil fuels and would avoid double counting.

Secondly, in the Fiscal Year 2023 Consolidated Appropriations Act, a similar approach to public procurement of CDR was taken. The law calls on the DOE to start a "competitive purchasing pilot program for the purchase of carbon dioxide removed from the atmosphere or upper hydrosphere". While the DOE has not yet announced how it intends to follow this directive, the idea is to provide public support to scale up carbon removals technologies. A suggestion to implement the plan arrived on 12 May 2023, with the introduction in the Senate of the Carbon Removal and Emissions Storage Technologies (CREST) Act. The bill has a twofold objective: it requires the US Departments of Energy and Interior to establish new research programmes for carbon removal approaches and introduces a reverse auction purchasing programme for removals. The bill has a significant focus on nature-based removals - referred to as biomass (incl. algae and soil), geological (carbon mineralisation) and aquatic (ocean) removals in the text - but also mentions atmospheric (DAC) removals. In the case of biomass, the R&D programme also includes the conversion of the carbon captured into valuable products and co-products. As for the 5-year purchasing programme based on a reverse auction mechanism, 30% of funding would be allocated to medium storage (from 100 to 1,000 years) and 70% to long-term storage (more than 1,000 years).

### *7.11.2 Assessment*

While interest in CDR is growing rapidly in the US, supporting mechanisms and legislation remain scattered, and a clear removal framework with dedicated targets, policy and funding is missing at the federal level. As with all climate policy at the US federal level, what has been enacted is also at risk of being rolled back rapidly depending on elections for both chambers of Congress and the presidency.

The lack of a robust CDR-dedicated policy framework identifying the concrete role of removals towards the US climate targets risks creating counterproductive outcomes, including an overreliance on removals as a panacea to reach climate neutrality. Also, the two main federal funding schemes to support removals, DAC hubs and the 45Q tax credit, do not focus on maximising the climate impacts of the removal solutions they support. In the first case, the DOE could encounter political pressure to include a range of projects, including those that support oil and gas production. In the second case, as lifecycle benefits are not considered, the tax credit could be used to support projects that increase emissions.

In addition, the definition of removals most often favoured by the government includes carbon storage in "value-added" products, which for permanence reasons have dubious environmental integrity. Finally, US measures to enhance CDR are too often mixed with CCS, where subsidies for CCU or enhanced oil recovery (EOR) are still high. However, two federal bills currently presented to Congress and the Senate, the CDR Leadership Act and the CREST Act, could alter the situation. Both have positive aspects. The CDR Leadership Act suggests a specific federal removals target for the period 2025-2035 by only focusing on technological and permanent removals. CREST brings nature-based removals to the table, drawing attention to the concept of permanence while establishing a reverse auction system which could be a good way to support removals in the public sector.