EU Framework for CO2 Removals – Targets and Commitments

Discussion Paper

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Nils Meyer-Ohlendorf

Contact

Dr. Nils Meyer-Ohlendorf
Head, European and International Governance
Ecologic Institute
Pfalzburger Straße 43/44
10717 Berlin

E-Mail: nils.meyer-ohlendorf@ecologic.eu

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Key messages

Carbon dioxide removals (CDR) are an important element of all scenarios compatible with the Paris Agreement. But scenarios are silent on how politics can help generate CDRs at the required scale. There are many CDR concepts but most are still speculative, untested, and unable to remove and store CO_2 at necessary scale. Some are even environmentally harmful. None is as safe as gas, coal and oil in the ground, the world's best carbon "sinks".

Despite the significant limitation of all existing CDR concepts, there is one no-regret option that offers many co-benefits for biodiversity, water and soils, and is capable of removing and storing large amounts of CO_2 at the same time: the restoration of degraded ecosystems. Ecosystem restoration has the potential to be the EU's main "CDR producer", possibly capable of helping to achieve climate neutrality even before 2050.

The new EU climate architecture should include a separate CDR target that builds primarily on restoring degraded ecosystems while giving emission reductions clear priority and incentivizing the development of supplementary CDR concepts that are safe, permanent and sustainable. This target should be legally binding and quantified – for the EU and Member States. For high levels of environmental integrity and clear responsibilities, this target should be separate from the EU's reduction targets. It should not be a combined target which treats reductions and CDRs equally. This EU's CDR target should be enshrined in the European Climate Law.

1 Summary

Practically all emission reduction pathways that keep global temperature increases **well below 2°C or even below 1.5°C depend on removing CO_2 from the atmosphere** – often in quantities equivalent to many years of global greenhouse gas emissions**.** Despite the importance of carbon dioxide removals (CDR), scenarios are often silent on the politics of how to generate CDRs at such scale. Some scenarios allocate CDR volumes to specific removal concepts but are mute on how to implement these concepts in the real world. Partly reflecting the silence of scenarios, CDRs **still play only a small role in the political debate**. The political debate is mostly general, rarely specific and often lacking strategic vision – although awareness of the importance of CDRs is growing fast and governments are beginning to engage more in CDR.

The **deficient political debate is a problem** because developing and implementing the CDR capacities at required scales takes long times, possibly decades. They need to be developed now and implementation should start well before 2050.

To help address this problem, the **EU should adopt targets for CDRs**. CDR targets should be legally binding, quantified and separate from reduction targets – for the following reasons:

- **Commitment:** Targets in law constitute the highest possible commitment. CDR targets are the best way to acknowledge the urgency and importance of CDRs. They are an established way for the EU to determine its strategic direction and to start adopting policies.
- **Accountability:** Quantified targets are the most robust basis for verification, enhancing accountability.
- **Enforceable:** Only legally binding targets are enforceable through infringement procedures, the EU's strongest compliance system.
- **Separate:** The CDR target must be separate from reduction targets. In contrast to separate targets, combined targets treat CDRs and reductions equally. This is a major problem because CDRs are an inherently weaker way of climate protection than emission reductions – all CDR concepts face challenges that reductions do not have, ranging from permanence to sustainability. Only separate targets for emissions reduction *and* CDRs can unpack combined targets that are as vague and intransparent as the EU's 2050 climate neutrality target or the newly proposed 2030 target.

There are various CDR concepts – nature or technology based –, but restoring degraded ecosystems is the best CDR option. Because of its many co-benefits for biodiversity, water and soils, it is a no-regret option that is a proven way of removing CO_2 in large amounts, possibly around 1,000 $MtCO_2e$ annually by 2050. Other nature based solutions, such as afforestation and reforestation, can have similar effects but they can be environmentally harmful. In addition, the lack of available land limit their potential, in particular in Europe where only small amounts of land are available for afforestation. **Technology based removal concepts, such as Direct Air Capture, BECCS or Enhanced Weathering, offer none of these benefits.** They are still largely speculative and – in the case of BECCS –

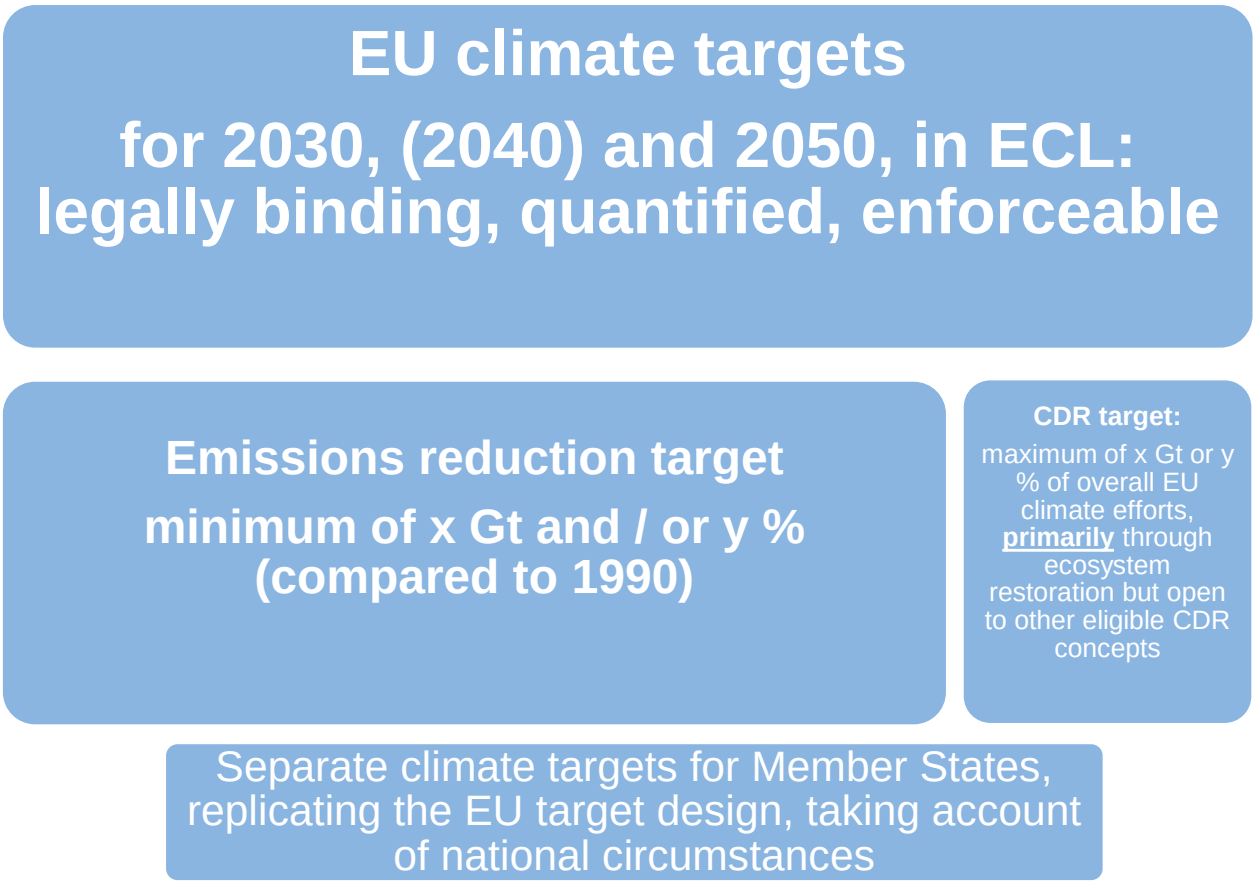
even harmful to the environment. This should change over time as technologies mature but at this point in time they are not a reliable pillar of climate action.

For these reasons, **the EU's CDR target should give clear preference to restoring degraded ecosystems while incentivizing research in other CDR options**. To this end, the EU's CDR target should include a commitment to restore specific areas of degraded ecosystems and / or to remove a specific amount of CO_2 through ecosystem restoration.

An EU removal target alone would be meaningless. To be effective, **Member States have to contribute to achieving EU targets**. In a hierarchical order of effectiveness, this could be done in the following ways:

- **CDR and restoration targets, legally binding and quantified:** As the strongest option, Member States could be legally obliged to remove specific amounts of CO_2 from the atmosphere – either measured in tonnes or percentage shares of the EU's overall emission reduction efforts. This option is similar to the Climate Action Regulation (CAR) or the 2009 Renewable Energy Directive – both of which include quantified and legally binding national targets. As a prescribed part of the overall CDR commitment, Member States should be obliged to achieve their CDR contributions *primarily* through restoring specific amounts of degraded ecosystems. To accommodate different national circumstances, the distribution of national targets would build criteria such as CDR potential, nature restoration capacities and / or per capita income.
- **Quantified non-binding reference values for Member States:** In this weaker option, Member States are only required to take non-binding CDR reference values into account when designing their CDR policies. This system is similar to the 2001 Renewable Energy Directive that guided Member States' policies through non-binding reference values.
- **Member States pledge to restore a certain amount of degraded ecosystems and/or to remove specific quantities of CO_2:** As the weakest option, Member States pledge certain amounts of CDRs and or the restoration of degraded ecosystems, based on qualitative criteria. This option is similar to the pledge and review system of the Governance Regulation or the NDC system of the Paris Agreement.

The following **graphic** illustrates this proposal of a strong EU target architecture, enshrined in the European Climate Law (ECL):



Content

2 Introduction

To keep temperatures to well below 2°C or below 1.5°C, drastic and immediate reductions of greenhouse gas emissions are essential, but probably not sufficient. Effectively all emission reduction pathways that keep temperature increases to 1.5°C and well below 2°C **assume that large quantities of CO_2 are removed from the atmosphere**. According to the IPCC, "*all pathways that limit global warming to 1.5 °C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100 –1 000 $GtCO_2$ over the 21st century*."[1] This means that the world could be required to remove as much as the equivalent of 25 years of global CO_2 emissions – based on current global emissions of around 40 Gt. Pathways for well below 2°C and even 1,5°C not only assume large amounts of CDR but also that CDRs exceed emissions in the second halve of the century – by then the world would remove more CO_2 from the atmosphere than it emits (net-negative emissions).[2] Scenarios hardly discuss the practical and political feasibility of generating CDRs at these scales.

To contribute to global CDR efforts, it could be necessary for the **EU to remove around 50 $GtCO_2$ until 2100** – roughly equivalent to the amount the EU has emitted over the last 10 years.[3] Some pathways assume that the EU will be one of the largest "producers" of CDR in the 21st century. Scenarios of the EU long-term strategy also assume considerable gross negative emissions of greenhouse gases in 2050.[4]

Science is not the only driver of CDRs. EU policies are another. In December 2019, the European Council agreed on a climate neutrality target for 2050,[5] after calls from the European Parliament.[6] The European Climate Law – expected to be adopted before the end of 2020 – would put this target into law. In theory, the climate neutrality target could mean reduction of 100% by 2050 but in practice the climate neutrality target implies CDRs – to offset residual emissions that are expected to continue after 2050. In its communication *Stepping up Europe's 2030 climate ambition*, the Commission presents a EU-wide, economy-wide greenhouse gas emissions reduction target by 2030 compared to 1990 of at least 55% including emissions *and removals*.[7]

Despite these first steps and years of discussion on CDR technologies, **discussions in the EU still lack momentum.** The political debate in the EU has not addressed the strategic role of CDRs in EU climate policies in detail, and discussion on the details of regulating CDR are still in an early phase. Member States are only beginning to discuss details of CDRs and negative emissions. A few companies have set themselves targets to achieve negative emissions.[8] The broader public seems largely unaware of the need for CDRs and negative emissions.

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[1] IPCC, 2018 Summary for Policymakers, in: Global warming of 1.5 °C. *Masson-Delmotte V./Zhai P./Pörtner H. O., et al*. (eds), 17.
[2] IPCC, 2018 Summary for Policymakers, in: Global warming of 1.5 °C. *Masson-Delmotte V./Zhai P./Pörtner H. O., et al*. (eds), 17.
[3] *Geden O., Schenuit F*, Unconventional Mitigation: Carbon Dioxide Removal as a New Approach in EU Climate Policy, 2020, available at: https://www.swp-berlin.org/en/publication/eu-climate-policy-unconventional-mitigation/
[4] In depth in support of the Commission communication COM(2018) 773, 198.
[5] European Council, Strategic Agenda for 2019-2024, available at https://www.consilium.europa.eu/en/press/press-releases/2019/06/20/a-new-strategic-agenda-2019-2024/ step 12 at 5.
[6] European Parliament resolution of 14 March 2019 on climate change (2019/2582(RSP)), par. 5.
[7] European Commission, communication: Stepping up Europe's 2030 climate ambition 17.9.2020 COM(2020) 562 final
[8] Microsoft wants to achieve negative emissions by 2050, offsetting all its emission since 1975, https://www.bbc.com/news/technology-51133811.

The **deficient political debate is a problem**. The lack of momentum could have dire consequences for climate protection because the CDRs capabilities at the required scale do not exist, and they need long timespans to develop, in some cases decades:

- **Enhancing natural sinks takes time:** Natural sinks need time to develop the necessary CDR capacities. Very problematically, removal capacities of natural sinks are declining – globally but also in the EU. Unchanged land use practices and further increases in harvesting could see the sink potentially further decline to 225 million tons CO_2eq by 2030, a significant decline compared to 2006 when LULUCF sectors removed 336 million tons CO_2eq.[9] To make matters worse, rising temperatures, reduced water availability, higher likelihood of forest fires will reduce CDR potential of natural sinks even further.
- **Developing CDR technologies takes time:** The development of negative emissions technologies also needs time but there is only little substantial research and investment to develop and deploy them. As some CDR technology consume large amounts of energy, rapid expansion of cheap renewable energy is critical, which, again, requires time.
- **Adopting a CDR regulatory framework takes time:** Many of the conflicts of mitigation policies will reoccur when adopting a regulatory framework for CDRs. Which Member State and / or sector will remove which amounts by when? Should some Member States or sectors generate negative emissions earlier than others? How do we ensure robustness, environmental integrity and permanence of natural sinks? It will take time to solve these conflicts and to develop the necessary regulatory framework.

The **European Green Deal (EGD)** is an opportunity to introduce a regulatory framework that supports CDRs**.** In its EGD communication, the Commission announced to review the climate instruments relevant for achieving a higher 2030 climate target by June 2021. The Commission also stated that in 2021 it will propose legally binding EU targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon. Part of the EGD, the Circular Economy Action Plan commits the Commission "to explore options for a regulatory framework for the certification of carbon removals". The Farm to Fork strategy and the communication *Stepping up Europe's 2030 climate ambition* gave the debate additional momentum.

Against this background, **this paper discusses** the EU's governance framework for CDRs. Chapter 3 briefly presents criteria for EU removal policies. Chapters 4 and 5 discuss designs for EU targets and Member State commitments. Chapter 6 discusses *where* targets could be incorporated in EU law. Containing concrete suggestions for amending relevant EU laws, Chapter 7 shows how to incorporate CDR targets into EU law. The paper does not discuss specific policies and measures that could support CDRs, such as certification system, tax incentives, subsidies, or CAP reform.

[9] Commission staff working document, impact assessment, accompanying Commission communication Stepping up Europe's 2030 climate ambition, 17.9.2020, SWD(2020) 176 final PART 1/2

3 Criteria for CDR targets

The IPCC defines CDRs as "*the withdrawal of greenhouse gases from the atmosphere as a result of deliberate human activities*".[10] In broad terms, these activities can be grouped into (1) nature based removals ("enhancing biological sinks of CO_2") and (2) technology based removals ("using chemical engineering to achieve long-term removal and storage"). Nature based CDRs include, for example, restoring degraded ecosystems, afforestation and reforestation, rewetting of peatland, ocean fertilization (OF), or soil carbon sequestration (SCS). Technology based ideas are, for example, bioenergy with carbon capture and storage (BECCS), direct air CO_2 capture and storage (DACS) or enhanced weathering (EW).

Each CDR option has distinct advantages and disadvantages. To inform the choices of removal policies and activities, the **discussion should take account of the following criteria**:

- **Unequivocal priority for emission reductions:** CDRs are essential, but compared to emission reductions clearly deficient – for four reasons: *First*, gas, coal and oil in the ground are the world's only safe "sinks". Any other sink – natural or technological – is environmentally less safe and less likely to reduce global warming. *Second*, the estimated potential of technology-based CDR concepts vary considerably, making them an unreliable pillar of climate action. *Third*, the CDR potential of natural sinks can decline because of the expected and unexpected impacts of climate change on natural sinks. *Fourth*, emissions reductions foregone in the present cannot simply be substituted by future emissions reductions because emissions accumulate in the atmosphere, leading to greenhouse gas concentrations that are much more likely to set in motion tipping points of the climate systems, which – in turn – can lead to additional emissions.
- **Biodiversity, water quality and soil protection:** Some removal concepts have strong co-benefits for biodiversity, climate resiliency of ecosystems, prevention of water runoff and erosion, improving water quality and soil protection, while other policies do not. Removal measures that have these co-benefits should be preferred.
- **More removals than emissions – in balance:** Any CDR option must remove more CO_2 than it emits, including life cycle emissions.[11] This is a problem for CDR concepts with international value chains, such as BECCS but also synthetic fuel from DAC, which can sustain the use of combustion engines.
- **Safety and permanence:** CDRs are only a meaningful tool of climate protection if they store CO_2 permanently and safely. They need to prevent leaks for very long periods. Accessible, safe and permanent CO_2 storage sites are preconditions for BECCS and DACS deployment, but only a few countries have actually stated identifying them. [12]

[10] https://www.ipcc.ch/sr15/chapter/glossary/
[11] Mathilde Fajardy et al. Negative Emissions: Priorities for Research and Policy Design, 2019, https://www.frontiersin.org/articles/10.3389/fclim.2019.00006/full
[12] Mathilde Fajardy et al. Negative Emissions: Priorities for Research and Policy Design, 2019, https://www.frontiersin.org/articles/10.3389/fclim.2019.00006/full

- **Verification and accountability:** Verification of CDR is an essential criterion, not only to understand the amount and a permanence of CDR but also to ensure accountability. Depending on the CDR option, verification can be fairly straightforward or complicated. Some technology based concept, for example, can be directly measured, while nature based CDR concepts must be modelled and based on proxy observation. Some nature-based concepts already have established verification methods, while some technology based concepts do not.
- **Commitment:** Legally binding target represents the highest possible commitment, while non-binding targets have political value but no legal force. If politically possible, there is – in principle – preference for high levels of commitment, i.e. for legally binding and enforceable targets.
- **Innovation, competiveness and employment:** CDR measures have different innovation and competiveness potentials. Some CDR options offer considerable innovation potential, and opportunities of creating new markets and industries. This is obvious for technological solutions, such as DAC, but it also applies to ecosystems restoration and management, CDR measures have different employment potentials but reliable data on employment effects of CDR are rarely available.
- **Cost effectiveness:** Cost effectiveness seems to be a straightforward criterion but it should be treated with care, clearly differentiating between long term and short term cost developments. Some removal policies might be costly in the short term but might offer required removal capacities in the long term, possibly at lower cost as technologies mature.

4 How to design CO_2 removal targets for the EU

There are various reasons for the EU to adopt CDR targets:

- **Targets are established drivers of climate policies:** Targets have driven EU climate and energy policies – practically since its inception. They have been an essential reference point of the political debate and have influenced heavily the choice and design of measures. They are an established and accepted way of policy making.
- **Avoid weakening climate mitigation:** Giving clear priority to emission reduction, a removal target can address concerns that CDR are only a pretext of slowing down mitigation efforts.[13]
- **Lack of momentum and strategy:** The political debate on negative emissions lacks the necessary momentum and – equally important – strategic vision. Adopting CDR targets helps addressing these problems. The target would drive actions across sectors, notably biodiversity, agriculture and forestry.
- **Implementing climate neutrality target:** With its climate neutrality target, the EU has practically agreed to remove CO_2 from the atmosphere. The necessity to remove the required volumes could change the EU climate policies drastically – a CDR target could help accommodate this change.
- **Accountability:** To a large extent CDR discussions have been abstract and at the global level, disguising individual responsibility of countries.
- **Investments:** CDR targets are essential for encouraging necessary investment and innovation in the land sectors and technologies – as it was the case in the energy sector where targets for renewable energies have been an important driver for investment, innovation and drastic cost decreases.

Against this backdrop, there is a **compelling argument for the EU to adopt separate CDR targets** – i.e. targets that clearly separate between reduction and CDR commitments –, and **to avoid combined targets** – i.e. targets that merge reduction and CDR commitments into one consolidated target:

- **Comparing apple and oranges:** In contrast to separate targets, combined targets treat CDRs and reduction units equally. This is a major problem because CDRs are an inherently weaker way of climate protection than emission reductions – all CDR concepts face challenges that reductions do not have, ranging from permanence to sustainability. Removed and stored CO_2 can leak, while emissions reductions cannot. The monitoring and enforcement of CDRs is fundamentally more difficult than the monitoring and enforcing of emission reductions.
- **Transparency and accountability:** Separate targets are more transparent than combined target. They provide clear responsibility for reducing emissions and increasing removals. The combined EU's 2050 climate neutrality target is a case in point. In theory, this target could be

[13] https://www.c2g2.net/wp-content/uploads/Options-for-supporting-Carbon-Dioxide-Removal_July_2020.pdf

achieved through 100 % reductions and no CDRs but it could also be reached through significantly smaller reductions, for example 80%, and – correspondingly – higher CDR shares.[14] These ambiguities obscure the extent and pace of the investment needed to deliver negative emissions.[15] This vagueness can also undermine setting the right research priorities.

- **Importance of CDRs and net-negative emissions:** CDRs and – ultimately – net-negative emissions are important elements for all 1,5°C or 2°C pathways. The EU should acknowledge that CDR is a key element of successful climate policies. Adopting a specific target for CDRs and negative emissions is a good way of doing so. A specific target for negative emissions after 2050 (or earlier) would help to ensure that CDRs ultimately lead to net-negative emissions – and not only to emission offsetting.[16]
- **Importance of CDRs before 2050:** For the most part, scenarios and the political debate treat CDRs as a post-2050 problem. This conceals that CDR options play a role for achieving temperature goals already before 2050. Separate CDR targets for the period until 2050 could address this problem.

As the main **question for the EU is not *whether*** to adopt a separate CDR targets, **but rather *how*** to design them. Possible designs include (1) quantified targets, (2) qualitative targets, (3) targets through a restoration of degraded ecosystems, (4) targets through removal technologies, (5) targets for the EU and / or for Member States, and (6) any combination thereof.

4.1 Quantified emission removal target for the EU

In principle, there are **two ways of how to design quantified CDR targets for the EU**. First, a quantified EU target could set specific amounts in tonnes of CO_2 emissions to be removed from the atmosphere by activities within EU territory. Second, a quantified EU target could specify a percentage share of the overall EU climate efforts, e.g. reductions of 95 % by 2050 and CDRs of 5 % compared to 1990 levels.

Next to this basic design, these additional elements to design a quantified removal target exist:

- **Timeframes:** The target could be based on annual, biannual timeframes, or any other timeframe - until 2050 or beyond.
- **Sector targets:** Sector targets would include CDR commitments for specific sectors, such as land use, energy production or – in principle – any other sector. Sector targets could indicate until when sectors have to become climate neutral, achieve zero emissions or generate negative emissions.

[14] The same problem applies to the newly proposed 2030 targets of reductions of 55 %, which includes reductions *and* removals. European Commission, communication: Stepping up Europe's 2030 climate ambition 17.9.2020 COM(2020) 562 final

[15] Duncan P. McLaren et al. Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions, 2019, https://www.frontiersin.org/articles/10.3389/fclim.2019.00004/full

[16] Duncan P. McLaren et al. Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions, 2019, https://www.frontiersin.org/articles/10.3389/fclim.2019.00004/full

- **Legally binding or indicative targets:** Similar to other EU targets, notably climate and some energy targets, CDR targets could be legally binding, putting a legal obligation on the EU and / or Member States. Alternatively, the target could be indicative. In this case, the target would have political value but no legal force. Only legally binding targets can be enforced in courts; in the case of the EU through infringements procedures.

These **elements can be combined in various ways**, each combination featuring distinct advantages and disadvantages. Quantified and legally binding CDR targets, however, are the EU's strongest possible CDR target system. A legally binding target represents the highest possible commitment. Clear quantification of targets – combined with strong accounting rules – provides for a robust verification basis, which in turn supports accountability. Experience in other policy fields support the case of a legally binding and quantified CDR target. Progress in expanding renewable energies, for example, has been driven by such target designs. This option can also be informed by Sweden's CDR system (see box). In principle, it can also be built on the no-debit rule of the LULUCF regulation, which stipulates a quantified and legally binding CDR target for forests and land use changes. In this case an obligation on Member States to ensure that accounted emissions from land use are entirely compensated by an equivalent removal of CO_2 from the atmosphere through action in the sector.

Sweden's CDR system

Sweden's climate law – in combination with a decision by the Swedish Parliament – obliges the country to become climate neutral by 2045. To this end, the Swedish climate policy framework requires emission reductions of at least 85 % by 2045 compared with 1990. The remaining 15 % are set to be achieved through so-called supplementary measures. The Swedish Government Inquiry on Negative Emissions (Swedish Government Official Reports 2020:4) quantifies these supplementary measures in detail but it does not represent a government position:[17]:

- By 2045, Sweden is to achieve supplementary measures equivalent to at least 10.7 million tonnes of CO_2 per year. This level is to be able to increase after 2045. Supplementary measures are divided into (1) increased carbon sinks in forests and land by 2,7 - ? Mt CO_2 equiv. / year, (2) BECCS by 3-10 Mt CO_2 equiv. / year, (3) other removal technologies with unknown quantities, and (4) verified emission reductions in other countries by 0 to very great Mt CO_2 equiv. / year.
- Between 2021 and 2045, the volume of annually generated supplementary measures will constantly increase. *The total volume of verified emission reductions in other countries should amount to a total of at least 20 million tonnes of carbon dioxide equivalents in the 2020s. Of this, 0.7 million tonnes are calculated as supplementary measures in the specific year 2030 in line with the direction above. The remaining volume is calculated partly as supplementary measures for the period 2021–2029 as the quantity of supplementary measures must be built up gradually, and partly as results-based climate financing.*

[17] https://www.regeringen.se/48ec20/contentassets/1c43bca1d0e74d44af84a0e2387bfbcc/vagen-till-en-klimatpositiv-framtid-sou-20204, note: the policy framework also quantifies CDR target for 2030, using the same categories for the 2045 target

4.2 Qualitative EU CDR target

Unlike quantified targets, qualitative targets **do not contain a numeric commitment**. Like quantitative targets, qualitative target can be legally binding or indicative. They can have a sectoral scope or not, and can be based on different timeframes. As an example, a qualitative CDR target could include an EU commitment to enhance sinks in a way that they contribute to keeping temperature increases well below 2°C or even 1.5°C. As another example, CDR targets could establish a general commitment to engage in CDR activities, or – more specifically – a commitment to engage in research and deployment of removal technologies. Qualitative targets have the disadvantage that verifying target achievement is considerably harder, weakening its accountability.

4.3 Removal targets through restoration of degraded ecosystems

Removal targets referring to restoring degraded ecosystems can feature as

- a commitment to restore specific areas of degraded ecosystems as a contribution to achieving the EU's overall removal targets. This option would quantify hectares of degraded ecosystems to be restored but not necessarily amounts of CDRs.
- a commitment to generate a specific amount of CDRs through restoring degraded ecosystems.

This option can build on a **number of other commitments,** including SDG goal 15.3 (Land Degradation Neutrality) and the Aichi Biodiversity Target 15. It can also build on new political momentum. In its EU biodiversity strategy, the Commission announced that it "*will put forward a proposal for **legally binding EU nature restoration targets in 2021** to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters*".

With much of Europe's land already taken up by agriculture, urban areas and other infrastructure, **the restoration of degraded ecosystems is effectively the most realistic and sustainable way to remove amounts of CO_2:**

- According to the European Commission[18], 500 $MtCO_2e$ could be removed annually by 2050 through forest management and afforestation, but other studies project up to 1,000[19] or even 1,200 $MtCO_2e$.[20]
- Crucially, restoration offers very significant co-benefits for biodiversity, water and soil. It is an indispensable element of the EU's biodiversity strategy.

[18] European Commission (2018): In-Depth Analysis In Support Of The Commission Communication COM (2018) 773 https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf, p. 186
[19] Lange, M., Eisenhauer, N., Sierra, C. et al. Plant diversity increases soil microbial activity and soil carbon storage. Nat Commun 6, 6707 (2015). https://doi.org/10.1038/ncomms7707
[20] Roe, S., Streck, C., Obersteiner, M. et al. Contribution of the land sector to a 1.5 °C world. Nat. Clim. Chang. 9, 817–828 (2019). https://doi.org/10.1038/s41558-019-0591-9

- Although the carbon sequestration flow decreases as trees age, studies show that large trees have high productivity rates and that even old forests continue to provide significant carbon sequestration. Young forests, in contrast, are often sources of CO2 because their creation frequently follows disturbance to soil resulting in CO2 emissions that can exceed the CO2 reabsorbed through the growth of young trees.[21]
- Healthy ecosystems are more resilient to many of the consequences of the climate crisis, such as storms, pests, diseases and droughts.

In light of these co-benefits and the limited amount of available land in Europe, the **restoration of degraded ecosystems is a no-regret option and the preferred CDR option.** It is positive that the Commission intends to propose legally binding EU nature restoration targets in 2021, in particular for ecosystems with the greatest CDR and resilience potential. This proposal or a delegated act could also define ecosystem restoration in detail.

What is ecosystem restoration?

Pursuant to the definition of the Commission's Biodiversity Strategy Impact Assessment, restoration of degraded ecosystems means: "In many cases full restoration would require measures to overcome the long-term impacts of some pressures, [...]."[22] According to other definitions, restoring means that a degraded area moves up one level to a better ecological status, or the restoration of the key species, properties and processes of ecosystems and their functions.[23]

4.4 Removal targets for other CDR concepts?

There are various ways how technology-based concepts can remove CO_2 from the atmosphere – DAC, BECCs, EW (see above). According to some studies, these concepts could have significant removal potentials[24] but at this point in time none of them are nearly capable of removing the required quantities of CO_2 from the atmosphere. Currently, there is **no technology-based CDR concept that is reliable, safe, sustainable, economically viable, and** widely politically accepted. BECCS, for example, holds the risk of repeating past mistakes in EU bioenergy support, damaging biodiversity, soils and water. Future technological innovation could change this but this is uncertain.

Because of these uncertainties, it is **not possible to quantify CDRs from these concepts**, and – in consequence – to set a quantified contribution from concepts to achieving removal targets. Instead, it is more useful to introduce criteria to make technological removals eligible for meeting CDR targets.

[21]Gaëtan du Bus de Warnaffe, Sylvain Anger: Forest Management and Climate Change: A new approach to the French mitigation strategy, 2020: https://www.fern.org/fileadmin/uploads/fern/Documents/2020/Study-Forest-Management_Climate-Change.pdf
[22] European Commission, Impact Assessment Biodiversity Strategy, 3.5.2011 SEC(2011) 540 final
[23] Lammerant, Johan; Peters, Richard; Snethlage, Mark; Delbaere, Ben; Dickie, Ian; Whiteley, Guy. (2013) Implementation of 2020 EU Biodiversity Strategy: Priorities for the restoration of ecosystems and their services in the EU. Report to the European Commission. ARCADIS (in cooperation with ECNC and Eftec).
[24] James Mulligan et. al.: Carbonshot: Federal policy options for Carbon Removal in the United States, https://wriorg.s3.amazonaws.com/s3fs-public/carbonshot-federal-policy-options-for-carbon-removal-in-the-united-states_1.pdf

Criteria could include, for example, permanence, sustainability and innovation. The sustainability criteria should take account of life-cycle emissions, energy efficiency, use of renewable energy, impacts on biodiversity, water and soil. Learning from past mistakes, notably in the area of biofuel support, these criteria need to be implemented by a robust compliance system. A commitment to engage in research on CDR technologies should complement this system. A Commission's delegated act could define these criteria in detail and with legal force. Alternatively, a guiding document from the Commission could also define criteria – in this case without legal force.

5 Involving Member States: National removal targets, reference values or pledges?

There are various ways of how to commit Member States to contribute to an EU CDR target:

- **Legally binding quantitative CDR targets for Member States:** In this option, Member States are legally obliged to remove specific amounts of emissions from the atmosphere – either measured in tonnes or percentage shares of overall emission reductions. In terms of design, this option is similar to the Climate Action Regulation (CAR), which sets out legally binding reduction targets for Member States. It is also akin to the 2009 Renewable Energy Directive (RED), which legally obliges Member States to meet specific national targets for shares of renewable energies in energy consumption. The distribution of national targets would take account of national circumstances, applying criteria such as natural removal potential or per capita income.
- **Quantified non-binding reference values for Member States:** Legally non-binding, quantified reference values are another option. Member States must take reference values into account when designing their CDR policies. This system is similar to the 2001 Renewable Energy Directive that guided Member States' policies through non-binding reference values.
- **Area targets for restoring degraded ecosystems:** To contribute to an EU restoration target, Member States could be obliged to restore hectares of degraded ecosystems.
- **Member States pledge to restore a certain amount of degraded ecosystems and to remove specific quantities of CO_2:** Member States could be obliged to pledge the restoration of certain amounts of degraded ecosystems.[25] Alternatively, they could also be required to pledge to generate specific quantities of CDRs. Member States could be required to base their pledges on qualitative criteria or quantified but non-binding reference values. This option is similar to the pledge and review system of the Governance Regulation. It is also similar to the system of the Paris Agreement.

[25] This option builds on the logic of the so-called "Bonn Challenge". The Bonn Challenge is a global effort to restore 150 million hectares of the world's deforested and degraded land by 2020, and 350 million hectares by 2030. To contribute to this objective, several governments, but also private companies and community groups, have publically pledged to re-store a certain amount of degraded forests. The Global Partnership on Forest and Landscape Restoration (GPFLR) reviews these pledges on a voluntary basis.

	Advantages	Disadvantages
Legally binding quantitative CDR target for MS	• Highest possible commitment. • Solid basis for verification and review. • Strong in holding MS accountable, possible basis for infringement procedures. • Allows to take account of different national circumstances • Established methods of engaging MS in related policy fields	• Politically difficult, in particular if legal basis were Article 192.2[26], which requires unanimity in Council.
Quantified non-binding CDR reference values	• Politically relatively ambitious but less difficult to adopt because probable legal basis is Article 192.1[27], which does not require unanimity in Council and Parliament is full co-legislator. • Quantitative reference values are a fairly solid basis for verification and review.	• Weaker commitment • Compliance weaker than legally binding targets as evidenced by relevant experiences in renewable energies.
Quantified restoration targets	• Solid basis for verification • Strong in holding MS accountable, infringement procedures possible. • Support to implement the biodiversity targets	• Measuring the restoration of degraded forests and corresponding CDRs is methodologically challenging. • Target achievement depends on natural processes, such as drought, fires or disease, which are difficult to control.
Pledge and review	• Political support for this option might be higher than for the previous options.	• Qualitative criteria weaken the Commission's ability to challenge pledged contributions.

[26] Meyer-Ohlendorf, Nils; Ana Frelih-Larsen (2017): EU climate policies: friend, foe or bystander to forest restoration and carbon sinks? EU Climate Governance for restoring degraded forests. Ecologic Institute: Berlin

[27] Meyer-Ohlendorf, Nils; Ana Frelih-Larsen (2017): EU climate policies: friend, foe or bystander to forest restoration and carbon sinks? EU Climate Governance for restoring degraded forests. Ecologic Institute: Berlin

6 EU removal targets – where is the best legal home?

The new EU Climate Law (ECL), the LULUCF Regulation, the Climate Action Regulation, the Emission Trading Directive, and new legislation containing a nature restoration target **could host the EU CDR targets** – using any of the design options discussed above. Depending on the scope of the CDR target, **each option has specific advantages and disadvantages**

	Advantages	Disadvantages
ECL	• Contains EU climate targets, most likely neutrality target for 2050, possibly also for 2030 and 2040. • The ECL will contain the climate neutrality target. To specify this target, the ECL could define climate neutrality target as percentage shares of emission reductions and – as an auxiliary tool – removals. • Sets overall EU climate architecture	• Not tested or established • Focus on mitigation, only to some extent on adaptation and sinks
ETS	• Established system of target setting and compliance • Covers energy production. With BECCS, this sector could remove CO_2 – not in the near future, but possibly in the long-term • Essential driver for emission reductions and – ultimately climate neutrality – in the sectors covered.	• In terms of climate protection, monitoring and enforcement, reductions and CDRs are distinctively different and must not be treated equally. This makes the inclusion of CDRs[28] in the ETS problematic, but very high discount factors might address this problem, e.g. 10 CDR units equal an EUA. • Covers some sectors probably not capable of removing CO_2 in the near future, such as steel, cement. • BECCS has many negative impacts on biodiversity, land, water and soil, unproven climate benefits. • CDR could make LRF increases more difficult and could decrease carbon prices, possibly locking in fossil fuel use.

[28] Wilfried Rickels et al.: The Future of (Negative) EmissionsTrading in the European Union: https://www.ifw-kiel.de/fileadmin/Dateiverwaltung/IfW-Publications/Wilfried_Rickels/The_Future_of__Negative__Emissions_Trading_in_the_European_Union/KWP_2164.pdf

		• Instead of CDR eligibility, a separate market for CDRs trading might be considered. [29]
Climate Action Regulation (CAR)	• Established system: legally binding and quantified targets, review and compliance • To achieve its climate neutrality target, the EU has to commitment to reduce emissions drastically and to generate – to a limited extent – CDRs. CAR needs to support this process. • Essential driver for emission reductions and – ultimately climate neutrality – in the sectors covered. • Already links mitigation and removals but only to a limited extent through flexibilities.	• Concerns similar to ETS, as discussed above: CDRs and AEAs are inherently different. • Covers only specific sectors • No clear link to CDRs • Covered sectors not capable of removing CO_2 in meaningful amounts in the near future, possibly not even in the long-term.
LULUCF Regulation	• With its no debit rule, LULUCF regulation already contains a removal target – in principle. • Covers natural sinks, the most relevant CDR • Already works with CO_2 removals, e.g. Member States can buy and sell net removals from and to other Member States.	• Covers “only” natural sinks • No link to new technologies, i.e. unable to drive technological innovation.
New legislation for restoration target	• Possibly legally binding and quantified target • Contains rules on ecosystem restoration • It is possible to design the target in a way that aligns restoration and CDR generation.	• Not primarily designed to remove CO_2

[29] Duncan P. McLaren et al. Beyond “Net-Zero”: A Case for Separate Targets for Emissions Reduction and Negative Emissions, 2019, https://www.frontiersin.org/articles/10.3389/fclim.2019.00004/full

In light of these advantages and disadvantages as well as the CDR criteria above, there is a **strong case to include a separate CDR target – legally binding and quantified – into the new EU Climate Law**.

- In all likelihood, the ECL will contain the climate neutrality target. To specify this target, the ECL could define climate neutrality target as a very large percentage shares of emission reductions and – as an auxiliary tool – a small amount of CDRs, for example of *at least* 95 % reduction and *no more than* 5 % CDRs – in line with the Commission's 1,5°C LIFE scenario and similar to the Swedish system (box above).[30]
- This system would ensure high levels of commitment, a solid basis for verification and – in consequence – accountability.
- With its small but specified maximum amount of CDRs, it would address concerns that CDRs serve as pretext for delaying emission reductions. With a clear preference for removals through restoring degraded ecosystem – the no regret CDR option – it would combine climate action and nature protection. Given persisting uncertainties and risks around technical CDR concepts, the CDR target should determine clearly that CDR technologies are secondary to restoring degraded ecosystems.

The **LULUCF regulation could support the ECLs overall targets** through a legally binding and quantified CDR sub-targets *for land use sectors* – primarily through the restoration of degraded ecosystems, with support from the envisaged legislation on ecosystem restoration. Improving the current no debit rule, the revised LULUCF regulation would set a quantity of CDRs to be generated from the land sectors. The new EU ecosystem restoration target could also feature a CDR target in addition to a hectares target.

Given today's lack of adequate and sustainable CDR technologies, the **ETS directive and CAR cannot include quantified removal targets– at this point**. Theoretically, BECCS is an option to generate CDRs in the ETS sectors but because of its many environmental problems and the negative lessons of EU biofuel target, EU law should not contain a quantified target for CDR generated by BECCS.

[30] The 1.5 LIFE scenario under the EU long term strategy assumes that sinks account for 6-9% of the EU's overall efforts to achieve climate neutrality by 2050. This could suggest domestic reductions of 95% (compared to 1990) and removals by 5%.

7 Putting CDR targets into the EU Climate Law (based on COM proposal)

Article 2 (amendments in bold)

1. Union-wide anthropogenic emissions by sources and removals by sinks of greenhouse gases regulated in Union law shall be balanced in the Union at the latest by 2050, thus achieving net zero greenhouse gas emissions by that date. ***Net zero greenhouse gas emissions shall be primarily achieved by reducing emissions covered by this Regulation and – as an auxiliary means – by carbon removals as specified in Article 2a (below).***

2. […]

New Article 2a: Carbon dioxide removal targets

1. As an auxiliary means to the achievement of the targets referred to in article 2, the European Commission shall present legislative proposals by 30 June 2021, where appropriate, to the European Parliament and to the Council to establish separate union-wide targets for removals of emissions covered by this Regulation by natural sinks, to be achieved primarily through the restoration of forests and other ecosystems.

2. Removals of emissions covered by this Regulation through technical sinks shall be an eligible means of achieving the targets referred to in paragraph 1 if these technical sinks ensure sustainable, permanent and safe removals of greenhouse gas emissions covered by this Regulation from the atmosphere. By 30 June 2021, the Commission shall adopt guidance (alternative: delegated act) defining the technical sinks that are eligible for this purpose.

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