Natural Carbon Cycles

Feedback EC Communication
Sustainable Carbon Cycles

Climate Cleanup Foundation
with ecosystem partners
April 2022
About this document

This document reflects the collected feedback from the natural carbon removal sector, as collected by Climate Cleanup Foundation with ecosystem partners* to the European Commission Communication ‘Sustainable Carbon Cycles’, dated 15.12.2021 (hereafter “the Communication”).

Financial support for this paper has been provided by the over 250 independent members of Climate Cleanup 1500 Club, who enable the authors to work without financial or other interests in the emerging carbon removal sector, other than those of future human generations and other life on earth. We like to express our gratitude.


Authors: Thomas Hobé, Sven Jense, Thyrza Zoons with suggestions by Anubhav Mohiley, Sam Zak.

Contact

Climate Cleanup Foundation
Moezelhavenweg 9, 1043 AM
Amsterdam, The Netherlands
sven@climatecleanup.org
www.climatecleanup.org

Climate Cleanup is a Public Benefit Organisation (PBO / ANBI)
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC Consultation</td>
<td>4</td>
</tr>
<tr>
<td>Recommendations</td>
<td>5</td>
</tr>
<tr>
<td>1. Follow the IPCC and define four MRV Protocols for Nature-based Solutions</td>
<td>5</td>
</tr>
<tr>
<td>Land Stored Carbon (LSC)</td>
<td>6</td>
</tr>
<tr>
<td>Construction Stored Carbon (CSC)</td>
<td>6</td>
</tr>
<tr>
<td>Ocean Stored Carbon (OSC)</td>
<td>8</td>
</tr>
<tr>
<td>Rock Stored Carbon (RSC)</td>
<td>9</td>
</tr>
<tr>
<td>2. Align the certification framework to financial sector structures and initiatives, including the PCAF Framework</td>
<td>10</td>
</tr>
<tr>
<td>Partnership Carbon Accounting Financials (PCAF)</td>
<td>10</td>
</tr>
<tr>
<td>ZEP Core CDR accounting and Oxford principles</td>
<td>11</td>
</tr>
<tr>
<td>The four core CDR accounting principles</td>
<td>11</td>
</tr>
<tr>
<td>3. Choose value chain-based empirical-crediting approaches with checks on biodiversity, additionality and permanence</td>
<td>12</td>
</tr>
<tr>
<td>Value chain-based MRV Protocols</td>
<td>12</td>
</tr>
<tr>
<td>Stocks vs Flux Based Carbon Accounting</td>
<td>12</td>
</tr>
<tr>
<td>Empirical crediting</td>
<td>13</td>
</tr>
<tr>
<td>Open Holistic framework</td>
<td>14</td>
</tr>
<tr>
<td>Conclusions</td>
<td>16</td>
</tr>
<tr>
<td>Sources</td>
<td>17</td>
</tr>
</tbody>
</table>
EC Consultation

The European Commission in its communication ‘Sustainable Carbon Cycles’ expresses the ambition of:

“developing a EU framework for the certification of carbon removals, based on robust accounting rules, for high-quality sustainable carbon removals from both natural ecosystems and industrial solutions.”

Recognizing that carbon removal through nature regeneration is necessary in order to reach the targets under the Paris Agreement, Climate Cleanup works with entrepreneurs to help implement natural carbon removal solutions. With regard to nature-based removal pathways it has been estimated that the maximum cost-effective potential thereof is around 11.3 Gt of CO2 equivalent (GtCO2e) per year\(^1\), which is a major contribution as compared to the current anthropogenic emission level of 42.1 GtCO2e per year, and counts for a >66% chance of limiting global warming to 2°C. On top of that, many Nature-based Solutions (NbS) have ‘additional’ benefits for social, human and other ecosystems. For these reasons, our recommendations focus on carbon removal through natural carbon removal pathways. In this paper we suggest three structural improvements for enhancing the support for NbS in the proposed carbon removal certification framework:

1. Follow the IPCC and define four Nature-based Solutions MRV Protocols
2. Align the certification framework to financial sector structures and initiatives including the PCAF Framework;
3. Choose value chain-based empirical-crediting approaches with checks on biodiversity, additionality and permanence.

These recommendations are further elaborated on below.

---

Recommendations

1. Follow the IPCC and define four MRV Protocols for Nature-based Solutions

The Communication from the Commission to the European Parliament and the Council on Sustainable Carbon Cycles focuses on developing an EU framework for the certification of carbon removals on land and mentions the opportunities in our oceans. The IPCC, more recently, (AR6, Chapter 12) defines more pathways towards carbon removal (Image 1a and 1b.).

We recognise these pathways as effectively framing potentially scalable and regenerative Nature-based Solutions (NbS). For these reasons, Climate Cleanup would suggest developing general MRV (Monitoring, Reporting and Verification) protocols not only for Land Stored Carbon but also for Rock Stored Carbon, Construction Stored Carbon and Ocean Stored Carbon. This would amount to four general MRV Protocols for carbon removal through NbS: land and agriculture, oceans (e.g. seaweed farming), rock weathering (‘enhanced weathering’ e.g. with olivine) and construction in the built environment (e.g. wood, flax, grasfalt, hempcrete). The main reason for these additions is that these removal pathways are physically very scalable (rock weathering and oceans in particular), as well as bring many other benefits.
Land Stored Carbon (LSC)

Carbon stored in land (e.g., afforestation, carbon farming) has been well addressed in the current Communication. Our main recommendation is to develop a general MRV Protocol that prescribes the preferred use of available data sources and frameworks. Current well-established carbon accounting practices can be simplified using empirical crediting methods, where actual measurements in the soil are leading, and above ground biomass in non-forestation projects is estimated according to the weight and kind of produce that leaves the land - data that often is collected anyway.

Construction Stored Carbon (CSC)

Land Stored Carbon projects can be much more effective when the carbon in ‘above ground biomass’ is fixed for a longer time period in building materials. Materials like wood and straw, when used in constructions (buildings), keep carbon out of the atmosphere for as long as the materials exist. In a circular economy that might be easily longer than 100 years, at which point the IPCC considers it to be permanent. This opens a whole new route to carbon sequestration, which has a multiplier effect: for every ton of CO₂ stored in buildings (in the form of carbon), about 1,2 tons of CO₂

---

2 Empirical Crediting principles have been described by Carbon Plan: [https://carbonplan.org](https://carbonplan.org), [https://carbonplan.org/research/soil-protocols-explainer](https://carbonplan.org/research/soil-protocols-explainer).
emissions from materials like concrete and steel are prevented\textsuperscript{3}. And where trees perhaps grow slowly, ‘construction crops’ like bamboo, hemp, silphie, grow about five times as fast. They are perennial crops, meaning the roots stay in the ground, sequestering more carbon, using less fertilisers and herbicides, while improving soil health. Construction Stored Carbon thus offers a new business model for farmers. This carbon business model is not capped by the capacity of the soil to hold carbon (which saturates at a certain level), but can facilitate continued revenue streams.

Permanence, the expected duration of the storage, is a central issue for Construction Stored Carbon for which a promising approach has been developed by the project partners. We deal with the temporal dimension by first, assessing that in the circular economy materials can not be burned but must be recycled. Secondly, the amount of stored carbon is calculated to align with IPCC conventions for permanent storage. The resulting metric is shown in Box 1.

\begin{equation}
CSC = V \times p \times C/W \times \frac{(L + (v \times Lr)(max100))}{100}
\end{equation}

Box 1. Construction Stored Carbon metric with provisions for estimating storage permanence.

With ASN Bank and Gideon building innovators, Climate Cleanup created a financial metric for measuring CSC, within the framework of the Partnership Carbon Accounting Financials (PCAF). The metric and its adoption can be found at http://constructionstoredcarbon.org.

These foundational ideas and metric offer a basis for a general MRV protocol for carbon sequestration in the built environment.

\textsuperscript{3} See Construction Stored Carbon metric, ASN Bank, Gideon and Climate Cleanup 2021. http://constructionstoredcarbon.org
Ocean Stored Carbon (OSC)

The Communication mentions the lack of understanding on carbon removals in the marine environment, also called ‘blue carbon’, which is an important recognition. However, blue carbon solutions are then not at all mentioned in Chapter 5 ‘Conclusion’. It is important to account for the potential of blue carbon in the regulatory framework for carbon removal, to the extent that our current knowledge allows for. This will create the space and opportunities necessary to further exploit blue carbon potential and strengthen the business case for carbon removal growth in the EU (e.g. seaweed sector, aquaculture sector, etc). There are five reasons as to why carbon farming along the coast and particularly on open oceans deserves special attention and space for growth.

1. The high carbon fixation rates and carbon sequestration potential of many marine ecosystems, such as mangroves, seagrasses, seaweeds and mudflats;
2. The vast number of people benefiting directly from this type of solution: the majority of the global population resides at or in proximity to the coast, which means that the human-felt effects of climate change will also concentrate here. In order to protect and adapt our global society in the face of climate change, investing in carbon farming projects (that often also provide climate adaption, social and economic benefits) is the most effective approach;
3. The vast amount of global area covered by marine and coastal ecosystems that is yet to be deployed for regenerative carbon farming solutions indicates high scalability, particularly in mostly empty areas of the open ocean. For instance, Marine Permaculture with deepwater irrigation systems are promising and scalable pathways towards gigaton production and sequestration scale;
4. Blue carbon storage approaches that store it in sediments have a high degree of permanence, that may be up to thousands to millions of years in some cases (Sarmiento and Sundquist, 1992);
5. Moreover, approaches that store carbon through biomass exported to the deep ocean will also have a carbon sequestration storage of hundreds to thousands of years (DeVries and Primeau, 2011; Gebbie and Huybers, 2012) depending on location, reflected by radiocarbon dating of the age of abyssal ocean waters, easily enabling them to qualify for carbon credits that the IPCC considers permanent. Indeed, in a climate disrupted world deep ocean storage may prove to be more reliable than terrestrial storage (e.g. wildfires that may rapidly destroy forest carbon stocks);
6. The research and development gap that conceals relatively large advancements that are yet to be realised in carbon removal and other impact dimensions (e.g. biodiversity, employment); and
7. Marine and coastal systems are highly interconnected, which will ease a spill-over of positive benefits to adjacent ecosystems and social systems. This concept is commonly referred to as 'seascape connectivity'.

Rock Stored Carbon (RSC)

Enhanced weathering of minerals is a rapidly emerging natural carbon removal pathway. The process is a chemical reaction of minerals with carbon dioxide (in the form of carbonic acid), which plays a major role in the earth's carbon cycle since before life on earth began. The main reasons for including this sequestration pathway are:

1. **Scalability.** Rocks like olivine and wollastonite are abundantly available. For example, Myers et al (2020) concluded that just the available olivine in Japan would be sufficient to remove 7,6GT CO₂ per year;
2. **Technical feasibility.** The processes to obtain the minerals from quarries, process (grind) and transport them are well developed and widely deployed;
3. **Permanence.** The removal pathway consists of a chemical process that results in storage over geologic (1000 year +) timespans;
4. **The research and development gap** that conceals relatively large advancements that are yet to be realised in carbon removal, ecosystem effects and other impact dimensions (e.g. biodiversity, employment); and
5. **Interconnectedness** and synergies with land and marine solutions, with substantial potential for coastal applications which will combine adaptation (protection from rising sea levels) with mitigation (carbon sequestration); eg. Project Vesta.

When enabling all these four removal sectors, all types of carbon innovators (e.g., carbon farmers growing construction crops, seaweed farmers, entrepreneurs developing enhanced rock weathering processes and builders using bio-based construction materials) are given space for growth. As the Communication explains that carbon farming is potentially a business model for healthier ecosystems, a framework including all four realms could help a wider variety of EU sectors to grow and pioneer in innovation and economic carbon removal opportunities.
2. Align the certification framework to financial sector structures and initiatives, including the PCAF Framework

A good opportunity to increase impact and efficiency of the carbon removal certification framework lies in aligning with financial sector stakeholders. Following financial sector conventions can have at least four advantages:

1. **Faster adoption** of the framework when financial sector players are methodologically aligned;
2. **More investments** in the carbon removal solutions, as financials aligned with the metrics are more effective in their due diligence processes;
3. Support the **re-routing of capital**: divestment from fossil resource players and re-investment into circular and sustainable emerging carbon removing industries;
4. **Support against vested interest pushback** (e.g. from energy or agricultural sector stakeholders), especially since financial sector players lik (re)insurance companies have a good view on climate risks.

Especially the very widely accepted Platform Carbon Accounting Financials (PCAF), which currently covers over 70 trillion Euro of capital under management,⁴ offers a major opportunity.

**Partnership Carbon Accounting Financials (PCAF)**

The Partnership Carbon Accounting Financials (PCAF) laid out now well accepted core principles of greenhouse gas accounting for the financial sector in the PCAF Accounting and Report standard report (PCAF 2020), which builds on the principles as set out by GHG Protocol⁵. Following GHG Protocol the standard requires scope 1, 2 and 3 inventories⁶ to be complete, consistent, relevant, accurate and transparent, with additional PCAF requirements for recognition, measurement, attribution, data quality and disclosure. These principles all apply to carbon removal accounting as well. The requirements for ‘measurement’ in the PCAF principles already have a provision for carbon removal, stating that “… removed emissions can also be measured if data is available and methodologies allow” (PCAF 2020, p34). Climate Cleanup and partners strongly advise to align the new carbon removal certification framework with the widely recognised PCAF Standard.

---

⁴ [https://carbonaccountingfinancials.com/financial-institutions-taking-action#overview-of-financial-institutions]


⁶ Scope 3 refers to indirect emissions related to products or services earlier or later in the value chains. They are opposed to scope 1 (direct) and scope 2 (indirect energy related) emissions.
ZEP Core CDR accounting and Oxford principles

To define when a practice can be considered to lead to actual carbon dioxide removal (CDR), Tanzer and Ramírez have laid out four principles (Tanzer & Ramírez 2019). These principles have been extensively quoted and analysed by the EU funded Zero Emissions Platform (ZEP 2021). The UK Workgroup on ‘Greenhouse Gas Removals’ chose to adhere to these core principles. While these principles might seem obvious in the current context, we think aligning around them will provide clarity for the sector. These principles include clean provisions on permanence. In addition, the Commission could decide to align its efforts with the Oxford Offsetting Principles.\(^7\)

### The four core CDR accounting principles

1. Carbon dioxide is physically removed from the atmosphere.
2. The removed carbon dioxide is stored out of the atmosphere in a manner intended to be permanent.
3. Upstream and downstream greenhouse gas emissions, associated with the removal and storage process, are comprehensively estimated and included in the emission balance.
4. The total quantity of atmospheric carbon dioxide removed and permanently stored is greater than the total quantity of carbon dioxide equivalent emitted to the atmosphere.

\(^7\) [https://www.ox.ac.uk/news/2020-09-29-oxford-launches-new-principles-credible-carbon-offsetting](https://www.ox.ac.uk/news/2020-09-29-oxford-launches-new-principles-credible-carbon-offsetting)
3. Choose value chain-based empirical-crediting approaches with checks on biodiversity, additionality and permanence

Value chain-based MRV Protocols

We suggest developing carbon removal accounting and certification rules as Value-chain based MRV ‘Protocols’. Currently available certification ‘methods’ for carbon removal accounting are based on project-level approaches, making the certification process needlessly complicated and expensive; certification needs to happen again at sometimes every harvest and the exact use of the resulting crop has to be evaluated beforehand. Value-chain based crediting, especially for construction crops (Construction Based Carbon) but also for Ocean and Rock weathering based value-chains, can vastly reduce complexity. Carbon stored in materials can at the product level (e.g. a wooden building element) be traced back to its origin, often building on well established rules and regulations about process emissions (like FSC/PEFC), from field to factory to construction project. Also, this approach can help to distribute carbon credit income over the value chain, making sure that the whole chain, including farmers, are equally compensated. The graphic example of a Construction Stored Carbon value chain below shows the number of potential stakeholders in a chain, and thus the inherent complexity of project-based carbon removal accounting. Chain-based certification practices serve to simplify the process while still adhering to sufficient rigour and transparency.

![Image 3. Example of a Construction Stored Carbon value chain (in Dutch). Source: Jan Willem van de Groep (Gideon).](image)

Stocks vs Flux Based Carbon Accounting

Many methodologies for monitoring, reporting and verification of carbon sinks rely on stock based approaches. That is to say, approaches that measure the accumulation of carbon within a fixed area, such as a terrestrial forest or in nearshore sediments. Often, these approaches rely on measuring carbon accumulation against baselines.

Such measurement approaches may not be appropriate for all contexts, notably for enhanced weathering, construction material as well as blue carbon sequestration approaches that sequester carbon through exporting biomass to abyssal waters of the deep ocean. For instance, for seaweed mariculture evidence shows a portion of the biomass will fall off cultivated seaweeds naturally during growth, like leaves falling off a tree (Duarte and Cebrian, 1996; Krause-Jensen and Duarte, 2016;
Ortega et al., 2019; Oceans 2050). For offshore seaweed mariculture platforms operating in deep water of >300m, the biomass that sinks to the seafloor will be either buried in sediments or respired by fauna or microbes, enabling it to be sequestered as dissolved inorganic carbon in abyssal waters. Scientific evidence from radiocarbon dating of the age of abyssal waters shows that respired carbon in abyssal waters will be sequestered for centuries to millennia depending on location, until it eventually makes contact with surface ocean waters. However, carbon measurement approaches based upon stock carbon accumulation and in situ measurements of carbon accumulation are likely to be unfeasible or ineffective in accounting for such approaches.

Carbon verification approaches based on measuring the flux of carbon to the deep ocean are likely better suited to such approaches and will provide similar levels of reliability. By measuring the quantity of biomass falling off platforms through nets and sediment traps per unit time over the course of a growing season, the total amount of biomass being shed from a seaweed platform can be determined. Tracking the sinking speeds of macroalgae through the water column and ocean currents will provide an indication of how much biomass might be eaten by marine life before it reaches sequestration horizons depths or the seafloor. Once at these depths, reference to physical oceanographic evidence such as the age of water and deep ocean currents will provide a robust indication of the length of time the biomass will be sequestered from atmospheric exchange. The increased flux at the site can be compared with nearby control sites.

While such flux based carbon measurement approaches are relatively new, they show great potential in enabling new carbon sequestration approaches to help meet the objectives of the Paris Agreement.

**Empirical crediting**

Accounting for carbon reduction credits comes with difficulties about establishing baseline, additionality, and lack of hard data. For instance, the factors facilitating ‘non-deforestation’ are many (political, economic, legal, etcetera) and setting the baseline as the ‘chance that a forest will be cut’ will remain arbitrary. Carbon removal is a fundamentally different process. Crucially, the actual carbon removed can be measured and – in products – weighted. This has led the NGO Carbonplan to describe the concept of Empirical Crediting, which bases carbon removal accounting on actual data. Following this advice, it seems that removal credits can be accounted for using simpler approaches than reduction credits. See also [https://carbonplan.org/research/soil-protocols-explainer](https://carbonplan.org/research/soil-protocols-explainer).
Open Holistic framework

The removal of carbon dioxide is one of the many sustainability benefits associated with climate change mitigation. However, meaningful and impactful carbon removal must assure a net positive outcome with regards to the other sustainability dimensions as well. A framework must enable holistic ecosystem approaches and sectoral crossovers. Nature based solutions offer a framework for valuing the systemic multiple benefits of nature based removal pathways, as opposed and in addition to industrial approaches. Industrial technologies like amine based direct air capture developed so far are energy intensive, while nature based solutions use direct solar energy.

The SDGs are one way to consider these multiple sustainability dimensions on a global scale, but most are not one-on-one applicable to the level of carbon removal projects. It is therefore essential that the SDGs are translated into local scale impact dimensions. The dimensions of the ‘Safe and Just Operating Space’ (a concept developed by economist Kate Raworth, also known as ‘the Doughnut’)

Image 4. Doughnut economic model with shortfalls and overshoots. Source: doughnuteconomics.org


14
Table 1. Doughnut economics dimensions on social foundation and ecological ceiling.

<table>
<thead>
<tr>
<th>A social foundation that should be maintained whilst removing carbon:</th>
<th>An ecological ceiling that should be protected by removing carbon:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Water</td>
<td>1. Climate change</td>
</tr>
<tr>
<td>2. Food</td>
<td>2. Biodiversity loss</td>
</tr>
<tr>
<td>3. Health</td>
<td>3. Ocean acidification</td>
</tr>
<tr>
<td>4. Education</td>
<td>4. Chemical pollution</td>
</tr>
<tr>
<td>5. Income &amp; Work</td>
<td>5. N&amp;P loading (nutrients)</td>
</tr>
<tr>
<td>7. Political Voice</td>
<td>7. Land conversion</td>
</tr>
<tr>
<td>8. Social equity</td>
<td>8. Air pollution</td>
</tr>
<tr>
<td>9. Gender equality</td>
<td>9. Ozone layer depletion</td>
</tr>
<tr>
<td>10. Housing</td>
<td></td>
</tr>
<tr>
<td>11. Networks</td>
<td></td>
</tr>
<tr>
<td>12. Energy</td>
<td></td>
</tr>
</tbody>
</table>

For many of the above mentioned dimensions, a connection can be made with existing EU policy fields and their sustainability strategies (e.g. food production, employment, clean air). In addition, we strongly recommend to adhere to open source and open data principles, as this will enable learning effects across the sector, in both carbon accounting and other fields of much needed innovation.
Conclusions

The EU framework for the certification of carbon removals should include four realms: land, oceans, rocks and constructions. The framework must also acknowledge the possibility for future additions and changes, encourage and support Open Source and Open Access data sharing, in order for innovation to add to the knowledge commons and foster the necessary growth of the carbon removal sector. Co-benefits beyond carbon removal should be included in order to avoid trade-offs with and counteracting impacts on other sustainability dimensions, ranging from ecological to social and economic aspects. Alignment with financial sector initiatives like the Platform Carbon Accounting Financials is highly recommended. If the regulatory framework is to promote true scaling and growth of the carbon removal capacity in the EU, it should follow a chain-based approach as opposed to the conventional project-level approach, as this will engage and reward all stakeholders in the value chain.
Sources

https://carbonplan.org, on empirical crediting:
https://carbonplan.org/research/soil-protocols-explainer

Climate Cleanup on simplifying carbon accounting (Tijn Tjoelker 2021)
https://medium.com/climate-cleanup/the-business-case-for-nature-eccc28acc47c

Doughnut Economics. http://doughnuteconomics.org

Duarte and Cebrian, 1996 The fate of marine autotrophic production


Krause-Jensen and Duarte, 2016 Substantial role of macroalgae in marine carbon sequestration


Oceans 2050 Global Seaweed Project

Ortega et al., 2019 Important contribution of macroalgae to oceanic carbon sequestration


https://www.thelancet.com/journals/lanplh/article/PIIS2542-51961730028-1/fulltext


Zero Emissions Platform (2021)