UNFCCC Article 6 Call for Input

The German Biochar Association (in German: Fachverband Pflanzenkohle e.V. - abbreviated as FVPK) appreciates the opportunity to provide commentary and input regarding Article 6.4 (especially on the information note A6.4-SB005-AA-A09 version 0.40) and the integration of carbon dioxide removal – more specifically: the integration of biochar carbon removal (BCR).

Fachverband Pflanzenkohle e.V. was founded in 2017 with the goal to support and promote biochar production and applications to permanently remove and store carbon dioxide from the atmosphere and thus contribute to climate and environmental protection efforts. Together with well over 200 members from Germany and Europe we advocate for the sustainable production and material applications of biochar through biomass pyrolysis. We consider ourselves partners for science, industry and manufacturers as well as policy makers. We promote biochar as an innovative key technology which will play a significant role in reaching the global climate objectives alongside drastic greenhouse gas emission reduction efforts.

Introduction to Biochar Carbon Removal

FVPK strongly agrees with the scientific community's opinion expressed in the IPCC reports that emphasize the mandatory provision of carbon removals combined with relentless global greenhouse gas emission reduction efforts. The need for carbon dioxide removal (CDR) has to be accepted as common sense and must be included in any climate protection efforts.

Biochar Carbon Removal (BCR) and **Pyrogenic Carbon Capture and Storage (PyCSS)** [1], are currently used as synonyms describing the same process, i.e. the pyrolysis of biomass to generate biochar, pyrolysis-oil and -gas. While pyrolysis-oil and -gas are mostly used to produce clean energy, biochar is used in applications that effectively avoid rapid oxidation of carbon in biochar and thus achieving a carbon removal.

BCR/PyCCS is based on the permanence of biochar in the environment: biochar contains carbonaceous compounds of different chemical composition and stability. At least approx. 75% of biochar carbon applied to soil is stable at least for millennia, up to 25% may decay within decades.[2] [3] [4] The ratio of stable to unstable carbon in biochar is determined mostly by the production parameters. Biochar's permanence is subject of current scientific discoveries and discussion that will be elaborated further within this response (see section on MRV and Permanence below).

---

[1] Schmidt, H.-P., Anca-Couce, A., Hagemann, N., Werner, C., Gerten, D., Lucht, W., & Kammann, C. (2019). Pyrogenic carbon capture and storage. Global Change Biology Bioenergy, 11(4), 573-591. http://doi.org/10.1111/gcbb.12553

[2] https://biochar.systems/durability-statement/

[3] https://www.biochar-journal.org/en/ct/109-Permanence-of-soil-applied-biochar

[4] The IPCC still looks at biochar as bulk carbonaceous compound, with results in residence times of few centuries.

Current research suggests that up to 2.6 Gt CO2 yr^{-1} could be sequestered by BCR/PyCCS[5]. If further available feedstock, such as sewage sludge, was included the drawdown potential of BCR/PyCCS would be even higher.

Biochar carbon removal (BCR) belongs to the category of engineered removal options like direct air carbon capture and storage (DACCS) and bioenergy with carbon capture and storage (BECCS). However, with a technology readiness level of 9, BCR is currently the only engineered CDR technology that is widely available and already in the process of being scaled up.
BCR/PyCSS is a fast-growing global industry that includes biomass pyrolysis to produce renewable heat/ energy and biochar. While many biochar-based products and applications are related to the use in agricultural and non-agricultural soils there are other applications in products, such as concrete. The latter would also guarantee that the captured carbon would stay removed from the atmosphere. Over the last three years the biochar industry has seen exponential growth in production capacity, with a 3-year CAGR of 68 % in Europe.[6] In 2022 European biochar producers were able to sequester roughly the equivalent of 100,000 t of CO_2 and by the end of 2023 this will rise to 150,000 t of CO_2eq with new plants starting production. The European biochar industry aims at 5 Mt BCR-based CDR by 2030 and 100 Mt by 2040.

Biochar pyrolysis and thus BCR has been developed and tested over the last two decades and has reached technology readiness level 8 or 9 depending on which sources are taken into consideration. It is ready to be scaled up to the gigaton level and become climate relevant. BCR/PyCCS is currently the only engineered CDR technology that is widely available and adopted worldwide. Also, BCR/PyCCS is the only technology-based CDR-effort that can be scaled from small artisanal production to decentralized systems for communal power and heat generation to large-scale industrial level. It is important to set the right policy signals as soon as possible so that the BCR/PyCCS capacity can grow significantly alongside other CDR technologies in order to stay within the 1.5 or at least the 2.0 °C boundaries. CDR projects will require support of a whole range of government instruments to scale up and become climate relevant. These will have to include, among others, financial support and subsidies. With government support, biochar carbon removal can be scaled up quickly, keep growing exponentially and become climate relevant within the next 10 years.

CDR efforts need to be coordinated internationally. We strongly suggest national and international carbon sink registries and to set CDR goals similar to but sharply distinguished from the emission reduction goals as well as carbon offsets and CDM for the next decades. The overall objective must be to reach the 1.5 °C goal.

On taxonomy, categorization and additionality

Both the IPCC and the UNFCCC put a strong emphasis on the categorization of CDR technologies which creates the risk that CDR technologies are valued primarily by the category that they have been put into rather than by the actual potential of each single CDR approach. This is especially true for biochar, which has some overlap to nature-based solutions, but is in its core an engineered solution. The hybrid nature of BCR/PyCCS often raises questions about permanence and additionality that are interlinked with taxonomy and

---

[5] Werner, C., Lucht, W., Gerten, D., & Kammann, C. (2022). Potential of land-neutral negative emissions through biochar sequestration. Earth's Future, 10(7), e2021EF002583. doi: https://doi.org/10.1029/2021EF002583
[6] EBI market report 2023 www.biochar-industry.com/market-overview/

does often not respect the many different types and applications of biochar that may impact its CDR-performance. Since there are not too many different CDR technologies, we propose that each and every technology is evaluated by itself before taxonomy and categorization create a discriminating framework that rules out CDR technologies based on an oversimplified view on CDR. If taxonomy cannot be avoided BCR/PyCCS must clearly be defined as an engineered CDR solution.

BCR/PyCCS is the only engineered CDR solution that creates co-benefits when used (besides enhanced rock weathering to some extend). BCR/PyCCS does create energy and biochar as a product, that can be used in various applications while still providing CDR. Therefore, some questions regarding additionality have been raised. However, under current market conditions BCR/PyCCS could not prevail without CDR-credits. Without the revenues from the credits the biochar would be used as fuel or reduction agent and thus the carbon sink will be lost. To put it differently: pyrolysis for biochar production cannot compete with conventional burning of biomass for energy generation, which is always more efficient from a strictly energy-based perspective.

Regulatory frameworks, Monitoring, Reporting and Accounting and Permanence

A regulatory framework is needed to define and monitor quality standards regarding sustainability issues, sustainable production, risk management and permanence of removals. Biochar carbon removal already has a robust MRV system in place that has been developed for the voluntary market by its stakeholders.

Certificates for BCR/PyCCS are based on the ICROA endorsed standard of Puro[7] or the EBC C-sink methodology that is based on independent third-party certification[8].

Both methods are based:

1. On chemical analysis of biochar to quantify the amount of carbon stored;
2. On tracking of biochar from the pyrolysis unit to its final application;
3. On generally accepted scientific evidence on biochar permanence; currently, only the portion of carbon that is stable for at least 100 years;
4. On accounting for process emissions for biomass supply and the pyrolysis process.

FVPK also has defined basic rules that need to apply for MRV systems that monitor BCR/PyCCS accounting.[9]

Regarding the impact that CDR will have, the question of permanence plays a major role. Biochar is a highly stable form of carbon that will not release carbon back into the atmosphere unless it is oxidized. Extensive research has been conducted trying to prove the permanence of biochar carbon removal in soil applications among others. While conservative estimates of the past years have concluded that at the very least 75% of the captured carbon in biochar from biomass pyrolysis with high temperatures will remain sequestered over at least several hundred years, more recent studies have come to the conclusion that these findings may have

[7] https://carbon.puro.earth/biochar
[8] https://www.european-biochar.org/media/doc/139/c_en_sink-value_2-1.pdf
[9] In German only: https://fachverbandpflanzenkohle.org/wp-content/uploads/fvpk-leitlinien-pflanzenkohle-c-senken.pdf

been too conservative. Petersen et al. (2023)[10] have described a measurement method used for the characterization of fossil carbon and applied this to biochar. This analysis distinguishes exactly between different carbon components and can make predictions about their permanence based on geological knowledge.[11] Biochars produced at temperatures above 600°C are basically indistinguishable from fossil Inertinite, which is known to be permanent and inert to degradation on a geological timescale. Until now a simplified linear model of biochar degradation is used in MRV of BCR/PyCCS. This model was derived from the fact that a small fraction of unstable carbon compounds in biochar degrade within the first decades of soil application. Now that analysis shows which parts of biochar are permanent and which are not, more precise models can be calculated which will be able to define very stable and even fully permanent fractions within each type of biochar.

Thus, MRV methods will soon upgrade the biochar degradation models and we would like the UNFCCC to take these new models into consideration, as soon as they are available.

Reversal, Leakage and Impacts on Environment and Society

Once biochar is applied to a suitable matrix[12] that effectively avoids rapid oxidation (burning) of biochar, reversals are almost impossible. As mentioned before leakage of a small fraction of volatile carbon components in biochar can be predicted precisely based on biochar characterization, and therefore these leakages can be subtracted ex ante, leaving only stable components for MRV.

BCR/PyCCS provides substantial co-benefits:

- The installation of a BCR/PyCCS facility can serve a local demand for high temperature heat, e.g. for district heating or industrial energy demand
- The BCR/PyCCS facility helps to recycle local waste biomass streams[1]. This may include other organic matter such as sewage sludge (this is common practice in Denmark for example).
- Further, biochar application in agriculture is motivated by its positive impacts on plant growth, biochar-induced built-up of further soil organic matter and the reduction of negative impacts of agriculture on the environment.[13] Especially in highly weathered soil or yet poorly developed soil, the application of biochar-based fertilizers increases yields.[14]

In Europe, North America and other industrialized regions, biochar is predominantly produced in industrial installations, that are mostly certified according to broadly accepted standards. These include biochar analysis to prohibit marketing of polluted biochar and regulate the use of sustainably sourced biomass.

---

[10] Petersen, H.I., Lassen, L., Rudra, A., Nguyen, L.X., Do, P.T.M., Sanei, H., 2023. Carbon stability and morphotype composition of biochars from feedstocks in the Mekong Delta, Vietnam. Int. J. Coal Geol. 104233. https://doi.org/10.1016/j.coal.2023.104233
[11] For a more extensive overview on this topic see: https://biochar.systems/durability-statement/
[12] https://www.european-biochar.org/media/doc/139/matrix_list_ebc.pdf
[13] Schmidt, H.-P., Kammann, C., Hagemann, N., Leifeld, J., Bucheli, T. D., Sánchez Monedero, M. A., & Cayuela, M. L. (2021). Biochar in agriculture – A systematic review of 26 global meta-analyses. Global Change Biology Bioenergy, 13(11), 1708-1730. http://doi.org/10.1111/gcbb.12889
[14] Melo, L. C. A., Lehmann, J., Carneiro, J. S. d. S., & Camps-Arbestain, M. (2022). Biochar-based fertilizer effects on crop productivity: a meta-analysis. Plant and Soil. https://doi.org/10.1007/s11104-021-05276-2

Those standards include:

- European Biochar Certificate (EBC)[15]: a globally applicable standard with independent third-party certification
- International Biochar Initiative Certification program, focusing on North America[16]
- Austrian Standard ÖNORM S 2211 (EBC is compliant with this standard)[17]
- ICHAR certification (Italy)[18]
- Working Committee Pyrogenic Carbon NA 062-02-85 AA of German Institute for Standardization (Standard in preparation)
- EU fertilizing product regulation (EU 2019/1009)[19] defines a component material category CMC 14 on pyrolysis and gasification materials.

While these standards differ in numerous details, they all set critical cornerstones to effectively avert hazards from the production and use of biochar.

In Low-Income, Lower Middle-Income and Higher Middle-Income countries as defined by the World Bank classification of countries, biochar is mainly produced artisanally, e.g. by smallholder farmers that are trained by non-governmental organizations. Again, their main motivation is soil improvement with a low to no cost input material (except for their labor needed to produce biochar from local harvest or pruning residues). The application of widely accepted standards for farmer training and quality assurance avoids negative impacts on people and the environment. Farmers instead benefit from additional income.[20]

Other applications for biochar for example in construction materials, concrete and asphalt have been thoroughly tested and developed over recent years and will not only serve as a stable application for carbon sequestration but furthermore replace components in these products with problematic carbon footprints.

Unlike other CDR technologies BCR/PyCCS will not create storage problems but climate positive products that - unless they are burnt - will create carbon removals.

Conclusion

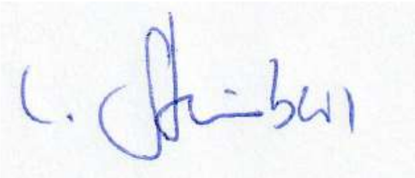
Biochar carbon removal is the only engineered CDR technology currently available that is already sequestering considerable amounts of carbon. Combined with relentless GHG emission reduction we need to start removing carbon dioxide from the atmosphere now and quickly grow towards a large scale in order to reach the climate goals. BCR/PyCCS offers a stable and low risk carbon removal opportunity and can be applied worldwide.

The German Biochar Association wishes to encourage the Supervisory Body to consider the above perspectives and engage in stakeholder discussions to deepen the understanding of engineered carbon removal technologies and biochar carbon removal in particular. Feel free to contact us for further details and/or access to our stakeholders and other biochar organizations worldwide.

---

[15] https://www.european-biochar.org/en/ct/1
[16] https://biochar-international.org/standard-certification-training/certification-program/
[17] https://shop.austrian-standards.at/action/de/public/details/583978/OENORM_S_2211_2016_11_01
[18] https://ichar.org/index.php/marchi/
[19] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02019R1009-20230316
[20] https://www.carbon-standards.com/docs/7c831c99c4c1f3639703621518a5cd87_artisan-c-sink-guidelines_v1_0.pdf

Yours sincerely,



Leopold Steinbeis, Managing Director

Dr. Susanne Veser, Chairwoman of the board

Benedikt Zimmermann, Vice-Chairman of the board

Fachverband Pflanzenkohle e.V.
Distelfeldstr. 15
71229 Leonberg
vorstand@fvpk.de

www.fachverbandpflanzenkohle.org