BIOCHAR BRIEF 1

We Need to Talk About Biochars, Not Biochar

1. About (this) Biochar Brief

Biochar Briefs are a series of short documents produced by the social sciences team on the UKRI funded Biochar Demonstrator programme (2021-2026). The series aims to present aspects of the social science research in an accessible form for a variety of audiences interested in biochar production, utilisation / deployment, governance, and science.

Biochar is increasingly discussed as one of several land-based options that could contribute to the UK's greenhouse gas removal (GGR) ambitions. Its appeal in this context stems from the ability of some biochars to store carbon in a relatively stable form, offering a removal pathway that is both measurable and potentially long-lasting.

Biochar Brief 1 focuses on the diversity and variability of biochar. Although biochar is often discussed as if it is a single, easily defined material, in practice this is not the case. Recognising biochar's diversity is important for developing governance arrangements because treating biochar as a single material may obscure differences that policies, regulations, and standards need to address.



Close up of a wood-based biochar

2. Evidence Base

Underpinning this document is a substantial body of qualitative social science research conducted as part of the Biochar Demonstrator project. Evidence was gathered using several methods from across the UK's agricultural and biochar sectors, as well as the wider set of organisations engaged with biochar. 58 in-depth interviews were conducted with farmers, industry actors, scientists, carbon market intermediaries, environmental advocacy groups, and national and local government officials. Farmers represented a particularly diverse group, reflecting different farm systems, farm size, and levels of experience with biochar —

from those experimenting with on-farm pyrolysis[1] to those using purchased biochar or considering future deployment. The Biochar Brief includes direct quotations from the interviews conducted with stakeholders. Additional insights were drawn from publicly available materials produced by organisations engaging with biochar.

This broad evidence base provides insight into how biochar is presented and understood both as a single, uniform category and as a diverse family of materials shaped by different feedstocks, production processes and uses.

3. How Biochar Is Made Singular

In documents, meetings and other discussions about biochar, this material is often referred to in unduly simple and singular terms, as a carbon-rich material produced by heating organic matter in an oxygen-deprived environment. It is a description that gives the impression of a stable, uniform category which makes biochar easy to communicate and helps position it within wider conversations about land-based GGR. However, it obscures the diversity of materials that fall under the label of biochar. Many stakeholders recognise that this is a problem.



"Again, it's that complication of people broadly implying biochar is one thing rather than a host of different types of densities. So, I think that's kind of a problem in itself" (community biochar producer).

The tendency to present biochar as a singular material is evident in authoritative publications. Organisations such as the Royal Society and the Royal Academy of Engineering[2] and the Environment Agency[3] briefly acknowledge that biochar varies depending on the feedstock and the production process. However, their overall discussions still present biochar as a single material. Carbon market standards appear to do something similar. For example, the Puro.earth website[4] states: 'Biochar is produced by heating biomass at high temperatures in the absence of oxygen. This process, called pyrolysis, converts biomass into a stable form of carbon that can store carbon dioxide removed from the atmosphere for at least 200 years, while also delivering social and environmental benefits'. This description treats biochar as a uniform product regardless of how, and from what, it is made. Although the wider methodology through the Puro.earth Certification Framework[5] accounts for differences in feedstock and production, its headline definition presents these varied materials through the generic definition of 'biochar'. Although these documents recognise variability to differing degrees, their overarching framing continues to present biochar as a single category that can be readily defined and governed.

[1] Pyrolysis means heating organic material, such as wood or crop residues, with little or no oxygen to produce biochar. Some farmers have their own pyrolysis equipment and produce biochar on their farm.

[2] Royal Society and the Royal Academy of Engineering (2018) *Greenhouse Gas Removal* [Online]. Available from Report: Greenhouse Gas Removal

[3] Environment Agency (2025) *Biochar - evidence on potential environmental impacts and social implications* [Online]. Available from Biochar - evidence on potential environmental impacts and social implications

[4] Puro.earth (2026) *Biochar* [Online]. Available from Biochar - Puro.earth

[5] Puro.earth Certification Framework (2025) *Biochar* [Online]. Available from Puro Biochar Methodology - Edition 2025 (version 2) - For Publication.pdf

In its report *Our Journey to Net Zero: Farming's 2040 Goal*[6], the National Farmers' Union (NFU) frames biochar as a singular product that can be applied across a wide range of farm and soil types and scaled nationally for carbon storage. This framing is particularly influential because agricultural land is often assumed to be the most suitable and practical place for biochar deployment because of a range of 'co-benefits' to agriculture associated with some biochars[7]. When an organisation with this level of sector authority presents biochar as a single, uniform material, it reinforces the perception of singularity across farming communities.

Taken together, these framings make biochar appear more uniform than it is, giving the impression that different biochars can be treated as though they are similar.



"I think first of all you have to be really clear about what you're using the term biochar to refer to because some people just call anything biochar" (environmental advocate).

4. Biochar Is Diverse and Variable

In practice, there are many different biochars. Variation in feedstocks and production processes can result in biochars with different properties and characteristics. Research on biochar characterisation within the Biochar Demonstrator project illustrates this variability. Biochars produced from wood and straw at different temperatures showed measurable differences in their properties, including carbon content and measures associated with carbon stability[8]. This diversity was also recognised by stakeholders, who described important differences between biochars according to what they are made from and how they are produced.

Feedstock plurality

Stakeholders described biochar as inseparable from the material from which it is made. Wood, straw, manure, and green waste produce biochars with distinct behaviours and qualities. Feedstock acts as a classificatory device: people talk about 'wood biochar' or 'straw biochar' as if they are separate materials. Feedstock plurality is one of the reasons why biochar cannot be understood as a single, uniform material.



"Straw is really like a grass … with straw you want a really good kiln. Straw is more difficult to make into biochar, and you've really got to be on top of your game to make a good biochar. If you could make it, it would make a good product to spread anywhere because the nutrients would be in the straw" (dairy farmer, international, producing biochar for own use).

[6] National Farmers' Union (2021) *Our Journey to Net Zero: Farming's 2040 Goal* [Online]. Available from our-journey-to-net-zero-2021.pdf

[7] See Biochar Brief 2: Stakeholder Visions for Biochar in UK Agriculture: Implications for Governance.

[8] Hagemann N, Schmidt H-P, Bucheli TD, Grafmüller J, Vosswinkel S, Herdegen V, et al. (2025) Proxies for use in biochar decay models: Hydropyrolysis, electric conductivity, and H/C_{org} molar ratio. PLoS One 20(9): e0330206. https://doi.org/10.1371/journal.pone.0330206



A recently applied biochar in a stubble field

Production variability

Pyrolysis is not a uniform process. Differences in temperature, heating rate, moisture, and the kilns or pyrolysis systems used produce noticeably different biochars. Stakeholders recognise that biochar cannot be understood without reference to how it was produced. Production conditions therefore become part of its definition, shaping expectations and determining what counts as biochar.

"Also, things like the way the wood burns, residence time, things like that change dramatically and also, you get a very different product out of it depending on if you take it up to temperature very quickly. If you take it up to temperate over a period of 10 hours or something like that then you get a much nicer product because it's had more chance for the moisture in the steam of the wood to escape … if you take it up to temperature very quickly, all the steam inside the logs goes and then you get lots of shattering and so you got lots of flakes" (smallholder, England, producing biochar for own use and for sale).

Diversity of Uses

A biochar considered suitable for one purpose may not be suitable for another. Stakeholders emphasised that what is required of a biochar depends on what it is expected to do, and that different uses may require different characteristics. Intended use therefore adds another dimension to biochar's diversity. Research on lifecycle assessment and techno-economic analysis within the Biochar Demonstrator project provides a practical example. Biochar produced from food-waste digestate was found to have a high proportion of stable

carbon, illustrating how particular biochar characteristics may make it more suitable for specific uses, in this case for long-term carbon storage[9].

> What exactly are you trying to do with it [biochar]? … You can make biochar into whatever you need to make it into. … But you've got to be specific on it. That's the difficult part. What exactly are they trying to do? (pyrolysis machine manufacturer).

Differences in feedstock, production processes and uses mean that there are diverse forms of biochar. What counts as biochar, and which of its characteristics are considered important, may therefore vary according to the context in which it is produced or used. Standards such as the European Biochar Certificate[10] (EBC) recognise variation in feedstocks, production processes, properties, and intended uses. For example, biochars must meet different requirements depending on their intended use, while new production batches are registered and tested annually, or when feedstocks or production conditions change.



Biochar pyrolysis unit

[9] Gamaralalage D, Rodgers S, Gill A, Meredith W, Bott T, West H, et al. (2025) Biowaste to biochar: a techno-economic and life cycle assessment of biochar production from food-waste digestate and its agricultural field application. Biochar 7(50) https://doi.org/10.1007/s42773-025-00456-0

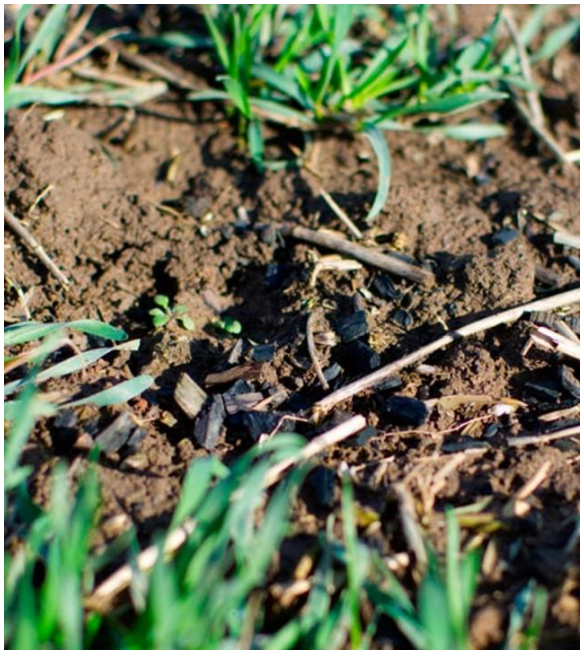
[10] European Biochar Certificate (2025) European Biochar Certificate – Guidelines for a Sustainable Production of Biochar [Online]. Available from European Biochar Certificate (EBC) - Carbon Standards

5. Why Biochar Diversity Creates Governance Challenges

The singular framings described above make biochar appear stable, uniform, and straightforward. However, biochar is diverse and shaped by feedstocks, production processes and uses. This creates a fundamental governance tension: standards, policies and regulations require categories that are sufficiently stable to support consistent rules and expectations, but stabilising 'biochar' as a single category risks obscuring differences that affect how particular biochars should be classified and governed.

Standards retain 'biochar' as a common category while differentiating materials according to selected characteristics. In doing so, they make diverse biochars governable by determining which differences matter. The European Biochar Certificate[11] (EBC) shows how standards manage biochar as both a single category and a diversity of materials. It begins with a singular definition of biochar, then differentiates materials by production processes, feedstock, quality, and use. The EBC establishes biochar as a recognisable category while also drawing boundaries within and around that category. This illustrates a central challenge for standardisation: a workable definition must be specific enough to identify what counts as biochar without concealing differences that affect the properties and suitability of particular biochars.

Diversity also complicates policy design. Policies often need to specify what counts as eligible, beneficial, or permissible. If biochar varies significantly depending on feedstock and production process, then policy instruments that treat biochar as a single category may struggle to target the outcomes they intend to support. For example, policies designed to support carbon storage will require different criteria from those intended to improve soil health. Each policy objective may prioritise different properties and uses of biochar. Treating biochar as a single category risks obscuring these distinctions and weakening the policy's ability to achieve its intended outcome.



Biochar in a field

[11] See previous footnote.

Regulation faces similar difficulties. Regulatory frameworks typically require clear boundaries around what is being regulated. When the term ‘biochar’ is applied inconsistently, and when materials that merely resemble biochar may be marketed as such, it becomes challenging to determine which materials fall within regulatory scope. This lack of clarity makes it harder to ensure consistent oversight, enforce requirements, or assess compliance. Regulation designed around a singular category may therefore fail to accommodate the diversity of materials encountered in practice.

Biochar carbon markets illustrate the tension between singularity and diversity particularly clearly. To calculate and verify carbon credits, methodologies must differentiate between biochars according to feedstock, production conditions, and application context, because these factors affect carbon stability and permanence. However, the public-facing website definitions used by biochar carbon market schemes present biochar as a single, uniform material. Singularity makes biochar easier to communicate and trade as a carbon-removal product, while diversity must be reintroduced within methodologies to make crediting possible and credible.

These examples show why the diversity of biochar creates governance challenges. Governance systems depend on stable categories, yet biochar’s diversity makes it difficult to establish these categories without oversimplifying. The question, therefore, is how governance can address distinctions in feedstock, production processes, and intended use.

6. How Should Governance Respond to Diversity

Policies, regulations, standards, and carbon market methodologies should distinguish between biochars according to their particular purpose and the risks they need to manage. Existing biochar standards and carbon market methodologies offer a starting point, as they retain ‘biochar’ as a common category while differentiating materials within it. However, the distinctions they make are shaped by particular objectives: biochar carbon markets prioritise characteristics relevant to carbon trading, such as carbon stability and permanence. Other governance purposes, such as soil health policy and environmental regulation, may need to differentiate biochars according to other characteristics, including feedstock, production processes, contaminant levels, effects on particular soils and crops, and intended application. Governance should therefore avoid assuming that one approach will be suitable for every context.

Organisations that discuss or govern biochar should ensure that their public-facing definitions reflect the variation already recognised within technical standards and methodologies. These communications should avoid presenting biochar as uniform and explain that its properties, benefits, risks, and suitability depend on feedstock, production conditions, and intended use.

7. Conclusion

Biochar is commonly presented as a single, clearly defined material, but this apparent singularity obscures significant differences arising from feedstocks, production processes, and intended uses. These differences matter for the benefits, risks and claims associated with particular biochars and therefore for how they should be governed. The challenge is

not simply whether to treat biochar as one thing or many, but how to make it governable without losing sight of its diversity. A common category may be necessary to provide a basis for policies, regulations, standards, and carbon market methodologies, while distinctions within that category allow important differences between biochars to be recognised. These distinctions might take account of feedstocks, production processes, and intended uses. They should also be reflected in public-facing definitions, product information, and claims. Recognising and communicating these differences would support more transparent and consistent governance without obscuring the diversity of biochars encountered in practice.

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Biochar DEMONSTRATOR

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