CO2RE THE GREENHOUSE GAS REMOVAL HUB

Biochar Regulation in the UK

A Wasteful Approach to Greenhouse Gas Removal

June 2025

Luka Štrubelj, Navraj Singh Ghaleigh

Executive Summary

Greenhouse gas removal (GGR) methods capture greenhouse gases from the atmosphere and store them for decades to millennia. These technologies will be required to meet the Paris Agreement's temperature goals, alongside rapidly reducing emissions. Biochar, a charcoal-like substance derived from organic material, is one such method, offering the potential to remove carbon dioxide from the atmosphere and store it durably in a cost-effective manner, while delivering other benefits for agriculture, soil remediation or construction. It can also be deployed as an emission reduction technology.

Biochar has been included for the first time in the Climate Change Committee's Seventh Carbon Budget pathway with enhanced rock weathering (another GGR method). These two methods are projected to remove 3 $MtCO_2$ a year by 2050 – about 8% of the UK's 2050 requirement for engineered GGRs – and do not need the carbon dioxide transport and storage infrastructure of other engineered methods. Despite this potential, several regulatory and policy gaps hinder investment in biochar and its potential contribution to net zero as a sustainable and scaled removal technology. A key barrier for biochar is waste regulation, which other countries are moving to address.

Biochar is regulated in the UK by waste law. The central issue is the contentious definition of waste, as enshrined in retained EU law. This definition includes biochar if it was produced from materials that are considered discarded or without a specified use. Biochar can be categorised as waste later in the value chain too, if the primary aim of production is its energy-intensive pyrolysis co-products, such as bio-oil, pyrolysis gas and the resultant energy. In these cases, the law requires biochar operators to treat biochar as waste unless a set of case-by-case tests are met whereby its environmental risks are compared with those of non-waste biochar.

Complying with end-of-waste and by-product tests has high transaction costs, being characterised by the absence of baseline standardisation (outwith voluntary certifications), and case-by-case assessments. Waste-related processes and obligations are burdensome, unclear and diverge across UK jurisdictions, which risks dampening the interest of entrepreneurs and investors in biochar.

As such, the waste regime imposes multiple and costly obligations on biochar operators, tying biochar to waste and hindering scaling, without providing environmental safeguards. This means that it neither supports biochar GGR nor ensures safe deployment. There is a clear risk that regulatory inadequacy damages the prospects of biochar as a GGR technology, making the UK's sector uncompetitive, while other jurisdictions such as the EU and EU member states move ahead.

This policy brief proposes two approaches to improve biochar regulation and unlock investment in this important GGR option:

1. **Making pragmatic improvements within legacy regulation.**
   The Environment Agency adopts a resource framework for biochar establishing an end-of-waste and by-product standard, and standard rules for pyrolysis facilities. This would swiftly decrease regulatory uncertainty for biochar operators by providing standardised rules for by-product and end-of-waste status, and pyrolysis permitting. Or:
2. **Developing a comprehensive biochar framework unifying rules for biochar operations across the UK.**
   A common biochar framework agreed across the UK would specify requirements on non-waste biochar standard utilisation, ensure unified access of biochar across the UK, and enable quality control of imported biochar. Provisions would establish a cascading hierarchy of biochar applications on a predetermined risk assessment, conditioning the intensity of controls on identified risks of application scale.

Introduction

The Climate Change Committee's (CCC) Seventh Carbon Budget advice once again recognises that engineered greenhouse gas (GHG) removals (GGR) will play a salient role in the UK's emission reduction efforts from 2038 to 2042. The growing scientific evidence base on biochar, which includes evidence from the UKRI-funded Biochar Demonstrator on biochar stability and the impacts of adding biochar to soils, has led to biochar being included in its projections for the first time.

Despite this important acknowledgement of the potential role of biochar, it continues to be viewed mainly through the lens of waste processes. The CCC, for instance, defines it as the heating of biogenic *waste* without oxygen to form a durable carbon-rich material which, when spread on soil, retains sequestered GHGs. The UK government currently views biochar through the prism of waste, regulating it as such, with the only biochar-focused regulation in England being the Low Risk Waste Position (LRWP), adopted by the Environment Agency (EA) in 2019.

To its advocates, biochar is more than just pyrolysed waste biomass. It is a versatile charcoal-like material of varying features. It can offer benefits in diverse applications such as agriculture, soil remediation, and aggregates for both construction and asphalt pavements. Biochar also serves as a climate mitigation technology. The energy resultant from pyrolysis co-products can, for instance, displace fossil-based energy,[1] and biochar can replace the use of coal in metallurgy. Finally, and most important for the present purposes, the biochar lifecycle serves as a durable GGR, rather than emission reductions only. This is because, as a carbonaceous material, it withstands decomposition on centennial and potentially even millennial timescales. Therefore, as highlighted by the CCC, it can play an important role in meeting the UK's climate commitments. While biochar's future contribution to the UK's Carbon Budget is still uncertain, it is expected to play a significant role alongside other engineered GGRs such as bioenergy with carbon capture and storage (BECCS), and direct air carbon capture and storage (DACCS). However, current levels of deployment are only a tiny fraction of what will be needed in the coming decades.

To navigate conflicting policy goals for large-scale biochar deployment, a more nuanced and institutionally diverse regulatory approach is required. An improved approach should ensure that the delivery of GGRs needed to meet the UK's climate targets can be effectively balanced against environmental regulation that protects against the potential risks of harmful consequences, such as the discharge of heavy metals and particulate matter into the environment. This is vital if the UK is to successfully boost investment to scale up biochar in an environmentally responsible manner.

This policy brief explains why the current waste regulation paradigm hinders the scaling of biochar in the UK. We build on a joint public letter from CO_2RE and the Biochar Demonstrator to the UK government, which identifies the current waste regime as a major inhibitor to scaling biochar in the UK. Additionally, we provide a detailed analysis of the regulatory challenge and put forward proposals to overcome it.

1 Industrial biochar production facilities co-produce gas and oil which are used to ensure a self-sustaining pyrolysis, and that can provide excess heat for export.

Biochar in waste law

Why is biochar treated as waste?

The distinction between waste and non-waste materials has long been contentious, a legacy of EU waste law retained after Brexit. Material is waste if its holder actively discards it,[2] but also if the holder has no intentions for its further use. Waste can thus include generally useful materials such as wood, straw and crop residues, if the holder sees no further use for it or if it must undergo processing to become useful. The EA interprets these scenarios on a case-by-case basis, considering, for instance, whether the material represents a burden to the holder, the value of the material, the certainty of its use, the specificity of its purpose, and environmental harm. In industrial production, materials that are not the primary output of the process will be designated as waste if they do not fulfil the conditions of a by-product.[3]

One of biochar's potential benefits is its production using a large pool of biogenic materials – ranging from crop and forestry residues to sewage sludge and domestic green waste – which holders may see no value in.[4] Correspondingly, biochar is generally treated as waste under current UK law, as it commonly uses biomass that holders have discarded.[5] However, it can evade waste status if it is made from dedicated biomass, or, for example, if it is made from wood pellets or wood chips (offcuts from virgin timber) which were designated as non-waste materials. This diminishes the utility of biochar use.[6] Biochar producers may be disincentivised from using the part of the biogenic pool that does not evade waste status, and instead may be more likely to use dedicated biomass, adding to competition for biomass and the associated demands on land, and rightly raising concerns about land-use change.

Biochar can also fall into the waste category later in the value chain. Suppose that biochar is produced industrially in a pyrolysis process, the primary aim of which is heat or other co-products. Sharing the production process with energy intensive co-products such as bio-oil makes biochar fall squarely under the definition of waste, given that the economic viability of biochar-centred production can be questionable due to a relatively higher value of energy compared to biochar. Namely, the rules on industrial by-products will designate such biochar as waste unless it fulfils specific by-product conditions (processes such as energy-to-waste are treated similarly).[7] Due to the absence of specific by-product rules on biochar, legally – despite the environmental potential of biochar – it may be substantially harder for it to be considered a product instead of waste.

---

2 The Environmental Protection Act 1990 s 75(2) and the Waste Framework Directive 2008/98/EC, Article 3(1) state: "*Waste is any substance or object which the holder discards or intends or is required to discard.*"

3 EA, understanding the complexity of defining waste, offers a paid definition of waste service for interested entities to figure out whether their material is waste.

4 The European Biochar Certificate, a leading certification of biochar in Europe, enables the use of diverse feedstock materials that range from aquatic plants, textile waste and kitchen waste to industrial wastes such as paper sludge, digestate and bio-solids.

5 Discarded materials used in biochar production would include waste materials such as woody biomass residues, vegetable waste, wood chips, papermill residues, bio-solids, and in some cases even residential waste.

6 Materials such as wood pellets or wood chips, which have not been categorised as waste, have a high competition for use too. Hence, using them as feedstock misses the opportunity to alleviate resource competition for biomass.

7 The Waste perception of biochar is further increased by past regulatory consideration that solid materials from incineration processes are considered waste and must be reduced. See, for instance, Environmental Permitting Regulations 2016 Schedule 13 para 4 and EU Industrial Emissions Directive Art 43 an 53. As an aside, confusion between pyrolysis and incineration has been a long-standing issue for waste-to-energy.

The implications of waste status

Waste status has important ramifications for the producers and users of biochar. In the UK waste regulation scheme, one person's trash cannot simply become another's treasure. Once material is designated as waste, it remains waste even if reprocessed, until its status formally ceases (end-of-waste). In England, case law requires a *comparator assessment* which would require biochar to be '*a distinct, marketable product, which can be used in exactly the same* way…and *with no worse environmental effects*' [¶63] as biochar made of non-waste materials. A similar test is used for by-products, but with a stronger emphasis on its place within the production process, determining whether the substance is produced as an integral part of the production process and can be used without further processing. The characterisation of materials as waste imposes significant obligations on the waste holder, as outlined in Box 1.

BOX 1: Regulatory obligations for waste holders

- **Environmental permitting and registration.** Regulations require permits for waste operations including recovery and disposal. This includes feedstock preparation, biochar production and use until processed material is waste. In specific cases, waste operations can be exempt, but they still require the operator's registration.[8]
- **Duty of care of the waste holder.** Statutory guidance requires that the waste holder ensures the lawful treatment of waste throughout its journey to disposal or recovery and prevents the unauthorised, harmful management and escape of waste. Biochar producers must engage with end-users to monitor proper use and environmental pollution.
- **Transboundary waste shipment obligations.** The shipping of waste materials is subject to substantial controls, including a general information procedure and a complex notification procedure depending on the type of waste shipped.
- **Planning permission for land application.** Applying waste biochar to land amounts to a material change of land use requiring planning permission, even when used in agriculture or forestry.

Note however, that in limited circumstances biochar operators in England can rely on Low Risk Waste Positions (LRWP) 60 and 61, which partially alleviate environmental permitting obligations for producers and users respectively. The two 'positions' are aimed at benign waste streams such as untreated forestry, agricultural residues and leftovers of industrial processes and only pertain to small biochar operations,[9] discharging environmental permitting obligations but failing to address other waste obligations for biochar, including registration (as outlined above).

8 Exempt waste operations are defined narrowly in terms of waste types and uses. Environmental Permitting Regulations 2016, Schedule 3 does not address solid material resultant from pyrolysis. However, it includes similar activities such as the burning of certain biogenic waste (D6 and D7), the use of ash from wood chip boilers on land to confer benefit (U10 and U11), and the incorporation of ash into soil (U14).

9 Allowed remnants of industrial processes include conservative feedstock such as sawdust, wood shavings and cuttings. Biochar production must be limited to 50kg per hour, storing maximum 30 tonnes of waste at the site of manufacture, whereas application is limited to 1 tonne per hectare annually, in the course of which only up to 10 tonnes of biochar can be stored in one place.

‘Waste’ as a barrier to a sustained and sustainable deployment of biochar in the UK

The above interpretation of waste law hinders biochar’s contribution to climate mitigation, given how difficult it is for biochar to avoid waste status. There are also a number of other barriers:

First, biochar cannot easily fulfil the by-product test, nor can waste status be avoided, once it is deemed waste, through an ‘end-of-waste’ test. Therefore, despite biochar’s multifaceted usefulness, biochar producers will be limited in what they can produce biochar from, how they produce it, and even who they sell it to, through waste obligations such as duty of care. Biochar cannot readily overcome the *comparator assessment*.[10] There are two main reasons for this:

- First, the comparison with non-waste biochar is difficult without a biochar-specific baseline standardisation, due to the variety of biochar compositions and utilisations. Consequently, it is difficult to identify a relevant comparator. In cases when biochar is made from distinct waste materials (i.e. sewage sludge), a comparator assessment is even trickier, as there is no clear non-waste comparable.
- Second, in cases when a biochar comparator cannot be identified or where there is no such comparator, a full risk assessment that includes a ‘*reasonable worst-case scenario*’ for environmental and human health safety would be required, given that the material could become unregulated. The potential environmental harm of improper utilisation (a possible worst-case scenario arising if the biochar is produced or applied inappropriately[11]) will make meeting end-of-waste and by-product tests improbable for biochar.

Furthermore, waste regulation is a source of substantial legal uncertainty, creating significant administrative burdens for regulated entities that are major sources of risk. This can impact the business case for biochar and decrease investors’ interest in funding biochar as a GGR technology:

- Initial waste and end-of-waste assessments rely on the EA making decisions on a case-by-case basis. Biochar operators face significant uncertainty over the result of such proceedings, which is further exacerbated by the end-of-waste and by-product complexities elaborated above.
- Arranging an environmental permit or planning permission is administratively burdensome as it involves abundant paperwork and long lead times [¶244], particularly considering biochar’s relative novelty and complexity.
- Shipping and duty of care obligations require producers to engage foreign waste authorities and biochar users to monitor proper and authorised use.
- Waste regulation is not unified across the devolved governments of the UK, meaning that biochar’s waste status and obligations can vary across the UK.[12]

Ultimately, waste law in England for biochar is based on the limitedness of LRWPs, which present issues both in terms of the small scale considered and ensuring effective environmental safeguards:

10 The environmental and human health requirement for end-of-waste has been further heightened by EU case law, which requires that the substance is ‘*devoid of any possible adverse impact on the environment and human health*’.

11 The choice of feedstock and production processes impacts the contents of polyaromatic hydrocarbons, dioxins, volatile organic compounds and heavy metals, whereas improper application can cause exposure to dissolved organic carbon in aquatic ecosystems and to particulate matter.

12 In Northern Ireland, for example, the EU Fertilising Products Regulation lays down by-product and end-of-waste criteria for biochar. After Brexit, Nothern Ireland retained a position within the EU single market, so it is still subject to some regulatory activity of the EU, including on fertilising products.

- First, these only accommodate biochar activity on a small scale, which is irrelevant for GGR scale-up. Activities are limited to 50kg of biochar production per hour, 1 tonne per hectare spread on land annually, and 10 tonnes of stored biochar at any one time. These provisions are inadequate for scaling up biochar quantities to Mt levels of CO_2 removed.
- Simultaneously, LRWPs avoid specifying cumulative limits on biochar in soil and environmental safeguards, as if the quality of biochar production and its proper use is a non-issue. They also fail to stipulate limit values (for heavy metals, polycyclic aromatic hydrocarbons, etc. as per the European Biochar Certificate (EBC) on allowed biochar use. The only safeguard in this regard is a vague clause that the activity "*does not, and is not likely to, cause environmental pollution or harm human health.*" Even when the biochar operator sticks to LRWP's conditions, liability for operating without an environmental permit could be found based on subsequent environmental damage. This provides neither the strong support nor the clear guidance that the nascent GGR sector requires.
- Finally, the LRWPs reinforce the classification of biochar as waste. In effect, they are statements by the regulator that biochar, even if produced from virgin materials, is to be treated as a waste material, tainting public perception and undermining the biochar's social robustness.

Other countries are moving ahead

These regulatory challenges for biochar are being resolved more productively in jurisdictions such as the EU. In 2022, the EU included biochar in the Fertilising Products Regulation, ensuring free circulation in the EU and establishing by-product and end-of-waste criteria for biochar as a fertilising product.[13] Biochar regulation is being further advanced under the EU's Carbon Removal and Carbon Farming Regulation through a GGR methodology for biochar. This methodology will establish quality thresholds for biochar when focused on GGR, thus presenting a potential biochar GGR standard that evades waste categorisation. Similarly, EU member states have not been sitting idle. Denmark, for instance, has adopted a pyrolysis-focused strategy which plans to streamline processes for authorising pyrolysis facilities and biochar application, including waste-related complexities. The UK risks falling behind these jurisdictions if it does not actively and promptly resolve the waste status dilemma of biochar.

Unlocking investment in biochar: piecemeal change or comprehensive reform?

The UK government could approach the issue of waste regulation in two ways: either adopting patchwork improvements within the confines of existing legal rules to rapidly upgrade regulation of biochar operations, or a comprehensive approach to streamline the sustainable scaling of biochar across the UK.

Pragmatic improvements to legacy regulation

Piecemeal improvements would utilise short-term guidance within the scope of existing rules, prioritising rapid improvements to provide greater certainty for biochar operators and investors. This would include a number of small adjustments:

- **The EA would need to develop a resource framework for biochar which would provide clear criteria whereby waste controls become redundant**. These reforms could even be requested from the EA by industry,

13 The EU enabled biochar to be treated uniformly across the EU as an EU fertilising product under the Fertilising Products Regulation 2019/1009. It adopted a specific component material category (CMC) 14 labelled "pyrolysis and gasification material" which establishes criteria for biochar certification.

although this would take time and be relatively costly.[14] The content could draw on the abundant experience from developing voluntary certifications and EU regulation of biochar. Governance of the GGR features of biochar would be more complex, as these features depart from the core properties of agricultural biochar, with durability and carbon content prioritised over agricultural effects. Coordination would be required with the Department for Energy Security and Net Zero (DESNZ), which is responsible for GGR policy. Although DESNZ has to date excluded biochar from the scope of its GGR business models policy, biochar's broad utility is supported by a growing body of evidence. This includes the Biochar Demonstrator's trials involving the application of biochar on grasslands and agricultural peatlands. This evidence base, along with recent parliamentary scrutiny of the UK government's approach to carbon capture, usage and storage (CCUS) should spur diversification of GGR efforts to support biochar.

- **The adoption of standard rules for pyrolysis facilities** is another possible small adjustment. In this scenario, the EA would pre-conduct an environmental impact assessment for facilities that require an environmental permit, including identification of potential risks and their mitigation. Such an approach would streamline the process of environmental permitting for pyrolysis facilities, and could apply to production of waste and non-waste biochar alike. This would make it easier for the EA and biochar producers to navigate the process. A similar approach is planned by Denmark, which will prepare guidance material for the environmental authority. The guidance will include a checklist for pyrolysis plants, data requirements regarding GHG emissions and rules on emissions to air. Denmark will even go a step further and mandate that local authorities provide guidance on the location of pyrolysis facilities.

The pragmatic steps set out above would offer a fix, albeit not a comprehensive solution, to scaling up biochar in the UK. In particular, these steps lack an overarching approach which accounts for the characteristics of the biochar production process and how it affects the rules on biochar application. When biochar is used as a form of GGR and application quantities increase, the type of biochar produced, and the manner of application, together determine the environmental safety of biochar utilisation. Furthermore, these pragmatic improvements would provide a solution for England but exclude devolved jurisdictions, limiting where biochar can be used and potentially creating regulatory barriers to the UK's internal market as a result of unaligned requirements.

A comprehensive biochar framework unifying rules for biochar operations across the UK

A comprehensive biochar framework would enable aligned requirements across the UK, but would take more time to set up, requiring a more thorough regulatory intervention and coordination across governmental departments, and indeed UK governments. It would enhance legal certainty and stimulate various utilisations while ensuring that biochar products are safe. A biochar framework would facilitate the distribution of standardised biochar across the UK and enable controls over imported biochar to ensure their quality meets the required thresholds for use in the UK. A comprehensive reform would have a number of features:

- **First, a definition of biochar categories would be needed**, similar to the EBC, including its use in agriculture, urban soils, feed supplements and construction.[15]

14 'Resource frameworks' – formerly 'Quality Frameworks' – are an administrative tool used by the Environment Agency to define processes by which a given form of waste, once fully recovered, becomes a non-waste product. This allows waste-derived material to be used in specific markets without the need for waste regulation controls. Operators can request new resource frameworks from the Environment Agency. The time (12 to 18 months) and cost (more than £40,000) involved in producing a new resource framework vary, depending on the complexity of the request. See further information here.

15 To the suggestion that the EBC classification could simply be adopted does not take into account the complexities of accommodation within various different regulatory regimes for (1) soil amendments; (2) feed supplements; (3) construction products; (4) GGR. Such adoption could be suggested as part of the resource framework (supra).

- **A GGR function would also have to be included**. It should be defined for each of these use categories, given that GGR can be a co-benefit of other biochar uses, as well as a separate category for when GGR is the main focus of a biochar activity.
- **A joint approach is required, as well as a common framework across the UK governments**, as biochar characteristics extend across the remit of the Department for Environment, Food and Rural Affairs (DEFRA) and DESNZ.[16] This would be required because fertilisers and waste currently have limited access to the UK internal market. Frameworks for fertilisers and waste have already been provisionally agreed between governments but have stalled after the parliamentary review. A framework for biochar would offer an aligned solution to waste status.
- **A biochar framework would need to include rules regarding soil application** to provide an additional boost to scaling environmentally safe GGR operations. One way to approach this could be to refine a common biochar approach to land contamination (see Box 2).

Box 2: A potential approach to rules for soil application in a biochar framework

To streamline biochar application, **a definition of a cascading hierarchy of applications could be established**, whereby the robustness of checks would depend on the biochar category and an analysis of the environmental and health risks of application on the land type in question:

- Similar to standard rules for environmental permitting discussed above [p 9], an upfront risk-based analysis of biochar applications would be undertaken. This would mean, for instance, that low-risk applications – e.g. on contaminated, derelict and urban land – could bear a higher rate of application and require lower controls.
- Biochar applications that reduce pollution (i.e. by applying biochar in conjunction with poultry manure to prevent run-off) would be subject to moderate controls if such utility of biochar could be demonstrated.
- Finally, in high-sensitivity settings, such as food production, application rates would be a function of the regulatory controls required. This would simultaneously ensure sound application, funnel GGR efforts to less risky applications, and foster clarity in application rules.

16 When biochar is used in construction and roads a common framework is not required as it is not a devolved matter but a reserved matter of the UK parliament. Therefore, the use of biochar in these sectors could be clarified as part of the upcoming Construction Products Reform.

Conclusion

As the UK looks to scale up GGR solutions to meet its climate commitments, this briefing considers some of the key regulatory barriers constraining biochar investment in England and the UK. Waste regulations are a major barrier to the use of biochar, as waste-related processes and obligations are burdensome, unclear and diverge across UK jurisdictions. These dampen entrepreneurial and investor interest in biochar, yet fail to provide environmental safeguards. There is a clear risk that regulatory inadequacy is damaging the prospects of biochar as a GGR technology, making the UK's sector uncompetitive compared with neighbouring jurisdictions, which are moving to address such hurdles.

This policy brief proposes two modes of improving biochar regulation by delivering:

1. **Pragmatic improvements within legacy regulation.**
   In this mode, the EA would adopt a resource framework for biochar to establish an end-of-waste and by-product standard and standard rules for pyrolysis facilities. This would swiftly decrease regulatory uncertainty for biochar operators by providing standardised rules for by-product and end-of-waste status and pyrolysis permitting.

Or

2. **A comprehensive biochar framework unifying rules for biochar operations across the UK.**
   A common biochar framework agreed across the UK would specify requirements on non-waste biochar standard utilisation, ensure unified access of biochar to different parts of the UK, and enable quality control of imported biochar. Provisions within the framework would establish a cascading hierarchy of biochar applications on a predetermined risk assessment conditioning the intensity of controls on identified risks of application scale.

CO2RE THE GREENHOUSE GAS REMOVAL HUB

www.co2re.org

Funded through the UKRI SPF Greenhouse Gas Removal Demonstrators (GGR-D) Programme, CO_2RE co-ordinates the Programme and conducts solutions-led research to evaluate a balanced portfolio of economically, socially and environmentally scalable Greenhouse Gas Removal options, with associated policy design, engagement and outreach.

This paper is the second in a series of policy briefings presenting findings and recommendations from the different areas of CO_2RE's research. The first briefing is available here.

The authors would like to thank Colin Snape, Professor of Chemical Technology at the University of Nottingham and Principal Investigator of the Biochar Demonstrator, for his feedback and advice.

UK Research and Innovation

CO_2RE , The Greenhouse Gas Removal Hub is funded by UK Research and Innovation grant reference NE/V013106/1.