BIOCHAR IN CONCRETE: A CIRCULAR, CLIMATE-EFFECTIVE PATH FOR EUROPE'S CONSTRUCTION SECTOR

BIOCHAR EUROPE POSITION PAPER

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“THE INTEGRATION OF BIOCHAR INTO CEMENTITIOUS MATERIALS REPRESENTS A DISRUPTIVE YET UNDERUTILIZED PATHWAY TO DEFOSSILISE THE CONSTRUCTION SECTOR, TRANSFORMING CONCRETE FROM A MAJOR EMISSIONS SOURCE INTO A POTENTIAL CARBON SINK WHILE ENHANCING MATERIAL PERFORMANCE. ADVANCING THIS APPROACH IS CRITICAL TO UNLOCKING A SCALABLE, CLIMATE-POSITIVE FUTURE FOR THE BUILT ENVIRONMENT.” AXEL PREUSS

ACKNOWLEDGEMENTS

This paper is developed by Axel Preuß (CarStorCon®) in cooperation with Biochar Europe (BCE) and the BCE Materials Working Group. To be cited as a BCE Position Paper.

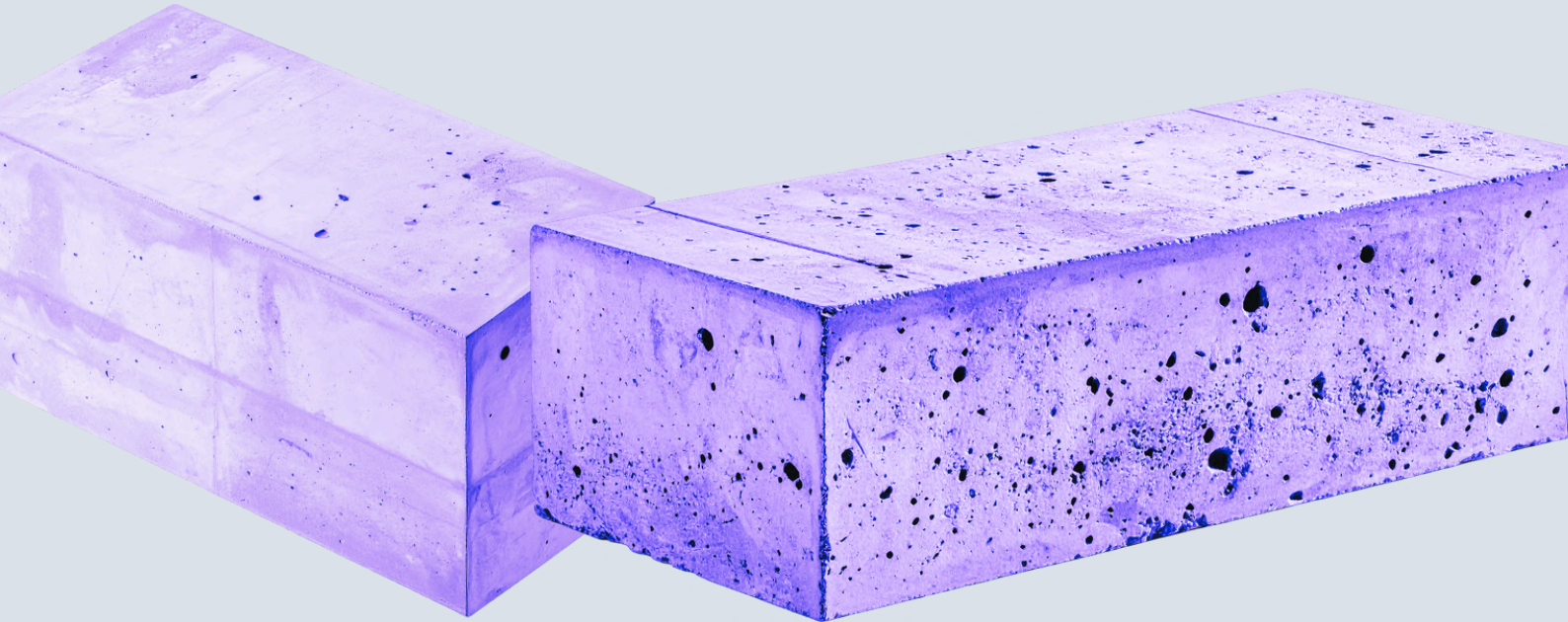
INTRODUCTION

Concrete is one of Europe's most widely used construction materials - and one of the hardest to decarbonize. Biochar-based carbon additives, Technical Carbon, offer a practical way to improve selected concrete properties while turning buildings into long-term carbon sinks.

That combination matters. The European policy framework is now catching up with the technology:

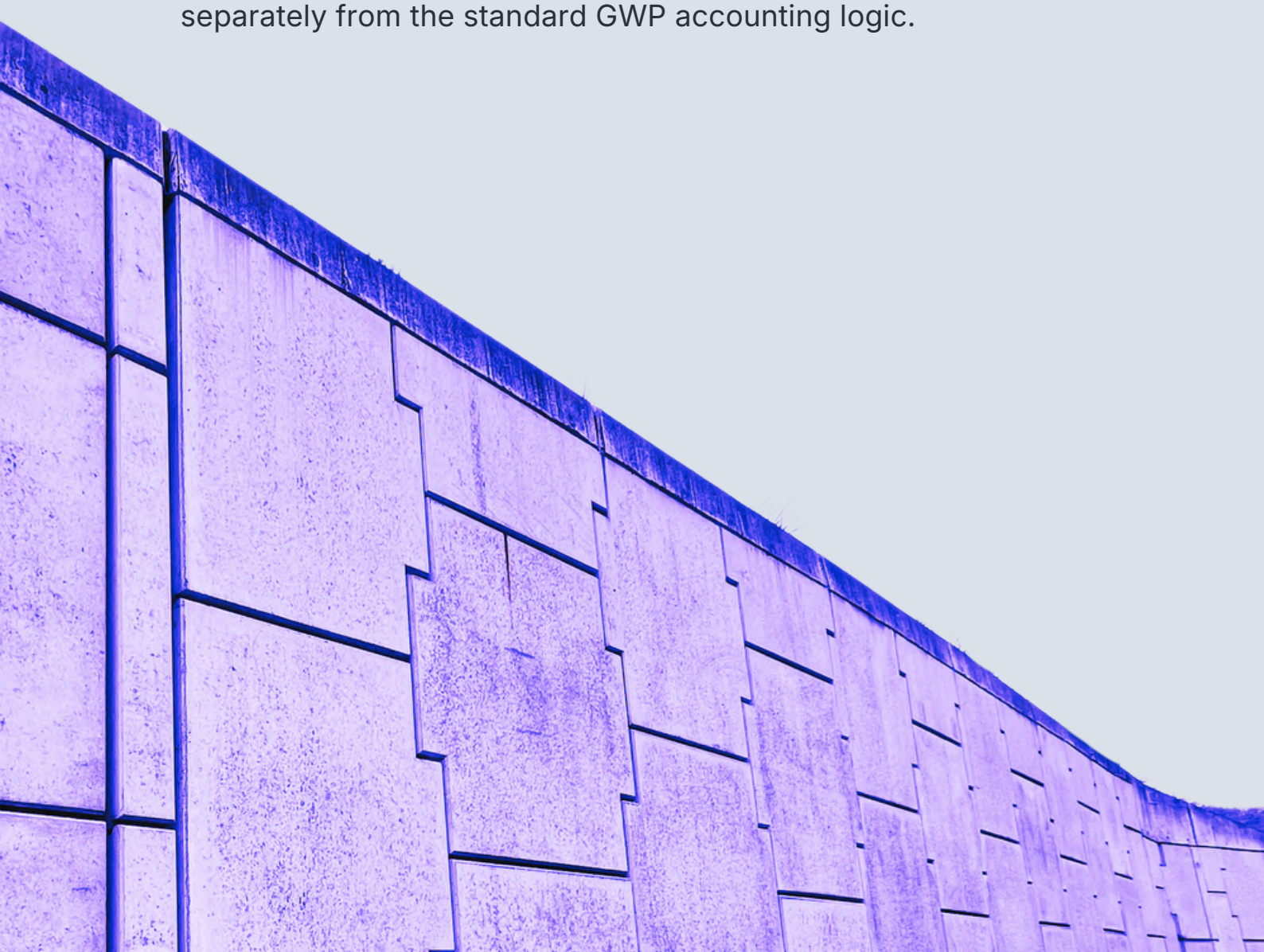
- Biochar Carbon Removal (BCR) through long-lasting building materials is formally recognized under the EU Carbon Removal and Carbon Farming (CRCF) Regulation,
- Elemental Carbon is already accepted in Europe as an inorganic pigment for cement- and lime-based building materials under EN 12878, and
- Environmental Product Declarations (EPD) under EN 15804 allow permanent carbon storage to be reported separately.

The core pieces are in place: a recognized carbon-removal pathway, a standards-based route into concrete, and a lifecycle framework that can make long-term storage visible. And with biochar production capacity in Europe growing, the opportunity is there.



KEY TAKEAWAYS

- Technical Carbon additives based on biochar can create durable carbon storage in concrete while supporting performance gains such as strength development, durability and internal curing.
- The EU CRCF now recognizes Biochar Carbon Removal as a permanent carbon-removal pathway.
- EN 12878 provides a standards-based route for elemental carbon as an inorganic pigment in cement-based building materials, including CE-marked products.
- EN 15804 allows permanent carbon storage to be disclosed separately from the standard GWP accounting logic.



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WHY TECHNICAL CARBON IN CONCRETE IS ATTRACTING ATTENTION

Biochar originates from biogenic residue such as wood offcuts, forestry residues or agricultural by-products. After thermochemical conversion, however, it is no longer comparable to its biomass feedstock. The material becomes a highly carbon-rich, strongly aromatized and largely inert carbon structure with long-term stability.

This distinguishes biochar-based Technical Carbon from conventional biogenic building materials such as solid timber or natural fibres, where carbon remains bound in biological polymers and is much more directly linked to biological degradation pathways. In concrete, the carbon serves as a functional material addition and as a C storage medium at the same time.

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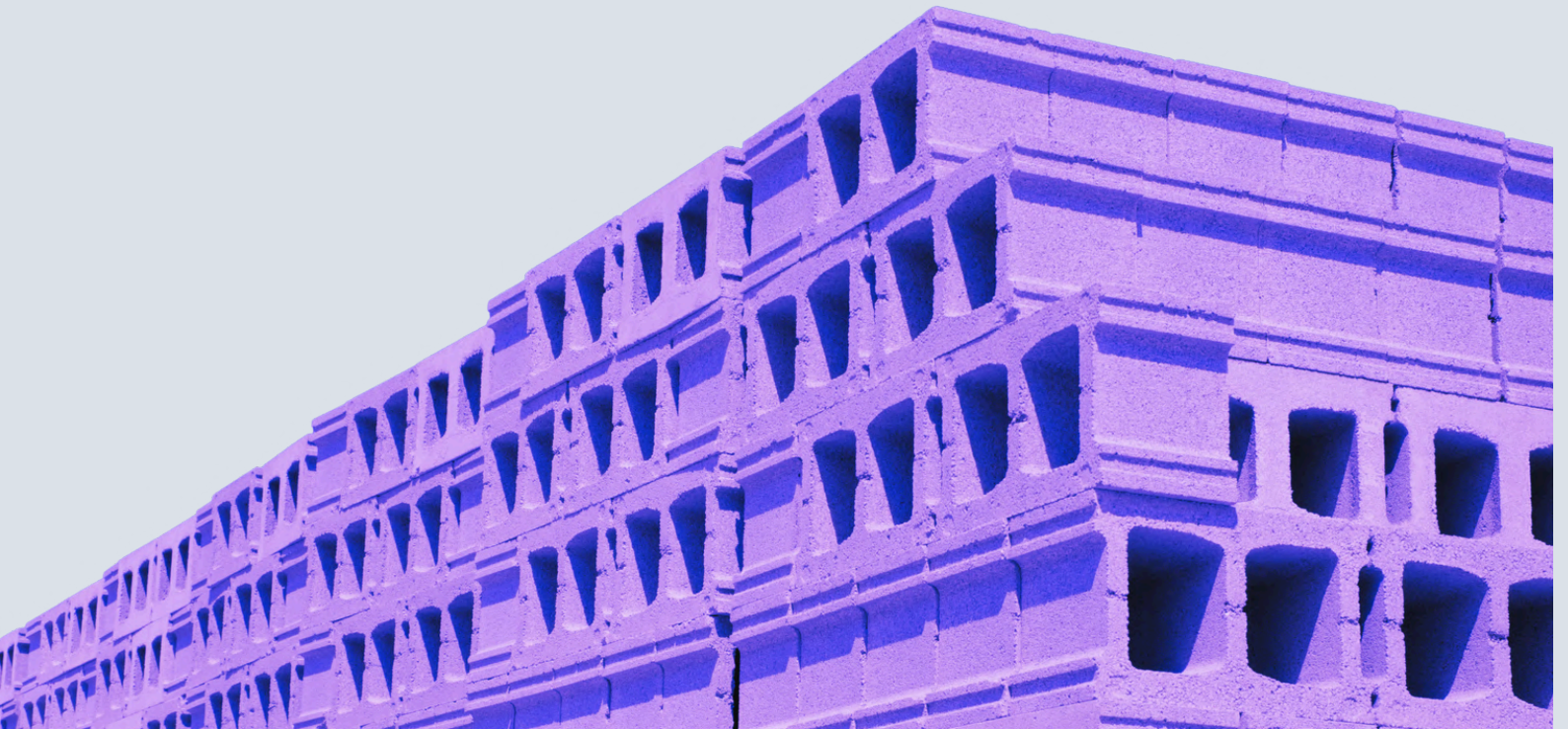
WHAT CONCRETE PRODUCERS GAIN

The case for Technical Carbon in concrete is not only climate-related. Its porous structure can act as a water reservoir and micro-filler, which can positively influence hydration, internal curing and the pore structure of the cement matrix.

Depending on formulation and dosage, studies and application experience point to potential improvements in compressive strength, flexural behaviour, crack and shrinkage control, chloride and sulfate resistance, and permeability. The same porosity can also contribute to reduced density and, in selected systems, support thermal or electrical functionality.

That is important commercially: adoption is much more realistic when climate performance comes with a materials benefit. In practice, the proposition is therefore to improve carbon storage AND material performance.



THE REGULATORY FRAMEWORK IS MOVING INTO PLACE

On 3 February 2026, the European Commission officially recognized three methodologies for permanent carbon removal under the EU Carbon Removal Certification Framework: Direct Air Carbon Capture and Storage (DACCS), Bioenergy with Carbon Capture and Storage (BioCCS), and Biochar Carbon Removal (BCR).

For the construction sector, this is highly relevant because the CRCF explicitly treats the incorporation of biochar into durable materials - including cementitious matrices - as a possible route to permanent carbon removal, provided the framework criteria are met. These criteria include robust quantification, monitoring, verification, sustainability of biomass sourcing and minimum durability requirements for storage.
This does not automatically certify every carbon-containing concrete mix. But it does establish a European policy signal: biochar in durable construction applications is now part of the recognized removal landscape, rather than an edge case outside the system.

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WHY EN 12878 MATTERS FOR CONCRETE APPLICATIONS

For market entry, standards matter as much as climate policy. EN 12878:2014 covers pigments for the colouring of building materials based on cement and/or lime and explicitly states that “elemental carbon” shall be regarded as an inorganic pigment.

That classification is important in a construction context. It means elemental carbon already has a recognized normative position in cement-based building materials. Products meeting the relevant requirements can be CE-marked under the Construction Products framework and used across European markets without needing a country-by-country reinvention of the product category.

To avoid confusion: this classification is normative, not a statement that every atom in biochar belongs to inorganic chemistry in the strict academic sense. In practice, the key point is that stabilized elemental carbon can be treated within an existing standards framework for concrete-related use and highly aromatised biochars are considered elemental carbon.

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HOW CARBON STORAGE APPEARS IN LIFECYCLE ASSESSMENT

EN 15804+A2 structures Environmental Product Declarations for construction products around modular lifecycle reporting and reports Global Warming Potential as separate values for fossil, biogenic, land-use, and total contributions.

Under standard biogenic accounting, carbon uptake during biomass growth and carbon release at end of life are often modeled through a "-1 / +1" logic. That logic is useful for many biogenic products, but it does not communicate the full significance of highly stable carbon stored over very long periods in durable materials.

This is why the ability to report permanent carbon storage separately is so relevant. Under the applicable PCR rules, permanent storage beyond 100 years can be disclosed in a dedicated subsection. For biochar-based additives in concrete, that creates a transparent way to show long-term storage in addition to the standard EPD presentation.

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A PRACTICAL CASE EXAMPLE

A product use case based on Clim@Add®, a CE-certified additive positioned within the EN 12878 framework, illustrates how the broader standards and carbon-accounting logic can be applied onto a marketable product for concrete applications.

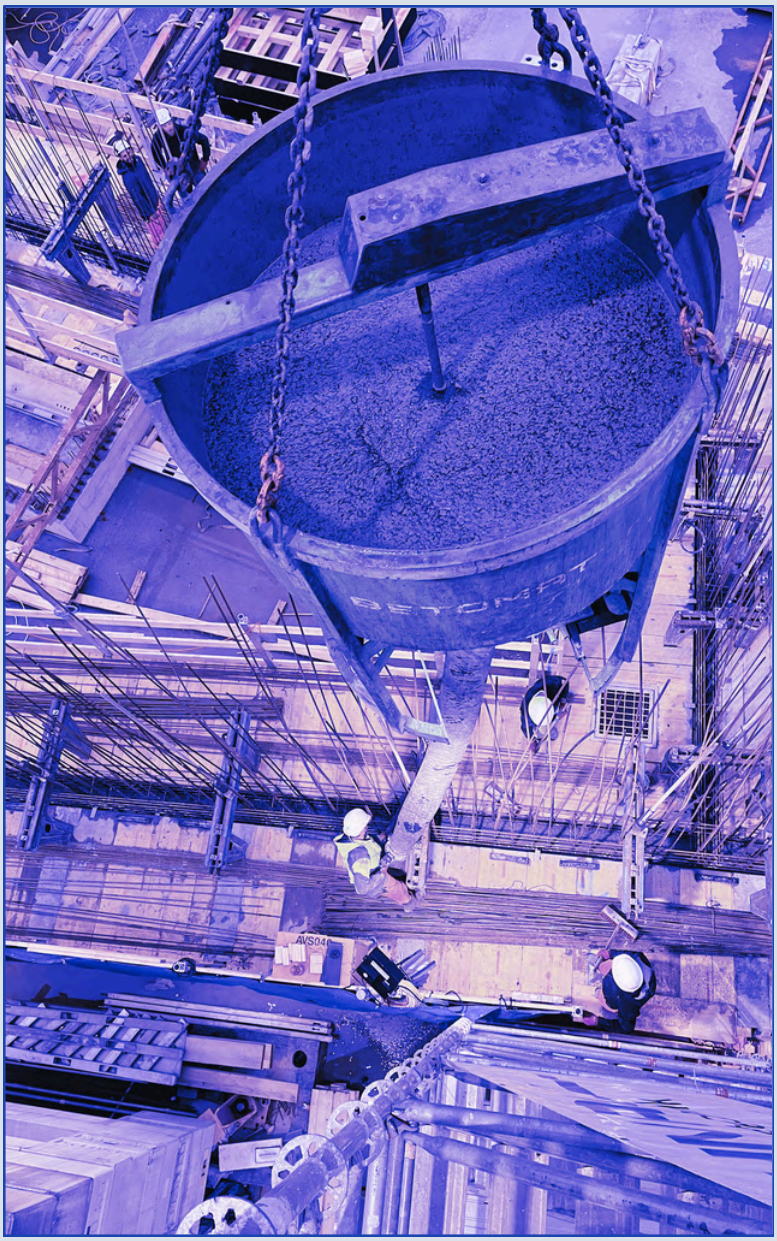
A modern heating plant is being built in Dornbirn, Austria – a milestone for the region's sustainable energy supply and an important step in the city's climate action plan. For the construction of the facility, the developers prioritized a maximum climate benefit, implementing the concrete elements with Clim@Add®.

A PRACTICAL CASE EXAMPLE

The pile foundation with Clim@Add® is also a first of its kind – the concrete additive has proven its worth here as well, demonstrating its versatility. A highlight of the project is the world's first combined use of climate-friendly concrete and an innovative slipform technique. This not only enables particularly efficient and seamless construction but also saves CO_2 during the building phase.

A PRACTICAL CASE EXAMPLE

The new Dornbirn heating plant is a showcase project for climate-friendly construction and energy generation, and a model of efficiency: the three construction phases of the Dornbirn Wallenmahd energy center were completed within a single year. Construction took place from May 2025 to March 2026.



A PRACTICAL CASE EXAMPLE

Concrete Elements
Pile supports / Foundation slab / Walls constructed using slipform technology / Stairs / Columns and beams / Ribbed slabs

Concrete volume
Pile supports 70 m^3 / Foundation slab 1200 m^3 /Heating plant 3078 m^3
Overall: 4.348 m^3 climate concrete

CO_2 sequestered through Clim@Add®
Pile foundation 4.25 t / Foundation slab 44.71 t / Heating plant 114.67 t

Overall: 163,64 tonnes of CO2 durably stored
This shows, that the use of Technical Carbon in construction is far beyond the pilot stage and that serious actors in the market are implementing it today.

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EUROPE NOW NEEDS SCALE, QUALITY AND PROCUREMENT SIGNALS

Europe already has substantial installed biochar capacity and additional production under development. The feedstock basis - regional residues such as waste wood, agricultural residues and green waste - is also present, provided sustainability rules are respected.

The bigger challenge is system integration. Scale-up requires reliable biomass supply chains, quality assurance, standardised performance data, integration into specifications and tenders, and procurement models that reward climate performance rather than only upfront cost. Public and private clients therefore have a major role to play.

If carbon performance becomes a binding procurement criterion, carbon-storing concrete can move faster from pilot projects into mainstream construction. Targeted EU support, including innovation and scale-up funding, could accelerate that transition.

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FROM PILOT PROMISE TO INDUSTRIAL RELEVANCE

Biochar-based carbon additives are no longer just an interesting lab concept. They now sit at the intersection of material performance, carbon removal and European product regulation.

That makes them especially relevant for a construction industry under pressure to reduce embodied emissions without abandoning familiar material systems. Concrete will remain indispensable in many applications. The question is how to make it better - and less carbon-intensive - within real market conditions.

The answer emerging in Europe is pragmatic: use stable carbon from sustainable residues where it adds technical value, store that carbon in long-lived building materials, and align certification, standards and procurement so the climate benefit becomes bankable. If those elements come together, today's early projects could become the foundation of a genuinely climate-effective building materials market.

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EUROPEAN BIOCHAR INDUSTRY CONSORTIUM E.V.
WWW.BIOCHAREUROPE.EU

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