Executive Summary

- **Storage ≠ Removal**: Timber buildings store carbon that was already sequestered by forests; they do not actively remove CO_2 from the atmosphere.
- **Net climate benefit depends on counterfactuals**: Climate impacts should be assessed against credible baselines to ensure additionality and attribution.
- **Carbon Storage Units (CSUs)**: CSUs can be introduced as a separate category, but only constitute a climate benefit if net gains can be demonstrated.
- **Carbon Storage Units ≠ Net Climate Benefit**: Only a harvested wood product (HWP) baseline can quantify net climate benefit from carbon storage. A zero-storage baseline (e.g. a concrete building) shows how much carbon is stored, but not whether this storage offers greater benefit than alternative uses of the wood.
- **Environmental trade-offs**: Increased demand for timber may lead to biodiversity loss, land-use change, or leakage, undermining broader climate and sustainability goals.

Recommendations

- **Timber should be integrated, not isolated**: Timber use should be part of project-level, integrated emission reduction strategies - be it for claiming climate benefits from carbon storage or from emission reduction from material substitution.
- **Ensure policy and market alignment**: Incentive mechanisms should align with robust decarbonization goals, inter-sectoral policy coherence, and integrity standards. Mechanism design should include safeguards to address potential land use and biodiversity trade-offs and promote nature-positive outcomes as co-benefits.

White Paper

Classifying Climate Benefits and Addressing Trade-offs of Timber Use in Buildings for Voluntary Carbon Markets and the EU Carbon Removal Certification Framework

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Abstract: Timber use in construction is increasingly promoted as a climate mitigation option due to its potential for carbon storage and material substitution. Current classifications often conflate storage with carbon removal, risking misalignment with voluntary carbon market integrity frameworks and the EU Carbon Removal Certification Framework. This paper evaluates the scientific and methodological basis for classifying timber-related climate benefits and advocates for integrating scientific evidence into future market and policy mechanisms. It outlines technical requirements for attribution, baseline setting, and carbon pool consistency, and assesses four classification options. The paper recommends treating timber as part of an integrated building-level mitigation strategy rather than a standalone component - be it for climate benefits from carbon storage or from emission reduction through material substitution. Further emphasis is placed on the need to safeguard against biodiversity and land-use trade-offs associated with timber demand as an integral part of any incentive mechanism.

1 Introduction

1.1 Scientific perspectives

According to the IPCC climate mitigation report 2023, buildings have been responsible for a share of 21 % of global Greenhouse Gas (GHG) emissions, and a share of 32% of global CO_2 emissions in 2019 alone. Decarbonization of the built environment is therefore a significant lever for transforming and reducing anthropogenic drivers of global warming and climate change. While the reduction of energy consumption by buildings and supply of renewable energy are a primary focus in the built environment, the sector has engaged in promoting mitigation strategies to further reduce GHG emissions from building materials in recent years. One strategy focuses on increasing the use of wood in buildings as a low-impact material. Use of timber in buildings has been promoted as a climate-beneficial construction material (Dzhurko et al., 2024; Himes & Busby, 2020; Mishra et al., 2022), underlining its potential to act as a “global carbon sink” (Churkina et al., 2020) by storing biogenic carbon retained in the wood for a long term and to avoid emissions from more emission-intensive materials such as concrete or steel. More recently, several studies have provided a more detailed picture of the mitigation potential of timber as a building material. Research using life cycle assessment in the built environment across different building types highlights mixed results regarding climate benefits from transitioning to timber-based buildings on the building and building stock level (Andersen et al., 2024; Hansen et al., 2024; Kumar et al., 2024; Zhong et al., 2021): Climate benefits from timber were found to depend not only on the building type but also on features of the building design such as combinations of different materials. Furthermore, increased use of timber was shown to correlate with negative impacts on biodiversity (Hansen et al., 2024), leading to further research on how to compensate land use impact from harvested wood products (HWPs) with other biobased building materials such as straw (Hansen et al., 2025).

1.2 Recent policy developments

Despite mixed scientific evidence of climate benefits from using timber in buildings, and clear evidence of its negative land use impacts, policy in various countries promotes its use as a construction material within the decarbonization strategy of the built environment. Most recently, as a market lever for potential climate benefits from biogenic carbon storage, certification of the use of long-lived wood products in buildings has been included in the European Carbon Removal Certification Framework (CRCF). Established under EU Regulation 2024/3012, the CRCF seeks to provide standardized methodologies to certify carbon removal and carbon storage interventions for voluntary markets, covering practices like afforestation, direct air capture, and carbon storage in products like biochar and timber use in buildings. It mandates proof of additionality, environmental and financial, based on standardized or activity-specific regional baselines, requires adjustments of net benefits for direct and indirect emissions caused by the intervention, and recommends uncertainty assessments and discounting. Under the CRCF, all activities have to follow a common methodology called QU.A.L.ITY, which is based on four core principles:

1. QUantification – calculating net carbon removals (Article 4).
2. Additionality – proving the activity goes beyond the baseline or status quo (Article 5).
3. Liability – ensuring long-term permanence or accountability for stored/removed carbon (Article 6).
4. sustainabilITY – showing the activity causes no significant harm (DNSH) to other sustainability areas in alignment with activities outlined in the EU Taxonomy (Article 7).

The framework currently includes use of long-lived wood products in buildings as a carbon storage method, while a detailed methodology remains still under development. A working group commissioned by the European Commission has published two reports examining existing methodologies on the market for assessing the climate benefits of timber use in construction (CRETA 2023, 2024) with the aim to provide a standardized methodology for using timber in buildings as a carbon storage medium within the scope of the European Carbon Removal Certification Framework.

1.3 VCM Integrity Requirements

Existing methodologies certifying climate benefits from timber buildings have been drafted for certification within the Voluntary Carbon Market which has increasingly formalized its integrity requirements for high quality and high integrity carbon credits during past years. Among these integrity efforts count the establishment of market oversight bodies including the Integrity Council for the Voluntary Carbon Market (ICVCM) and the Voluntary Carbon Market Integrity Initiative (VCMI), both of which focus on ensuring the quality and integrity of carbon credit issuance, their use and the integrity of associated mitigation claims. Integrity frameworks for carbon accounting have been introduced and updated, including the GHG Protocol to provide globally recognized standards for measuring and managing greenhouse gas emissions, the

Oxford Principles for Net Zero Aligned Offsetting to guide credible use of carbon offsets in net-zero strategies and ensure they contribute to long-term decarbonization (Allen et al., 2020; Axelsson et al., 2024), the SBTi guidelines for Net-Zero Target Setting in the Corporate Sector and their various standards (2021, 2023), and the Core Carbon Principles guiding integrity of credits within the Voluntary Carbon Market.
The Core Carbon Principles define integrity requirements for the VCM, establishing criteria that carbon credits have to meet to qualify as high-integrity, high-quality tradable units measured in CO_2 equivalent (ICVCM, 2023). Emission reduction, removal, or avoidance benefits from interventions must be transparent, traceable, verifiable, effective, and measurable. They must result in permanent climate benefits, be additional relative to a credible baseline, and contribute to a net-zero transition. Moreover, all carbon accounting approaches must avoid the risk of double counting climate benefits.

While carbon market policy, both regionally and globally, clearly aims to establish binding principles for market integrity, standardized methodologies, and the formalization of climate effects, climate benefits of timber use in construction remain debated. For one, recent studies using consequential LCA on the building and building stock level demonstrate that the classification of timber as a building material with unconditionally low climate impact is not defensible (Andersen et al., 2024; Hansen et al., 2024, 2025; Hoxha et al., 2025; Zhong et al., 2021). Assuming that climate benefits from using timber in construction may exist compared to emission-intensive material and from storing biogenic carbon, its negative impact on biodiversity still indicates that it can have indirect negative effects on the climate as well by negatively impacting biodiversity and ecosystems. Furthermore, current market approaches sometimes conflate fundamentally different mechanisms of quantifying net climate benefits from timber under a single category of “carbon removal”. This blurring of boundaries not only risks overstating the mitigation value of timber construction but also challenges the alignment with integrity requirements established by frameworks such as the CRCF, GHG Protocol, and the Core Carbon Principles. Without a clearer analytical distinction between the mechanisms that support emission avoidance, carbon storage and removal, and without consistent treatment of baselines, permanence, and attribution, the credibility of timber-based credits and their eligibility within high-integrity carbon markets remains uncertain. The following sections therefore outline the methodological requirements and technical challenges for classifying climate benefits from timber use in construction, followed by a discussion of classification options and their compatibility with VCM integrity requirements.

2 Toward enhanced carbon accounting and integrity in classifying climate benefits from timber-based building development

2.1 Mitigation actions and Attribution Logic

Avoided, reduced or removed emissions are distinct effects from mitigation actions that correspond to different steps in the mitigation hierarchy (e.g. Arlidge et al., 2018). Climate mitigation interventions rely on different mechanisms, produce different effects, and often vary regarding the time frames of these effects. The effect size of interventions to avoid, reduce or remove emissions is measured or approximated in tons of CO_2 equivalent, based on an equivalence principle that allows emissions from different sources to be compared. Adjustments to the effect size are made to account for direct and indirect emissions caused by the intervention, as well as for limitations of durability, and the additionality of effects from the intervention are assessed. This ultimately quantifies or estimates the net climate benefit (Δ) attributable to the intervention. This is often expressed in a simplified equation:

Δ = (Observed outcome under project) - (Associated emissions) - (Counterfactual outcome or baseline)

A net climate benefit means that there is net less greenhouse gas in the atmosphere than there would be without the project, whether because the project avoids or reduces the release of net emissions, or removes additional emissions from the atmosphere. Hence, proving additionality of the net climate benefits of mitigation interventions requires showing that these benefits would not have occurred in the absence of the intervention under a counterfactual scenario. This counterfactual analysis does not only serve to quantify net climate benefits but also to determine whether those benefits can be attributed to the intervention as their cause. It serves not only as a means to compare the mitigation mechanism against a scenario in which it is absent but to solidify the causal relation in the first place. Both aspects - quantitative and qualitative - are part of establishing internal validity of making inferences based on observations. Attributing net climate benefits to a specific intervention as their cause is specifically crucial to avoid double counting of emission avoidance, reduction or removal. Further, attribution is important in carbon markets where companies or countries make use of these claims in their net zero transitions.

2. 2 Technical Considerations

2.2.1 Mixed-Method Approach

Classifying climate benefits from using timber as a construction material is challenging due to the mixed-method complexity involved. While the statistics of impact evaluation have evolved through experimental work collecting observational data, evaluating benefits from use of timber in construction requires a combination of different methods. A challenge arises because Life Cycle Assessment, carbon accounting, and attribution logic are methodologically different and rely on different assumptions:

- **Life Cycle Assessment models** project material flows based on modeled system behavior at the product level (Andersen et al., 2024; Hansen et al., 2024; Kumar et al., 2024). LCA considers the entire lifespan of a building or a construction product, including emissions associated with different life cycle phases, both positive and negative (see Figure 1: Life Cycle Stages).

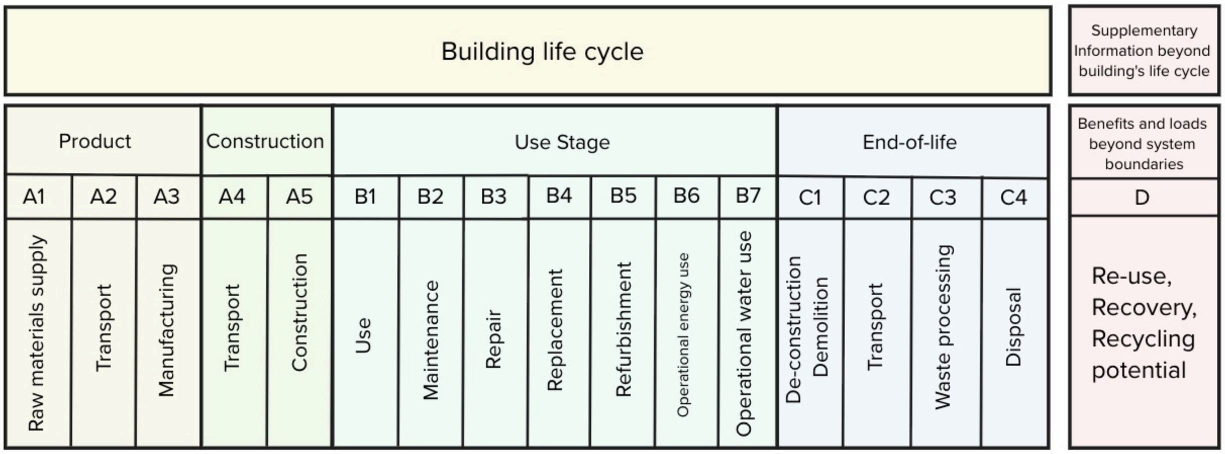

Figure 1: Building life cycle stages according to EN 15978.

- LCA results for construction products are reported in **Environmental Product Declarations (EPDs)**. In accordance with norm EN 15804+A2, Global Warming Potential (GWP) outcomes are disaggregated by emission source into GWP-fossil, GWP-biogenic, and GWP-land use and land use change (GWP-LULUC) (see Figure 2, taken from the EU Level(s) Framework Indicator GWP 1.2, Dodd et al., 2021). While most LCA software allows for uncertainty and sensitivity analysis (with MC simulation being the most frequently used method according to Marsh et al., 2023), EPDs do not disclose methodological choices or uncertainty measures. Hence, serving as a data base for building material emissions requires using methods that can work around the information as disclosed in EPDs (e.g. Hoxha et al., 2025).

Indicator	Unit	Product (A1-3)	Construction process (A4-5)	Use stage (B1-7)	End of life (C1-4)	Benefits and loads beyond the system boundary (D)
(1) GWP - fossil	kg CO_2 eq					
(2) GWP - biogenic	kg CO_2 eq					
GWP – GHGs (1+2)	kg CO_2 eq					
(3) GWP – land use and land use change	kg CO_2 eq					
GWP – overall (1+2+3)	kg CO_2 eq					
Notes:						

Figure 2: Disaggregated Global Warming Potential (GWP) across life cycle stages and emission sources, following EN 15804+A2.

- **Carbon accounting** in land-use sectors is typically mass-based.
- **Additionality assessments** use quasi-experimental statistical methods applied to observational data to estimate net benefits relative to a counterfactual (for examples from forestry see Swinfield et al., 2024; Swinfield & Balmford, 2023; West et al., 2020).

- **Validity of attribution**: These methods are designed not only to quantify net climate benefits of an intervention but also to ensure attribution of these net benefits to the intervention itself (as part of internal validity of the inference), rather than to potential confounding causes.

While mixed-method approaches are not inherently problematic, they require careful integration and transparency regarding assumptions, boundaries, interoperability, and interpretability to avoid conflating distinct forms of evidence.

2.2.2 System Boundaries, Carbon Pools and Flows

Methods may also differ in how they define system boundaries and the system-level assumptions they imply.

- **The IPCC Guidelines** for National Greenhouse Gas Inventories treat forests and harvested wood products as separate carbon pools (IPCC, 2006; Rüter et al., 2019). This distinction is designed to prevent double counting in national inventories.
- **Carbon Flows:** While carbon may flow between pools, any methodological framework applied to voluntary carbon markets should respect such distinctions to credit net climate benefits to the appropriate carbon pool only once.
- **System boundaries** of LCA may carry different assumptions than additionality assessments based on counterfactual scenarios. While evaluating impact against baseline scenarios always implies assumptions that extend beyond the individual project level, building life cycle assessment and its norms and standards impose strict boundaries on the building level.

To ensure consistency across different levels of carbon accounting and the data used in these methodologies, project-level assessments should aim to harmonize methodological approaches or assess and evaluate their potential alignment and conflicting assumptions and respect the logic of distinct carbon pools.

3 Key Classification Issues

3.1 Classification of timber as a CDR technology

Methodologies to certify climate benefits from use of timber in buildings show a variety of approaches, some classifying climate benefits from timber as a carbon removal technology, others as storage or reduction. The classification of timber use in buildings as a CDR technique may stem from an earlier IPCC taxonomy of carbon removal methods, presented in a table in the Sixth Assessment Report, Climate Change 2022: Mitigation of Climate Change (Figure 3 from Shukla et al., 2022). The report refers to an earlier categorization adapted from Minx et al. (2018) which lists negative emissions technologies but does itself not include timber or long-lived wood products as a carbon removal activity (see Figure 4 from Minx et al., 2018). While the 2022 IPCC report on climate mitigation discusses emission reduction strategies for buildings in detail (Chapter 9), it does not provide the reasons for the classification of using timber in construction as a carbon removal method in either of the chapters that include discussions related to climate mitigation in buildings (Chapters 9 and 12). As a result, the basis for the inclusion of timber as a CDR option in the report remains unclear.

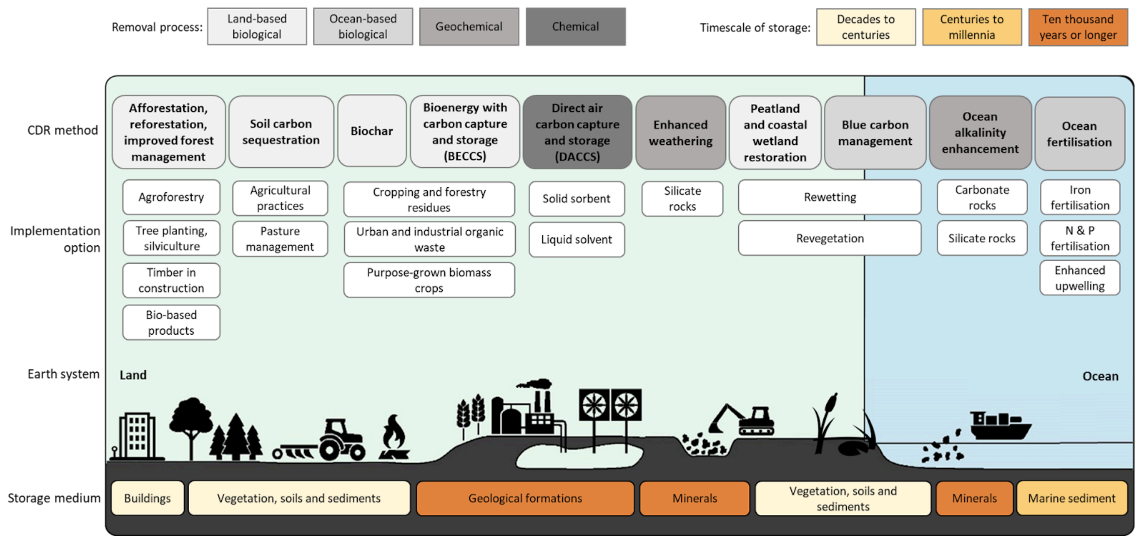

Figure 3: Overview taken from IPCC 6th Assessment report CDR Carbon dioxide removal taxonomy (Shukra et al., 2022).

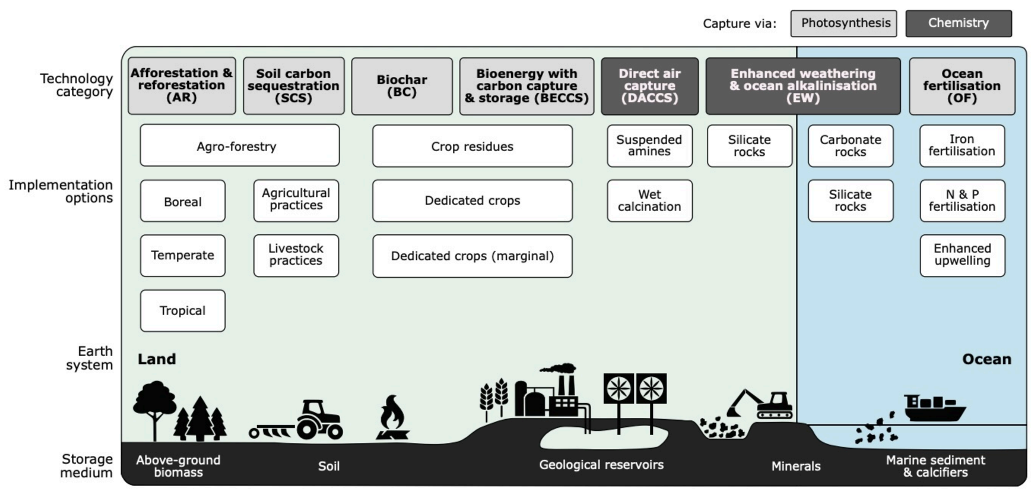

Figure 4: Overview of negative emissions technologies as included in Minx et al. (2018) not listing timber as a CDR method.

3.2 Clarifying the mechanism: Storage is not removal

The use of terminology might have caused confusion about the correct classification of climate benefits from using wood in buildings, risking conflating removal with storage. An intervention can claim to have removed net emissions permanently only if the intervention and its mechanism capture CO_2 from the atmosphere and store it in a durable carbon sink and only if this can be attributed to that intervention. Hence, carbon storage is a necessary condition for making a removal claim but it is alone not sufficient.

To qualify as net carbon removal two further conditions must be met:

A. **Removal mechanism:** There must be an intervention that actively removes CO_2 from the atmosphere such as tree planting or direct air capture.

B. **Attribution and effect:** The carbon removed must be additional and attributable to the intervention, meaning it would not have been stored without the project intervention.

Timber in construction violates the first condition: it does not remove carbon from the atmosphere but only extends storage duration of already-sequestered carbon. There is no removal mechanism in using timber in construction, hence, there can also be no removal effect attributable to the intervention. The removal mechanism is forest growth and must be credited to the forest sink (Figure 5).

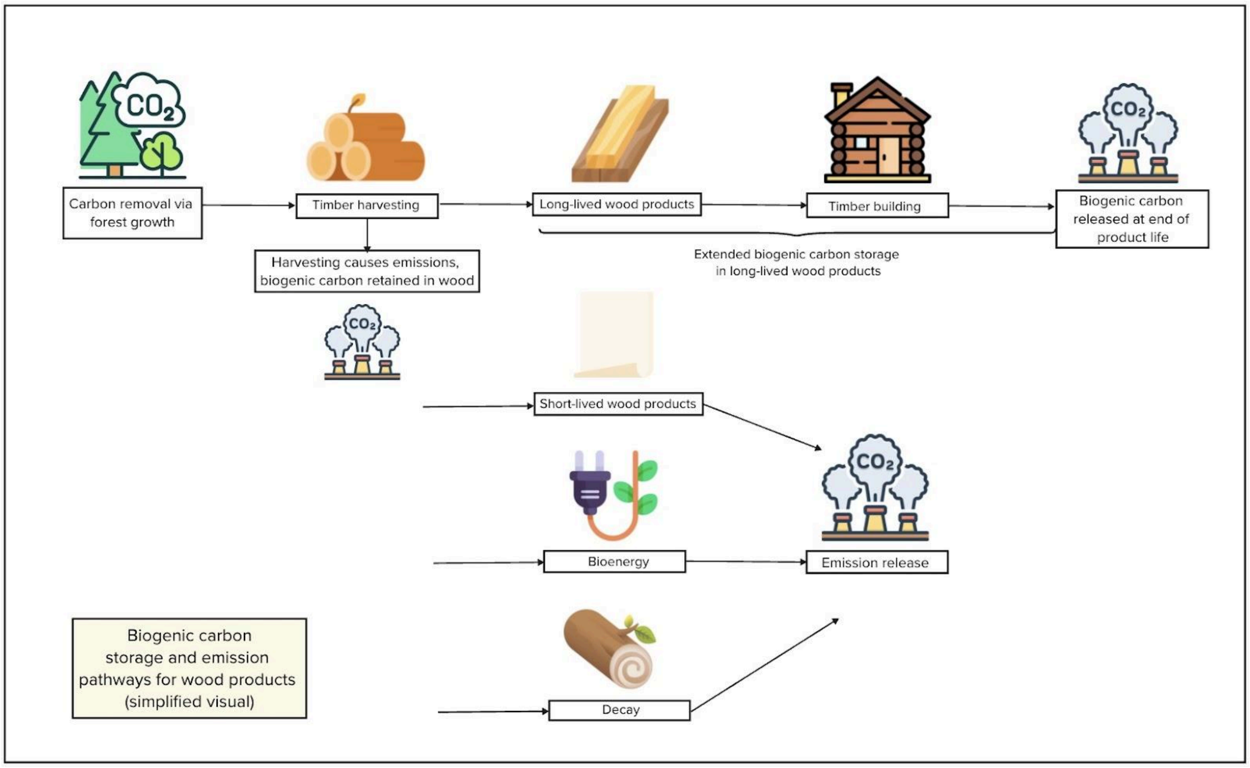

Figure 5: Biogenic carbon storage and emission pathways for wood products (simplified visual). Carbon is removed from the atmosphere through forest growth and temporarily stored in biomass. Timber harvesting generates emissions, but the biogenic carbon remains stored in wood. Long-lived wood products, such as timber buildings, extend storage duration before eventual release at the end of product life. Short-lived wood products, by contrast, result in earlier emissions through decay or conversion to bioenergy. Only forest growth constitutes a carbon removal mechanism; wood product use affects the timing of emissions, not the net atmospheric drawdown.

3.2 Can Timber Support an Emission Avoidance or Reduction Claim?

Storage is a necessary condition of a carbon removal mechanism, but it is not sufficient. Carbon storage can also be an implication of certain avoidance or reduction mechanisms, for instance in cases where deforestation and the associated emission release is prevented or delayed. Although the prevention of deforestation preserves an active natural carbon sink and therefore differs in mechanism as well as in effect from the use of timber which only prolongs carbon storage of already harvested "dead" wood, both options have in common that prolonging storage for the prevention or delay of emission release can under favorable baseline conditions count as a climate benefit.

For emission avoidance or reduction through the use of timber in construction there are two pathways:

A. **Substitution Effect:**
   Timber can avoid or reduce emissions by replacing emission-intensive materials such as steel or concrete in construction.
B. **Storage Effect:**
   Timber delays biogenic emission release relative to alternative harvested wood product pathways, such as short-lived uses, combustion, or natural decay.

In both cases, additionality depends on counterfactual (baseline) scenarios:
Avoidance or reduction can only be credited if it can be demonstrated that the emissions would have occurred or would have occurred earlier in the absence of the intervention. This requires a credible baseline and robust counterfactual analysis.

3.3 Carbon Storage Units as a new classification option

To uphold accounting integrity while acknowledging the climate value of long-lived wood products, methodologies can introduce a separate category for “carbon storage” and account for carbon storage units. This would allow recognition of the extended retention of biogenic carbon without conflating it with atmospheric removal or baseline-substituting avoidance. However, biogenic carbon storage in wood products alone - without differentiating against a credible baseline - does not represent new atmospheric removals or net avoided emissions.

3.4 The amount of carbon storage units in a building does not equal its net climate benefit

A central question arises around how to quantify net climate benefits from carbon storage units. Net climate benefits must be assessed relative to a credible baseline, demonstrating that there is less CO_2 in the atmosphere than would be without the project intervention. Currently, broadly two methodological approaches exist for assessing carbon storage in timber buildings:

1. Quantification against a zero-storage baseline, i.e. a conventional non-timber building, and
2. Quantification against a baseline of alternative harvested wood product storage pathways.

To understand what the net climate benefits of storing wood products in buildings consist of, it is important to remember that a potential climate benefit originates from delaying the release of emissions from already harvested wood by extending the storage duration through their use in buildings. While the first approach, using a zero-storage baseline, may quantify the amount of carbon stored in timber buildings, it does not reflect the net climate benefit of that storage. This is because the net benefit stems from extending the lifespan of existing biogenic carbon stocks, rather than introducing new removals. Therefore, to assess net climate benefits at the system level, carbon storage in buildings should be quantified against alternative wood product storage pathways, as suggested by the second approach.

While incentive mechanisms for both approaches to carbon storage are conceivable, methodological choices should be transparent about whether net climate benefits are quantified or not. Only net climate benefits meet additionality requirements set out in VCM integrity principles. Crediting carbon storage units on the building level without claiming net climate benefits could still be used for corporate disclosure or insetting of emissions along the timber value chain.

4 Harmonizing Market Incentives with Climate and Environmental Integrity: Ensuring certification includes safeguards and clear disclosure to prevent false or misleading claims about climate and nature impacts

Considering the mixed scientific results on the climate impacts of using timber in buildings and the trade-offs between timber use, land use and biodiversity protection, the question arises: how can potential incentive mechanisms be structured so that they deliver real climate and environmental benefits rather than creating adverse climate and nature effects?

4.1 Learning from trade-offs in forest-based carbon projects

Nature-based climate solutions and carbon crediting for removal, reduction, or avoidance have long been debated regarding potential inherent trade-offs between carbon-focused incentives and other environmental or social goals (e.g. Díaz et al., 2009 on carbon-biodiversity trade-offs in forestry). A lesson is that monetized carbon should not stand alone; incentive mechanisms can and should be complemented by eligibility requirements, safeguards, co-benefits, and disclosure requirements that promote balanced management for carbon, biodiversity, and social outcomes (e.g. Springer et al., 2024). Translating this to carbon storage or emission reduction in buildings implies that certification should not only go beyond carbon metrics for timber to consider other sources relevant for GHG emissions and benefits but also comprise DNSH criteria as listed in the EU Taxonomy, environmental and social safeguards and co-benefits, and transparent disclosure across the building lifecycle. Eligibility requirements should include deforestation-free supply chains, thresholds for carbon intensity of buildings, sustainable forest sourcing, conducting whole life cycle and life cycle impact assessments, compliance with energy efficiency standards, while implementing environmental safeguards to address potential land use tradeoffs, and promoting circular material use, biodiversity targets, water stewardship, health and social well-being as co-benefits should be encouraged. Disclosing ratios such as GHG stored/GHG emitted across lifecycle phases could provide a more integrated view of climate benefits from timber use in buildings (Dzhurko et al., 2024).
Addressing potential land use trade-offs in the mechanism design is particularly important, where incentives (e.g. for timber use) can increase deforestation risk. If forest harvesting increases to supply timber demand, there's a risk of deforestation elsewhere (leakage) or pressure on natural forests, reducing overall net benefit. To avoid unintended effects such as increased deforestation, environmental safeguards, such as caps on amounts of timber used in the building stock, could be considered. By implementing adequate safeguards and eligibility requirements, adding co-benefits and disclosure mechanisms, carbon storage or emission reduction certification of timber use could help incentivize holistic sustainable building practices, avoid mitigation deterrence, and address potential trade-offs.

4.2 Ensuring intra- and inter-sectoral policy alignment

Use of timber or biobased material in general is only one lever for decarbonization in the built environment and incentive mechanisms can be structured accordingly. Policy should therefore align timber use with other high-priority measures for decarbonization in the built environment and align with policy in other adjacent sectors such as forestry and the energy sector. The design of incentive mechanisms should be informed by scientific findings that identify the conditions under which timber use delivers favorable climate and nature outcomes. These conditions may include, for example, integration with lightweight building design, application in specific building types, or the combination with other bio-based materials (Andersen et al., 2024; Hansen et al., 2024, 2025; Zhong et al., 2021).

5 Classification Options

Provided that eligibility requirements comprising DNSH criteria and other sustainable building features, and environmental and social safeguards are in place, and nature-positive targets and other co-benefits are encouraged, there are several options for classifying and quantifying the potential climate benefits from using timber in buildings - through carbon storage as well as emission avoidance or reduction through substitution.

Option 1: Avoidance or reduction of emissions through material substitution

Use of timber can contribute to avoid and reduce emissions through substitution of more emission-intensive materials such as steel or aluminium. This net emission reduction benefit is quantified against use of conventional material and associated GHG emissions in a comparable building project as a baseline. Emission avoidance or reduction refers to mitigation across all GHG emission categories - fossil, LULUC and biogenic (see table above in Figure 2).
VCM Compliance: Yes. Avoidance and reduction credits are still considered valid mechanisms in many voluntary carbon market frameworks, especially when coupled with rigorous methodologies and conservative assumptions.

Option 2: Removal through additional afforestation or reforestation upstream the value chain

Looking forward, methodologies could evolve to assess the entire timber value chain, from forest management to end-of-life treatment, to evaluate cumulative climate and environmental impacts and benefits. Incentivizing timber construction could, in some cases, stimulate additional forest regrowth; however, the carbon sequestered and stored would be credited to the forest sink, while the use of timber would merely prolong biogenic carbon storage.
By accounting for the full forest–timber system, certification of carbon removal, for example, through afforestation or reforestation, could become applicable again. However, such removal should be tied to net sequestration in forests, and the credit would belong in land-use carbon accounting, not in product-level or building certification claims.
VCM Compliance: Yes. VCM-compatible for land-use removals, not for timber use itself.

Option 3: Integrative Project-Level Emission Reduction Credit

Rather than crediting timber use in isolation, this option proposes to monetize the net emission reductions of an entire building project as an integrated carbon credit. Timber use would be

treated as one component within a broader mitigation strategy that includes energy efficiency measures, material reuse, circular design, renewable energy systems, and low-carbon construction practices.The climate benefit would be credited based on net lifecycle emission reductions relative to a robust counterfactual scenario (e.g. a conventional design baseline without these interventions). The focus shifts from individual materials or actions to the combined decarbonization effect of the building project as a whole.
This option requires a composite methodology that aggregates mitigation outcomes across multiple levers including avoided emissions, reduced operational energy use, retained biogenic carbon, and material circularity and translates them into a single quantified emission reduction claim. This could form the basis for issuing project-level carbon credits under a dedicated methodology tailored to the built environment.
By accounting for interactions of building components and trade-offs between mitigation actions, this integrated approach promotes climate-effective design and aligns carbon crediting with whole-system performance.
VCM Compliance: Yes, in principle compatible but requires careful methodological development.

Option 4: Introduce a Separate Category for Carbon Storage Units
A distinct category for carbon storage or retention can acknowledge the temporal climate value of prolonged carbon storage in wood products. This benefit refers to the emission category of biogenic GHG emissions only (see table in Figure 2). However, as mentioned, carbon storage alone does not provide a net benefit to the climate system unless net climate benefits are calculated from comparisons with alternative storage scenarios. Otherwise carbon storage units do not represent a change to the system-level carbon balance. Furthermore, it should be disclosed clearly that under no condition does climate benefit from using timber represent a claim to emission removal.
VCM Compliance: Ambivalent:
- **No** - if not calculated against a credible baseline.
- **Yes** - if net storage benefit can be demonstrated in assessment against credible alternative storage pathways.

Policy Recommendation:
Embed timber use in comprehensive building emission reduction strategies that include environmental safeguards, DNSH criteria, and promote nature-positive targets and further co-benefits - be it for climate benefits from carbon storage or emission reduction from material substitution. Timber use for climate benefits from carbon storage or emission reduction should be integrated into a diversified mitigation portfolio that prioritizes robust, systemic emission reductions across the building sector, aligned with scientific results (Andersen et al., 2024;Hansen et al., 2024, 2025; Zhong et al., 2021). This includes:
- Reducing overall material demand through circular design, lightweight design, and refurbishment,
- Maximizing energy efficiency throughout the building lifecycle,
- Promoting use of renewable energy,

- Combining sustainably sourced timber with other low-emission materials and sustainable building features,
- Leveraging upstream impacts in the timber value chain to promote sustainable forestry, afforestation, and improved forest management,
- Including Do No Significant Harm requirements, environmental and social safeguards, and co-benefits to protect biodiversity and social outcomes.

This portfolio approach aligns with the precautionary principle and the need for systemic decarbonization, while still allowing timber to play a constructive and context-appropriate role within ecological and functional limits.

To ensure methodological rigour across all VCM-compatible options, the following aspects should be taken into consideration:

1. Require counterfactual baseline to ensure additionality: Avoidance, reduction or removal credits should only be granted if a credible baseline demonstrates additionality.
2. Maintain methodological clarity across LCA, carbon accounting, IPCC guidelines and attribution logic: Clearly differentiate and integrate LCA model-based projections, data uncertainties from EPDs, mass-based accounting, and counterfactual statistical analysis to avoid misleading conclusions.
3. Respect carbon pool boundaries in line with IPCC guidelines: Align methodologies with the IPCC's separation of carbon pools, ensuring consistency between project-level and system-level accounting.
4. Avoid conflation of storage and removal in certification logic: Emphasize that storage without atmospheric drawdown is not removal. This distinction is critical for maintaining market credibility and policy integrity.
5. Account for temporal dynamics and credit validity in line with SBTi and Oxford Offsetting Principles: Crediting should reflect the duration and reversibility of climate benefits.
6. Ensure policy coherence and maintenance of priorities within climate transition pathways
7. Proactively address potential adverse and system-level effects of promoting use of timber in construction on other environmental aspects such as biodiversity, water, forest ecosystem degradation and environmental policy in mechanism design.
8. Promote intra- and intersectoral policy and disclosure coherence.
9. Implement eligibility criteria such as deforestation-free supply chains, DNSH criteria and E&S safeguards, promote nature-positive targets as co-benefits, holistic building sustainability and co-benefits.

Conclusion Timber buildings can contribute to lower embodied emissions through emission reduction from substitution and carbon storage effects, but they are not a carbon sink and don't remove GHG emissions from the atmosphere. The carbon stored in the timber was sequestered by the forest before harvest. Putting that timber into a building extends storage duration, it does not actively remove new carbon from the atmosphere. Storage benefits depend on baselines and end-of-life scenarios. Use of timber should be seen as one lever within a broader decarbonization strategy in the built environment, not as a standalone solution. Therefore, mechanisms promoting use of timber should align with other decarbonization measures and integrate scientific evidence on conditions under which climate benefits from timber are more likely to emerge. Further, biodiversity and land-use trade-offs cannot be ignored. Increased demand for timber can lead to forest degradation or biodiversity loss if sourcing isn't carefully managed. This undermines broader sustainability goals even if substitution benefits exist. Therefore, mechanism design for financial instruments and policy should align various decarbonization measures in the built environment and address potential trade-offs or adverse effects proactively in mechanism design through eligibility requirements such as deforestation-free supply chains, implementation of environmental and social safeguards, and co-benefits.

Disclaimer: This white paper draws on academic work currently in progress. It is a non-peer-reviewed preprint and may be revised based on feedback or subsequent peer review.

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References

Allen, M., Axelsson, K., Caldecott, B., Hale, T., Hepburn, C., Mitchell-Larson, E., Malhi, Y., Otto, F., Seddon, N., n.d. The Oxford Principles for Net Zero Aligned Carbon Offsetting 2020.

Andersen, C.E., Hoxha, E., Nygaard Rasmussen, F., Grau Sørensen, C., Birgisdóttir, H., 2024. Evaluating the environmental performance of 45 real-life wooden buildings: A comprehensive analysis of low-impact construction practices. Building and Environment 250, 111–201. https://doi.org/10.1016/j.buildenv.2024.111201

Arlidge, W.N.S., Bull, J.W., Addison, P.F.E., Burgass, M.J., Gianuca, D., Gorham, T.M., Jacob, C., Shumway, N., Sinclair, S.P., Watson, J.E.M., Wilcox, C., Milner-Gulland, E.J., 2018. A Global Mitigation Hierarchy for Nature Conservation. BioScience 68, 336–347. https://doi.org/10.1093/biosci/biy029

Axelsson, K., 2024. Oxford Principles for Net Zero Aligned Carbon Offsetting (revised 2024).

Churkina, G., Organschi, A., Reyer, C.P.O., Ruff, A., Vinke, K., Liu, Z., Reck, B.K., Graedel, T.E., Schellnhuber, H.J., 2020. Buildings as a global carbon sink. Nat Sustain 3, 269–276. https://doi.org/10.1038/s41893-019-0462-4

CRETA, DG CLIMA, Partners for Innovation & Wageningen University and Research, 2023. Review of certification methodologies for longterm biogenic carbon storage in buildings.

CRETA, Partners for Innovation & Wageningen University and Research, DG CLIMA, 2024. Technical assessment of certification methodologies for long-term temporary biogenic carbon storage in buildings.

Díaz, S., Wardle, D.A., Hector, A., 2009. Incorporating biodiversity in climate change mitigation initiatives, in: Naeem, S., Bunker, D.E., Hector, A., Loreau, M., Perrings, C. (Eds.), Biodiversity, Ecosystem Functioning, and Human Wellbeing. Oxford University PressOxford, pp. 149–166. https://doi.org/10.1093/acprof:oso/9780199547951.003.0011

Dodd, N., Donatello, S., Cordella, M., n.d. Level(s) indicator 1.2: Life cycle Global Warming Potential (GWP).

Dzhurko, D., 2024. Forest, city and their carbon cycle – Quantification of the carbon impact of different construction types for Schumacher Quartier, Berlin.

European Environment Agency, 2024. Greenhouse gas emissions from energy use in buildings in Europe.

Ferraro, P.J., 2009. Counterfactual thinking and impact evaluation in environmental policy. New Drctns Evaluation 2009, 75–84. https://doi.org/10.1002/ev.297

Hansen, R.N., Eliassen, J.L., Schmidt, J., Andersen, C.E., Weidema, B.P., Birgisdóttir, H., Hoxha, E., 2024. Environmental consequences of shifting to timber construction: The case of Denmark. Sustainable Production and Consumption 46, 54–67. https://doi.org/10.1016/j.spc.2024.02.014

Hansen, R.N., Hoxha, E., Birgisdóttir, H., Pittau, F., 2025. Reducing the land-use impact of wooden buildings with fast-growing biobased materials: A Danish case study. Resources, Conservation and Recycling 212, 107926. https://doi.org/10.1016/j.resconrec.2024.107926

Himes, A., Busby, G., 2020. Wood buildings as a climate solution. Developments in the Built Environment 4, 100030. https://doi.org/10.1016/j.dibe.2020.100030

Hoxha, E., Birgisdottir, H., Röck, M., 2025. Climate IMPACT of EU building materials: Data compilation and statistical analysis of global warming potential in environmental product declarations. Sustainable Production and Consumption 54, 64–74. https://doi.org/10.1016/j.spc.2024.12.015

Intergovernmental Panel On Climate Change (Ipcc) (Ed.), 2023. Buildings, in: Climate Change 2022 - Mitigation of Climate Change. Cambridge University Press, pp. 953–1048. https://doi.org/10.1017/9781009157926.011

IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Kumar, V., Lo Ricco, M., Bergman, R.D., Nepal, P., Poudyal, N.C., 2024. Environmental impact assessment of mass timber, structural steel, and reinforced concrete buildings based on the 2021 international building code provisions. Building and Environment 251, 111195. https://doi.org/10.1016/j.buildenv.2024.111195

Marsh, E., Allen, S., Hattam, L., 2023. Tackling uncertainty in life cycle assessments for the built environment: A review. Building and Environment 231, 109941. https://doi.org/10.1016/j.buildenv.2022.109941

Minx, J.C., Lamb, W.F., Callaghan, M.W., Fuss, S., Hilaire, J., Creutzig, F., Amann, T., Beringer, T., De Oliveira Garcia, W., Hartmann, J., Khanna, T., Lenzi, D., Luderer, G., Nemet, G.F., Rogelj, J., Smith, P., Vicente Vicente, J.L., Wilcox, J., Del Mar Zamora Dominguez, M., 2018. Negative emissions—Part 1: Research landscape and synthesis. Environ. Res. Lett. 13, 063001. https://doi.org/10.1088/1748-9326/aabf9b

Mishra, A., Humpenöder, F., Churkina, G., Reyer, C.P.O., Beier, F., Bodirsky, B.L., Schellnhuber, H.J., Lotze-Campen, H., Popp, A., 2022. Land use change and carbon emissions of a transformation to timber cities. Nat Commun 13, 4889. https://doi.org/10.1038/s41467-022-32244-w

Rubin, D.B., 2005. Causal inference using potential outcomes: Design, modeling, decisions. Journal of the American Statistical Association Volume 100, 2005, 322–331.

Rüter, S., William, R., Lundblad, M., Sato, A., Ahmed Hassan, R., 2019. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Chapter 12 on Harvested Wood Products.

Shukla, P.R., Skea, J., Reisinger, A.R., IPCC (Eds.), 2022. Climate change 2022: mitigation of climate change. IPCC, Geneva.

Springer, K., Manning, P., Boesing, A.L., Ammer, C., Fiore-Donno, A.M., Fischer, M., Goldmann, K., Le Provost, G., Overmann, J., Ruess, L., Schöning, I., Seibold, S., Sikorski, J., Neyret, M., 2024. Identifying the stand properties that support both high biodiversity and carbon storage in German forests. Forest Ecology and Management 572, 122328. https://doi.org/10.1016/j.foreco.2024.122328

Swinfield, T., Balmford, A., 2023. Evaluating carbon credit claims and co-benefits. Working paper on Cambridge Open Engage, March 2023.

Swinfield, T., Shrikanth, S., Bull, J.W., Madhavapeddy, A., Zu Ermgassen, S.O.S.E., 2024. Nature-based credit markets at a crossroads. Nat Sustain. https://doi.org/10.1038/s41893-024-01403-w

Swinfield, T., Toye Scott, E., 2025. Scientific credibility for high-integrity voluntary carbon markets. https://doi.org/10.33774/coe-2025-f0j70-v2

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, 2024. REGULATION (EU) 2024/3012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 November 2024 establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products.

United Nations Environment Programme, 2023. Building Materials and the Climate: Constructing a New Future. United Nations, Erscheinungsort nicht ermittelbar.

West, T.A.P., Bomfim, B., Haya, B.K., 2024. Methodological issues with deforestation baselines compromise the integrity of carbon offsets from REDD+. Global Environmental Change 87, 102863. https://doi.org/10.1016/j.gloenvcha.2024.102863

Zhong, X., Hu, M., Deetman, S., Steubing, B., Lin, H.X., Hernandez, G.A., Harpprecht, C., Zhang, C., Tukker, A., Behrens, P., 2021. Global greenhouse gas emissions from residential and commercial building materials and mitigation strategies to 2060. Nat Commun 12, 6126. https://doi.org/10.1038/s41467-021-26212-z