Living Carbon Capture

A Pilot Concept for Durable CO_2 Storage and Fire Risk Reduction

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1. Purpose of this briefing

This briefing outlines a **pilot-scale concept** for exploring whether managed forests can act as a form of **durable carbon capture**, by combining continuous biological growth with **long-lived carbon storage in materials**.

The proposal is not intended as a substitute for emissions reduction, energy transition, or industrial decarbonisation. Instead, it examines whether **forest management and material use** can complement existing strategies by:

- Reducing wildfire risk and associated carbon losses
- Increasing the permanence of biologically captured carbon
- Producing useful materials with low embodied emissions

The aim is to define a **testable, low-risk pilot**, identify uncertainties, and invite technical critique.

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2. Background and context

2.1 Wildfire emissions and carbon permanence

Wildfires are an increasing source of CO_2 emissions in many regions, releasing large quantities of stored carbon over short time periods and reducing the future capacity of forests to function as carbon sinks. In fire-prone landscapes, unmanaged biomass can represent a **volatile carbon store** rather than a stable one.

Current climate mitigation frameworks largely focus on:

- Reducing fossil fuel emissions
- Technological carbon removal (e.g. direct air capture)
- Tree planting and forest expansion

Less attention is given to **carbon permanence**, particularly the risk that existing biological carbon stocks may be rapidly lost through fire, drought, or disturbance.

2.2 Forest composition and fire behaviour

A substantial body of research indicates that:

- Forest composition and structure strongly influence fire behaviour
- Broad-leaved and mixed forests generally burn less intensely than resin-rich conifer plantations under comparable conditions
- Managed forests with reduced ladder fuels and canopy discontinuity tend to exhibit lower fire severity

These characteristics suggest that **forest management choices** can materially affect both fire outcomes and carbon retention.

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3. The core concept

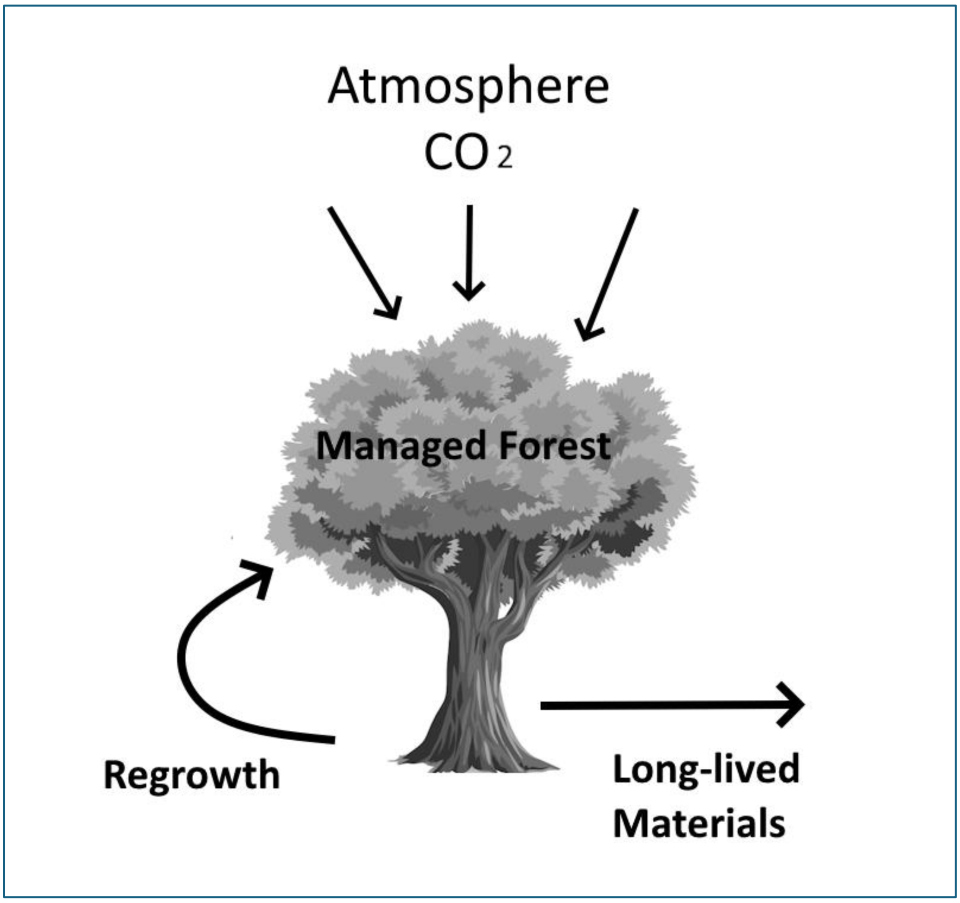

Figure 1. In a managed system, forests continue to absorb CO_2 while a portion of harvested biomass is transferred into long-lived materials, increasing carbon permanence.

3.1 Living carbon capture

This proposal explores whether trees can be treated as **living carbon capture systems**, provided that a meaningful portion of the carbon they absorb is transferred into **long-lived materials** rather than returning rapidly to the atmosphere.

The concept combines:

- Continuous biological growth
- Repeated, non-destructive harvesting
- Durable material use
- Fire-resilient forest structure

The intention is to move some forest carbon from **high-risk biological storage** into **lower-risk material storage**, while maintaining ongoing carbon uptake.

3.2 Management approach

The proposed approach focuses on **broad-leaved tree species** managed through traditional techniques such as:

- **Coppicing** (harvesting stems at ground level with regrowth from the stool)
- **Pollarding** (harvesting above browsing height with repeated regrowth)

These systems:

- Maintain permanent root systems
- Allow repeated harvest cycles (typically 5–15 years)
- Support long-lived trees (often centuries)
- Reduce canopy fuel continuity

Such practices have a long history in Europe and elsewhere, but are rarely framed in contemporary climate terms.

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4. Biomass use and carbon storage

4.1 Material pathways

To maximise carbon permanence, harvested biomass from coppicing and pollarding would be directed **exclusively into long-lived uses**, such as:

- Wood fibre insulation

- Engineered wood panels (non-structural in early pilots)
- Durable building components (e.g. cladding, boards)

Short-lived uses and combustion (including biomass energy) would be explicitly excluded within the pilot.

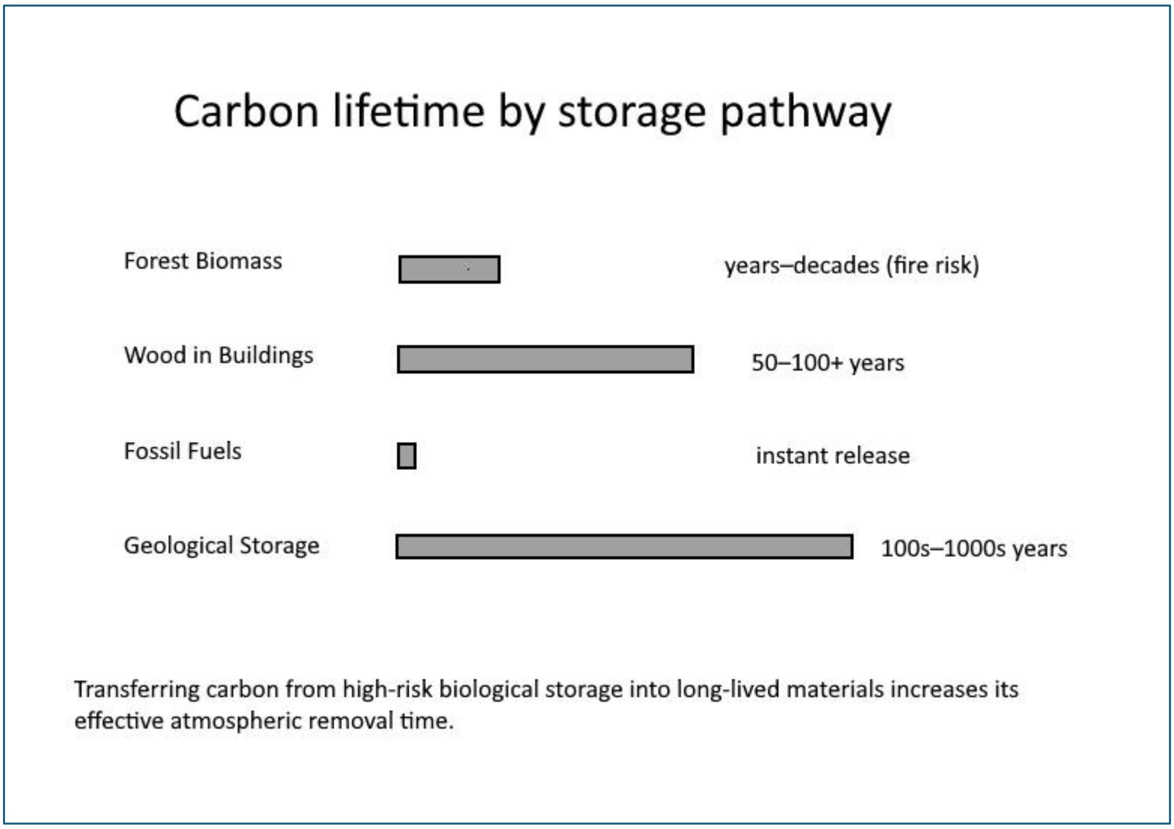

Figure 2 Comparison of Carbon Lifetime Storage Methods

4.2 Carbon storage characteristics

When used in buildings, wood-based materials typically store carbon for:

- Several decades at minimum
- Often 50–100+ years
- Potentially longer if materials are reused or recycled

In practical terms, this represents **above-ground carbon storage with durability comparable to many engineered sequestration approaches**.

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5. Pilot project outline

5.1 Scale and duration

A pilot of **500–1,000 hectares** is proposed, large enough to generate meaningful data but small enough to manage risk.

Indicative duration:

- 10–15 years
- Initial results within 5 years

5.2 Location criteria

Suitable pilot locations would:

- Be fire-prone but not arid
- Use non-primary forest or degraded land
- Have existing forestry capacity
- Be near demand for building materials

Regions such as Mediterranean Europe, western North America, southern Australia, or comparable climates may be appropriate.

5.3 Measured outcomes

The pilot would track:

- Biomass growth and harvest volumes
- Carbon retained in long-lived materials
- Forest structure and fuel characteristics
- Indicators of fire risk and resilience

Avoided wildfire emissions would initially be treated as **contextual evidence**, not credited removals, to maintain conservative accounting.

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6. Indicative carbon impact (order of magnitude)

Based on existing forestry and materials data, managed broad-leaved systems may plausibly achieve:

- **5–8 tCO_2/ha/year** of biological uptake
- **3–5 tCO_2/ha/year** retained in long-lived materials

At pilot scale (1,000 ha):

- **30,000–50,000 tCO_2 stored over 10 years**, subject to verification

These figures are indicative and intended to frame testability rather than to make performance claims.

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7. Relationship to other climate strategies

This approach is intended to be:

- Complementary to emissions reduction
- Complementary to technological carbon removal
- Aligned with climate adaptation and fire management

It does not eliminate the need for:

- Energy system decarbonisation
- Industrial emissions control
- Long-term negative emissions technologies

Instead, it aims to **reduce risk and protect existing carbon stocks** while contributing modest but durable storage.

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8. Open questions and uncertainties

Key uncertainties that a pilot would need to address include:

- How durable are different biomass material pathways in practice?
- How should harvested biomass be treated in carbon accounting frameworks?
- What management regimes optimise both fire resilience and carbon storage?
- Where does this approach perform poorly or create trade-offs?

This proposal is explicitly framed as **exploratory**, and negative findings would be as valuable as positive ones.

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9. Why a pilot is justified

A pilot of this type:

- Is relatively low cost compared to engineered capture pilots

- Generates valuable data even if carbon benefits are modest
- Improves fire resilience regardless of accounting outcomes
- Produces useful materials rather than waste streams

As such, it represents a **high chance of positive outcome experiment** in climate risk management.

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10. Next steps

Possible next steps include:

- Technical review by forestry and materials experts
- Identification of suitable pilot sites
- Refinement of conservative carbon accounting methods
- Exploration of public or philanthropic funding

This briefing is intended as a starting point for discussion, not a finished proposal.

Contact

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