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Designing a robust carbon certification methodology for forest management in Europe

> Results and recommendations for carbon certification from INFORMA project

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informa SCIENCE-BASED INTEGRATED FOREST MANAGEMENT FOR CLIMATE MITIGATION

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An Improved Forest Management (IFM) methodology has been initiated under the Carbon Removals and Carbon Farming regulation (CRCF), alongside a near-finalised afforestation methodology. As concerns grow over the declining capacity of Europe's forests, determining which forest management practices should be incentivised through carbon certification is far from straightforward.

This policy brief highlights that the diversity of European forests excludes a one-size-fits-all list of IFM practices. A risk-based framework is needed to account for disturbance and to tailor eligible practices to biogeographical regions and local conditions. In low-risk contexts, conservation-oriented practices (e.g. extension of rotations period) can increase carbon stocks. In higher-risk contexts, adaptive management approaches (e.g. species diversification, fire management) may be preferable to ensure long-term resilience benefits.

A credible baseline is essential, as baseline setting remains the main source of over-crediting in IFM projects. This is particularly challenging because quantification must incorporate disturbance risks and demonstrate that project activities deliver greater resilience than the baseline scenario. While emerging concepts such as dynamic baselines may offer useful guidance, they will need to be adapted to the European context to ensure practical applicability.

Beyond methodological design, financing remains the critical challenge. Forestry projects require long-term investment, while costs are largely upfront and carbon benefits materialise only over decades. The EU buyers' club could help bridge this gap, provided it supports specific long-term investment use cases. It is also essential to provide market visibility on the gradual integration of compliance-based incentives, complementing voluntary carbon finance, to unlock Europe's full forest mitigation potential.

SYNTHESIS MATRIX OF THE STAKEHOLDER DISCUSSIONS DURING INFORMA PROJECT

Theme	Sub-theme	✓ Consensus	Tension
Practices	Forest management eligible practices and assessment timeframe	No-regret solutions with both short and long term positive impact to be prioritised	Disagreement over the time frame for assessing climate impacts: 2050 horizon vs. longer-term forest dynamics
Baselines and additionality	Baseline design approach	Hybrid approach with standardised parameters to limit gaming, integrating independent and high-quality local data.	Tension between EU-wide prescriptive standardisation and locally grounded context-specific approaches reflecting Europe's forest diversity.
	Disturbance in baselines	Disturbance regimes must be incorporated into baseline and project scenarios	Disturbance treatment in baseline accounting unresolved, because of modelling challenges, particularly for Mediterranean fire-risk contexts.
	Dynamic baseline	Conceptually attractive for improving additionality and reducing over-crediting vs. static historical approaches.	Practical implementation contested: - Twin-plot identification in heterogeneous forests is challenging; - Uneven National Forest Inventory data access across Member States.
MRV	MRV innovations	Digital apps (e.g. Arboreal) show interesting potential to reduce field labour costs while maintaining measurement accuracy and precision. They also ensure data consistency across projects and over time.	Ground-based verification remains necessary. Extent to which digital tools can substitute conventional measurement -and auditor culture changes this requires- is contested.
Permanence tool	Buffer pool and temporary credits	Buffer pools commonly used by existing standards and well-accepted even with high buffering rates.	'Temporary' framing perceived as commercially unattractive by voluntary market actors despite the recognised long-term storage risks. Doubts regarding the benefits of combining temporary credits and buffer pools.
Sustainability	Co-benefits	Sustainability integration non-negotiable. Carbon-only framing is reductive. Certification must align with biodiversity protection and sustainable forest management principles.	No consensus on bundling vs. stacking carbon and biodiversity credits, with carbon credits seen as more advanced than biodiversity credits.
Accessibility	Smallholder accessibility	Aggregation models and alignment with SFM existing schemes (PEFC, FSC) broadly supported. Europe's fragmentation of forest ownership necessitates inclusive design.	No consensus on aggregation model design or how transaction costs should be distributed across developers and individual owners.

This table documents areas of consensus, unresolved tensions, and conditional acceptance regarding certification innovations based on five online focus groups and two in-person workshops, gathering a total of 136 unique participants from 97 organizations.

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The EU forest carbon sink has declined from an average of -457 MtCO2/year in 2010–2014 to -333 MtCO2/year in 2020–2022 (Migliavacca et al., 2025). Climate-related disturbances are expected to increase across Europe (Grünig et al., 2026), raising concerns about forests' ability to contribute to the EU's climate neutrality objective. Only a limited share of this carbon sink can be directly influenced through forest management, restricting the range of effective mitigation levers available (I4CE, 2026). In this context, the development of the EU Carbon Removal and Carbon Farming certification framework (CRCF) represents a critical opportunity to identify and incentivise climate mitigation practices in forestry. The first forest-related CRCF methodology - focused on afforestation - is expected to be adopted through a delegated act by autumn 2026, while an Improved Forest Management (IFM)[1] methodology is expected to follow in 2027. This raises a key question: how can IFM projects strengthen forest resilience and adaptive capacity while delivering credible and measurable climate benefits under increasing disturbance risks?

This policy brief addresses this question by combining scientific evidence from the INFORMA project with insights from stakeholder engagement processes conducted throughout the project. It identifies the main methodological and policy challenges associated with IFM carbon certification and proposes directions to support the development of effective CRCF methodologies.

1. IFM projects are a type of carbon projects implemented in existing forests and involving changes in management practices aimed at enhancing carbon sequestration compared to a baseline scenario. Other major forest carbon project types include Afforestation and Reforestation (A/R) and Reducing Emissions from Deforestation and Forest Degradation (REDD+).

1. A need for diversity in IFM practices

1.1 Conservation-oriented practices dominate existing IFM methodologies

A review of forest carbon certification methodologies highlights that more than 15 Improved Forest Management (IFM) methodologies are approved worldwide, in the main standards. IFM projects have generated approximately 200 million carbon credits since 2005, representing around one quarter of forest carbon credits globally (*Wetterberg et al., 2024*).

While IFM encompasses a broad range of practices in principle, existing methodologies are largely dominated by conservation-oriented approaches. These typically include extending rotation periods, reducing harvesting intensity, or setting aside forest areas, reflecting research findings that these are the most effective practices to generate mitigation benefits from existing forests *(e.g. Pilli et al., 2017; Soimakallio et al., 2022; Valade et al., 2018)*. The associated projects are mainly implemented in North America.

In Europe, where there are much fewer actual projects, adaptive and climate-resilient forest management principles are often cited as mitigation levers in Europe *(Nabuurs et al., 2017)*, particularly under different structural forest conditions and perturbance scenarios in the biogeographical regions (Boreal, Atlantic, Continental, Alpine and Mediterranean). This structural tension is also reflected in EU policies. On the one hand, instruments such as the LULUCF Regulation aim to enhance carbon sinks, while on the other hand, the EU Bioeconomy Strategy promotes increased use of wood as a substitute for fossil-based materials and energy *(Hetemäki et al., 2024)*. As a result, approaches based solely on reducing harvest intensity may conflict with broader decarbonisation objectives and with other political objectives such as strategic autonomy and industrial dynamism.

This highlights the need to expand the range of eligible IFM practices to active management strategies, sifting for the few jewels that can deliver climate benefits without reducing wood supply.

1.2 A diversity of risks on carbon stocks implying a variety of responses

European forest carbon stocks are subject to increasing risks, including climate-induced disturbances such as droughts, fires, pests, and storms *(Grünig et al., 2026)*, making resilience a central dimension of carbon strategies. The nature and intensity of risks vary significantly across European biogeographical regions and forest types, requiring differentiated management responses tailored to each specific context.

A risk-based approach to IFM is therefore essential. Risk assessment should be conducted at two levels. At the biogeographical scale, the INFORMA project has shown that risks vary in both nature and intensity. At the stand level, assessments should account for tree species composition, soil conditions, and topography, which are key drivers of risks such as drought. An increasing number of science-based tools are available to carry out such assessments *(e.g. ClimEssences[2] or Lerma-Arce et al., 2023)*.

- **In low-risk contexts,** conservation-oriented practices such as extending rotation periods can increase carbon stocks as INFORMA's review shows significantly higher carbon stocks in unmanaged forests compared to managed ones *(Simons et al., under review)*.
- **In high-risk contexts,** adaptive management strategies aimed at reducing forest vulnerability, such as thinning, species diversification, Integrated Fire Management, preventive silviculture and landscape-level fuel management, may be more appropriate, even if they temporarily reduce carbon stocks. In these situations, assessing carbon payback time becomes essential in order to prioritise interventions capable of delivering climate benefits within reasonable timeframes.

Stakeholder discussions within the INFORMA project confirm the importance of recognising this diversity of approaches, avoiding one-size-fits-all solutions and recognising the strong variability of European forests across biogeographical regions. Ongoing and emerging European initiatives already highlight this tension with for instance extension of rotation age projects in the Boreal and Atlantic region[3] and post fire restoration project in the Mediterranean region[4]. Although Integrated Fire Management

2. https://climessences.fr/node/547.

practices show promise as mitigation and adaptation strategies, they still face implementation challenges *(Oliveras Menor et al., 2025)*.

This recognition of the need to diversify IFM practices in Europe must be accompanied by methodological approaches and MRV frameworks tailored to this context.

2. Balancing standardisation and innovation in IFM methodologies

2.1 Baseline definition is the weakest point of IFM projects

Baseline definition remains the most critical and vulnerable component of IFM carbon certification methodologies. Evidence from various recent reviews of projects confirms that baseline setting is a primary source of uncertainty and a key driver of over-crediting risks in the USA *(Badgley et al., 2022; Haya et al., 2023; Stapp et al., 2023*) while similar loopholes are emerging in European standards *(INRAE, 2024; Stanley and Cusworth, 2025)*. IFM methodologies reviewed under INFORMA often provide significant flexibility to project developers in defining baselines, increasing the risk of biased assumptions and inflated carbon credits. **Strengthening the framing of baselines within methodologies is therefore essential to ensure environmental integrity.** This includes clearer rules and pre-defined parameters – for example, by species – that are consistent with national inventory parameters. Governance must be carefully designed to allow for independent and competent review of baseline, and avoid conflicts of interests in decision-making.

Dynamic baselines have recently emerged as a promising alternative and are implemented by the main standards[5]. By updating baseline estimates based on observed data rather than fixed projections, they can better reflect actual forest dynamics and reduce over-crediting risks. However, their implementation in Europe remains challenging due to data accessibility and structural differences in national forest inventories, ownership structures and very heterogeneous forests. As a result, while dynamic baselines should be further explored, their deployment will require significant methodological adaptation and institutional coordination in Europe.

2.2 Biogeographical regionalization in Europe

A central conclusion of the INFORMA project is that IFM methodologies should not rely on universal management prescriptions across Europe. Forest structures, species composition, ownership patterns, management traditions and disturbance regimes differ substantially across boreal, Atlantic, continental, alpine and Mediterranean regions. **Consequently, both IFM practices and MRV methodologies should be regionally adapted to ensure ecological relevance, policy legitimacy and environmental integrity.**

2.3 MRV: Making the best use of modelling, remote sensing and field measurements

The CRCF Regulation states that methodologies must combine modelling, field measurements, and remote sensing approaches. Striking the right balance between these components is essential to ensure both accuracy and scalability.

Remote sensing technologies offer strong potential for large-scale monitoring but still face important limitations, particularly in capturing subtle management-related changes that can occur in IFM projects *(Van Winckel et al., 2025).* New technological breakthroughs could make remote sensing an attractive option in the coming years; in the meantime, however, field surveys remain necessary for monitoring IFM projects in Europe. In this context,

3. e.g. https://carboncapturecompany.se/en.
4. e.g. https://landlifecompany.com/en-us/projects/spain-and-portugal or https://www.miteco.gob.es/fr/cambio-climatico/temas/registro-huella.html.
5. See e.g. 1. Verra-VCS https://verra.org/methodologies/methodology-for-improved-forest-management/, 2. ACR https://acrcarbon.org/resources/dynamic-baseline-in-acr-improved-forest-management/ and 3. Gold Standard https://www.goldstandard.org/consultations/sustainable-transformation-afforestation-reforestation-revegetation-starr

digital innovations offer promising pathways to improve efficiency of this labour-intensive step. Mobile apps have recently been developed to carry out field measurements, taking advantage of the emergence of LIDAR technology on certain mobile phones and tablets *(Borz et al., 2024; Howie and De Stefano, 2024).* **Evaluating one of them -the Arboreal App- across different European biogeographical regions within INFORMA showed that such a tool can significantly reduce operational costs, reducing time spent on plot measurements by an average factor of three while maintaining acceptable levels of accuracy.** Nevertheless, total fieldwork time remains often driven by travel between plots. Interacting with stakeholders revealed that another benefit of such a tool is ensuring data consistency across projects.

However, no single monitoring approach is universally optimal. Trade-offs between accuracy, cost, and feasibility depend on forest type, sampling design, and monitoring objectives. This supports the development of hybrid MRV systems combining conventional methods for robustness and innovative tools for scalability, while remaining adaptable to regional ecological conditions and management realities.

2.4 Differences in measurability between carbon pools

Not all forest carbon pools can be monitored with the same level of accuracy, cost-efficiency, or relevance for certification purposes.

The review of the IFM methodologies shows that :

- All methodologies include aboveground biomass, which also serves as a proxy for belowground biomass;
- Deadwood and shrub pools are generally not cost-effective for routine carbon crediting;
- Soil carbon is generally not included because it remains difficult and costly to measure accurately and often associated with large uncertainties relative to expected additionality as the sequestration of carbon in the soil is generally a very slow process. Comparison between managed and unmanaged forest show marginal difference for soil carbon stocks (Simons et al., under review) Recent literature reviews have shown that management practices either have uncertain effects or can be offset by increased N_2O emissions (e.g. nitrogen fertilization) *(Mäkipää et al., 2023; Mayer et al., 2020)*. An innovation designed to reduce cost of soil analysis has been tested during the INFORMA project in 146 plots in the five European biogeographical regions: Near-Infrared (NIR) spectrometry. The method showed limited applicability in a forest context due to the lack of sufficiently large and representative spectral libraries for robust calibration, resulting in low precision for both soil and litter layers.

2.5 Striking the balance between scientific robustness and accessibility

A central challenge in designing IFM methodologies lies in balancing scientific robustness with practical accessibility for project developers. Highly complex methodologies may improve accuracy but they also risk limiting participation and substantially increasing costs, particularly for small forest owners. Conversely, overly simplified approaches may undermine credibility and increase the risk of over-crediting.

INFORMA findings highlight the importance of well-designed methodological “framing” to balance these objectives.

This includes:

- **clear rules for baseline definition;**
- **standardised monitoring protocols ;**
- **and structured approaches to non-permanence risk management.**

Such framing reduces the cost of project development, reduces the risk of 'gaming' and allows for more straightforward auditing.

3. Scaling IFM projects: the need for a market-based perspective

3.1 Bridging long-term investment gaps in forestry

Forestry projects operate over long-time horizons, with carbon benefits -and timber revenues - materialising only after several years or decades, while most costs occur upfront. This structural mismatch with conventional financing, which favours short-term returns, means that many IFM projects remain uninitiated despite being economically viable in the long term. The constraint is particularly acute for small forest owners, who often lack the capacity to cover initial costs related to certification and management changes, especially in contexts exposed to high climate-related disturbance risks, where uncertainty over investment returns is greater. Innovative financing approaches are therefore required to bridge this gap. In this context, the European Commission's creation of a buyers' club and associated purchasing facilities provides an opportunity to test upfront payment schemes and blended finance mechanisms. **The specific temporal economics of forestry need to be fully accounted for, alongside the development of strategic portfolios rather than purchasing only what is readily available at the lowest cost *(Gardiner et al., 2026).***

3.2 Keep consistency between different incentives

Whilst the forestry and timber sector offers a range of mitigation levers (carbon sequestration, substitution) across different stages of the value chain, these are accounted for in different ways within carbon accounting frameworks. Even within the CRCF, forest carbon removals and carbon storage in wood products in buildings are in different methodologies. **Ensuring consistency across climate incentive policies at different value-chain levels is therefore essential.**

3.3 Limits of voluntary carbon finance

A voluntary system alone will not be sufficient to meet IFM financing needs in Europe. Voluntary carbon markets are currently experiencing a period of declining confidence, as concerns over environmental integrity have made buyers more cautious. But beyond these integrity issues, the voluntary market is inherently limited in its ability to mobilise significant and sustained funding. Only the introduction of regulatory instruments to price emissions and reward removals in the LULUCF sector will be sufficient to enable the scaling up of forest removals *(ESABCC, 2025)*. Carbon compliance and voluntary markets have historically been closely interconnected (Wetterberg et al., 2024). Among other examples, the largest source of demand for carbon credits has historically come from the EU Emissions Trading System (EU ETS), which drove the retirement of approximately 1.57 billion credits between 2008 and 2012[6] *(European Commission, 2021)*. This single example of a "compliance market" that lasted only 5 years exceeds the cumulative retirements observed in the voluntary carbon market since 2002, estimated at around 1.2 billion credits *(Ecosystem Marketplace, 2025)*.

3.4 Alternative financing mechanisms do not provide greater clarity

Growing expectations are being placed on downstream value chain finance to support EU carbon farming (including forestry). In agriculture, food processors and retailers are facing a combination of growing scrutiny (e.g. environmental labelling of food products) and carbon-intensive inputs (e.g. meat). But even in this favourable context evidence of the ability of the downstream value chain to deliver financing at scale remains limited. **In the forestry sector where Scope 3 financing initiatives are almost inexistent, the potential of voluntary downstream value chain finance seems even more elusive.** One key limitation lies in the absence of clear accounting rules for the forest-wood value chain. In particular, the postponement of forestry guidance in the GHG Protocol's Land Sector and Removals Standard (LSRS)[7]

6. Strictly speaking, the EU ETS accepted CDM credits until 2020, but most participating firms reached their use limit in 2012, leading to the tumbling of CDM credits price that year (Stephan et al., 2014).
7. https://ghgprotocol.org/land-sector-and-removals-standard.

creates uncertainty for companies willing to invest in forest-based climate mitigation. Another major difference with agriculture is that most emission reductions in the forest-wood sector are not expected to occur at the producer level *(e.g. Forster et al., 2023; Smyth et al., 2014)*, meaning that value chain mitigation efforts are, often legitimately, directed toward other stages of the chain rather than forest owners.

The ongoing development of initiatives with a stronger focus on biodiversity, such as the Nature Credits Roadmap of the EU[8], is welcome, but these too rely on voluntary commitments: such initiatives are therefore unlikely to increase substantially the volume of funding available for environmentally sound practices.

This uncertain landscape reduces investment incentives and slows down the development of IFM projects.

8. https://ec.europa.eu/commission/presscorner/detail/es/ip_25_1679.

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