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D7.3

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About OptFor-EU

OptFor-EU wants to co-develop a Decision Support System (DSS) with forest managers and other forest stakeholders, that provides them with suitable climate adaptation and mitigation options for science-based optimising forest ecosystem services (FES) (including decarbonisation) and enhancing forest resilience and its capacities to mitigate climate change across Europe.

The project 'OPTimising FORest management decisions for a low-carbon, climate resilient future in Europe (OptFor-EU)' will build a Decision Support System (DSS) to provide forest managers and other relevant stakeholders with tailored options for optimising decarbonisation and other FES across Europe.

Based on exploitation of existing data sources, use of novel Essential Forest Mitigation Indicators (EFMI) and relationships between climate drivers, forest responses and ecosystem services, OptFor-EU has five specific objectives:

- Provide an improved characterisation of the Forest-Climate Nexus and FES;
- Utilise end-user focused process modelling;
- Empower forest end-users to make informed decisions to enhance forest resilience and decarbonisation;
- Provide a novel DSS service; and
- Bridging different EU strategic priorities, robust science, and stakeholders in the forest and forest-based sectors.

Based on a supply-demand approach, the methodology combines an iterative process of data consolidation, modelling, and co-development of solutions alongside forest managers and other practice stakeholders in all European Forest Types. The DSS will be designed and tested at eight case study areas, to provide a ready-to-use service, near to operational (TRL7) at European level, while a user adoption and up-take plan will maximise the societal and business impact.

LIST OF ACRONYMS

Acronym / Abbreviation	Meaning / Full text
CSA	Case Study Area
DSS	Decision Support System
EAPs	Environmental Action Plans
ECV	Essential Climate Variables
EGD	European Green Deal
EUFS	EU Forest Strategy
EFMI	Essential Forest Mitigation Indicators
EFT	European Forest Types
FES	Forest Ecosystem Services
FMP	Forest Management Practices
GHG	Green House Gas
MAA	Multi-Actor Approach
NBS	Nature-Based Solutions
SDGs	Sustainable Development Goals
SFM	Sustainable Forest Management

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EXECUTIVE SUMMARY

This deliverable describes the framing context, synergies and contributions of the OptTor-EU project to the European Green Deal (EGD) and the New European Forest Strategy (EUFS). The two documents are briefly introduced in the context of the project, and the deliverable details the linkages between each working package and EGD and EUFS. It is stressed and argued that many activities performed within the OptFor-EU contributes to the objectives of both EGD and New EUFS.

Besides, this deliverable presents the networking activities developed during the project implementation, emphasising the networking with the project Forwards, with other ongoing projects tackling similar topics, as well as other networking activities.

The deliverable will be updated in month 36.

1. Introduction

OptFor-EU addresses various domains of European policies, it focuses on climate change mitigation and adaptation measures but also the impact on biodiversity, deforestation, circular economy and soil and land degradation. Paving the way for decarbonisation and the achievement of the environmental ambition of the EU Green Deal, OptFor-EU aims to provide suitable climate adaptation and mitigation options for Forest Ecosystem Services (FES), including decarbonization and enhancing forest resilience and its ability to mitigate climate change across Europe. Such challenging objectives are carried out by empowering forest managers and other relevant stakeholders to take part and be involved in providing integrated informed decision through a co-developed Decision Support System (DSS). This DSS helps secure their rights and needs as well as achieving the goals of the European Green Deal (EGD) and its related derivative frameworks.

One of the major objectives for the OptFor-EU is to significantly improve the science characterization of European FES, especially in old-growth forests. The available datasets are quantified, and this facilitates novel findings on a range of socio-economic and climate scenarios and uncertainties. Such actions are highly necessary for a proper representation of FES to the forest managers and stakeholders otherwise, the work will lack proper direction.

Strengthening the project contribution to the European Green Deal (EGD) and its related derivative frameworks, is assured not only by improving the representation of forest land cover and forest management practices (FMP) across Europe but also by enhancing the understanding of the cross-impacts of FMP, socio-economic and climate scenarios on forest processes and the prerequisites of FES at different scales. Achieving such an ambitious objective will consider the integration of a common set of EU forest land cover data and FMP into the OptFor-EU models.

However, the contribution to the environmental policy frameworks requires practical implementation and making sure no-one is left behind. Making informed decisions and creating new knowledge needs a more stable demand structure and equally important, participation and involvement throughout the whole process. For that reason, OptFor-EU delivers a ready-to-use solution to better understand the differences and benefits of various FMP. This solution is based on existing data and high-resolution model simulations and prioritises bridging the gap between validation and representativity. It also empowers and supports forest managers and other relevant stakeholders through a co-developed DSS that actively engage not only stakeholders but also end-users.

Since the usability and performance of a DSS is on a constant shift and on-going optimization, some might even attach a participatory approach to it; however, that poses great implications. Such limitations are addressed through the novel OptFor-EU co-developed DSS and its toolboxes that aim, among others, to optimize FMP by enabling

forest managers to identify optimal management options and nature-based solutions for maintaining and enhancing FES and forest ecosystems across Europe, respectively.

Such approach delivers informed decisions and implementation while considering an efficient use of resources from all points of views, especially economic and inter-operability. Therefore OptFor-EU DSS toolboxes are built on co-development and engagement throughout the whole process securing an integration of good practices coming from science-based solutions provided by the DSS and stakeholder knowledge through multi-actor approach. Such system combines harmonised observational and model data ranging from forest characteristics, practices and climate variables to carbon stocks and sinks, land cover and derived indicators contributing to and facilitating the transfer of knowledge and climate mitigation potential of forests for climate action.

Bridging the gap between different EU strategic priorities and legislative frameworks targets, requires high consideration of robust science and stakeholder needs, single objective optimisation does not suffice when analysing complex interactions between the ES and other variables (growth, species richness etc.) (Lundholm et al., 2020). Therefore, OptFor-EU co-developed DSS contributes to the objectives of different strategies, action plans, initiatives and frameworks, especially to the ones under the umbrella of EGD (e.g. new EU Forest strategy, EU Biodiversity strategy for 2030, etc.). Moreover, OptFor-EU also contributes to the Paris Agreement, mainly towards reduction in net emissions of greenhouse gases related to FES, boost use and smart use of forest resources and its circularity.

This deliverable also syntheses the networking activities over month 1 to month 18 implementation period of OptFor-EU. This is in the light of the collaboration requested by the call text between the OptFor-EU project and the projects financed in the call HORIZON-CL6-2022-CLIMATE-01-05: Forestry - European observatory of climate change impacts and demonstration network of climate smart restoration pilots. The networking activities between OptFor-EU and other Horizon Europe projects with similar topics are also described.

2. European and global environmental policies arena

Environmental objectives and goals do not only consider the qualities for SMART or various concepts, but they historically act towards being participatory, flexible, dynamic, understandable, and transdisciplinary (Slocombe 1998; Cradock-Henry et al., 2020). The importance of public engagement in setting environmental goals is often put forward as a reason why goals need to be participatory and bottom-up. Goals that are developed through public engagement are believed to foster support for implementation and action (Roman et al., 2021) mainly because environmental goals manage systems that are dynamic, open, interrelated, creative, complex and quite often unpredictable. A sudden change in the system asks for improved and immediate revision of the goals once set as some actions might reduce the impact on a variable however, it might enhance others (e.g. removing poverty overlaps with changes in education, health and climate change.) (Slocombe 1998; Bali Swain et al., 2019)

Since Brundtland Commission's report on the global environment and development in 1987, the term "sustainable development" flooded the policy discourse despite the initial consideration of the term being an "oxymoron" (Redclift, 2005). The Brundtland report has set the tone for several policy framework and relevant discourses, from the Summit in Rio de Janeiro in 1992 and the Kyoto Protocol in 1997, to the Paris Agreement & 2030 Agenda in 2015. In 2019, the EGD was created through a communication by the European Commission and although in legal terms, it acts as a soft law or benchmark, its content, guidelines and goals or targets support and help the development of various EU and national actions.

EU: 6th and 7th Environmental Action Plans

Starting with the Lisbon Strategy in 2000 and Gothenburg Sustainability Strategy in 2001, the EU marks its long-term sustainability strategy which targets economic growth backed by the key pillar, of environmental protection. The implementation of the above-mentioned strategy relied on Environmental Action Plans (EAPs) which were also seen as the guide for the EU effort in environmental protection, with the 6th and 7th EAPs being relevant in the recent decades. Even though its goals have met limited achievements, it sets the requirements for future development in environmental policies and ways to reduce potentially social impacts of multifaceted problems posed by climate change.

UN: Paris Agreement and 2030 Agenda for Sustainable Development

Strongly backed by the society increased attention regarding the dangers associated to climate change, in 2015 a major change happens once the Paris agreement takes place. This important piece of policy has changed the way people see climate change and environmental protection, by its focus on integration and including the social dimension with planning, policymaking and governance, looking towards collectively achieving

reduced GHG emissions or/and carbon neutrality. In this case, not only a mind shift happens but also the approach towards a sustainable society and smart use of resources, which in fact is quite like the 7th EAP aims.

As compared to EAPs, the Paris Agreement through its 2030 Agenda enables a global process of involvement and recognition in international climate and environmental policies, regardless of its true value as it is difficult to achieve certain goals since it requires a factor of emission reduction that is unattainable with todays' governance and technology. To this matter, in the same timeframe of the Paris Agreement, the UN adopted the 2030 Agenda for Sustainable development with a total of 17 Sustainable Development Goals (SDGs) and 169 targets, placing a strong loop on developing regions. Regardless of the SDGs impact status on modern society, it has produced changes in approaches, policy development and ultimately, recognition of the importance posed by engaging all users in mitigating climate change and living well in a healthy environment in the limits of our planet.

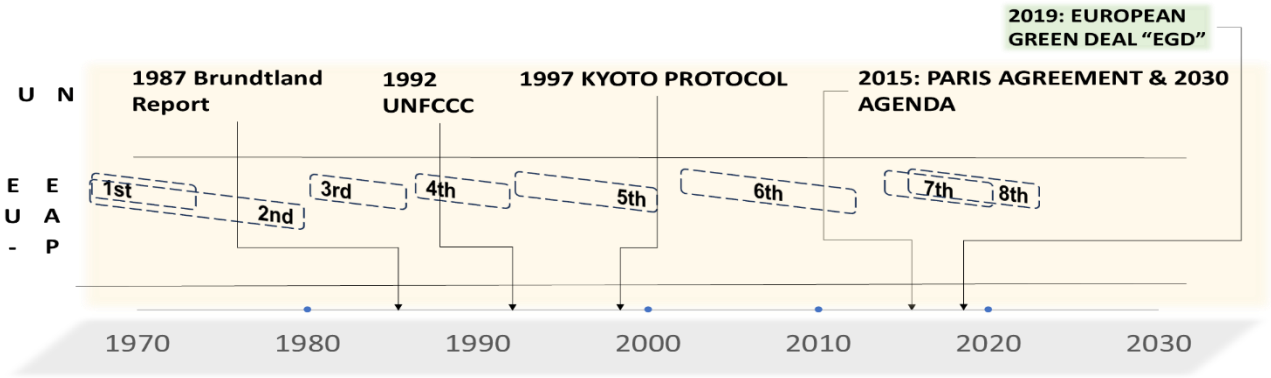

Figure 1 Policy overview from 1970 to 2020 (adapted from Hereu-Morales et al., 2023)

Being based on the Paris Agreement and the SDGs framework, the EGD highlights the sector which contributes to the neutrality goals, being it carbon or climate. Moreover, it provides the prerequisites for necessary actions that should be carry out by national administrations which will promote its implementation by society and the business sector, emphasizing the challenges and targets set by EGD on carbon neutrality and emissions reduction considering the two critical milestones, 2030 and 2050. Conversely, the SDGs cover a set of domains which could be in collision with the EGD targets and goals. The high energy prices have impacted certain goals under the UN framework (welfare, poverty reduction etc.) whereas it gave the EGD the upper hand in reducing emissions and contributing to climate mitigation and neutrality at the expense of other goals.

The influence of states and institutions towards goals implementation goes beyond politics and public policies formulation. Since each SDG corresponds to either one or more of the main pillars of sustainable development, its activities should avoid negative social and economic phenomena as well as environmental degradation. Therefore, individual SDGs are integrated and related to each other, affecting the results of activities

that have an impact on the simultaneous implementation of several goals or objectives. Social goals affect the achievement of environmental and economic goals, and conversely, economic goals affect the achievement of social and environmental goals while the implementation of the objectives within individual SDGs varies in time and space. The role of SDGs in achieving environmental goals and their impact on environmental policy is crucial and matters for strengthening environmental protection. Its impact transcends from mere environmental to creating new opportunities for addressing the relationship between poverty and the environment in a more integrated and holistic way. Regardless of the path taken, compromises should be considered together with the deep changes in the measurement and understanding of development which are required as, environmental development and intervention are designed to positively influence prosperity.

3.Goals of the European Green Deal and New EU Forest Strategy

3.1. European Green Deal

The EGD comes as an instrument of soft law, its content being rather about guidelines and targets and not technically binding even though its initiatives produce legal effects through implementation by each Member State.

To reduce EU net domestic production of greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and attain climate neutrality by 2050, the EGD has facilitated the formulation and development of specific Strategies, Action Plans, and Laws that define objectives and identify various initiatives and means to achieve them. In broad sense, the EGD is focusing on 9 main targets or objectives (Table 1) which should be reached through the help of the bundle of policy instruments and initiatives in place.

The impact of EGD is seen across all key sectors of the economy, especially through its legally binding climate targets such as: emissions reduction targets across a broad range of sectors; boosting natural carbon sinks; updated European Trading System (ETS) to cap emissions while setting a price for pollution which generates financial reserves that facilitate green transition and, last but not least, socially supporting citizens and small-medium enterprises (SME).

Strictly related to nature and planetary health, the EGD looks to enlarge NATURA 2000 protection network and provides the prerequisites for a Nature restoration plan through one of a kind, highly debated, Nature restoration law which comes to complement and introduce measures to tackle the global biodiversity challenge through the effort of member states.

Table 1 European Green Deal Objectives

Objectives (Targets)	Objective details
Climate Neutrality	The primary goal is for the EU to become climate neutral by 2050, meaning the amount of greenhouse gases emitted is equal to the amount removed from the atmosphere.
Reducing Greenhouse Gas Emissions	The EU aims to significantly reduce its greenhouse gas emissions, including carbon dioxide and methane, to limit global warming and mitigate climate change impacts.
Clean Energy Transition	The Green Deal promotes the transition to renewable and low-carbon energy sources, such as wind, solar, and hydropower, to decrease reliance on fossil fuels and decrease emissions.
Circular Economy	It seeks to foster a circular economy where resources are used more efficiently, waste is minimized, and products are reused, repaired, or recycled to reduce environmental impact.

Biodiversity Preservation	The EU aims to protect and restore biodiversity, ecosystems, and natural habitats, recognizing their critical role in sustaining life and providing essential services to society.
Sustainable Agriculture	The Green Deal promotes sustainable agriculture practices that enhance biodiversity, reduce greenhouse gas emissions, and ensure food security while minimizing environmental harm.
Clean Transport	It supports the adoption of clean and sustainable transportation methods, such as electric vehicles and public transportation, to reduce emissions from the transport sector.
Energy Efficiency	The EU aims to improve energy efficiency across various sectors, including buildings, industry, and transportation, to reduce energy consumption and emissions.
Just Transition	The Green Deal emphasizes the importance of a fair and inclusive transition, ensuring that no one is left behind in the shift towards a sustainable economy and that vulnerable communities and workers are supported.

3.2. New EU Forest Strategy for 2030

As demands on forests have evolved over time, the European Commission adopted in July 2021 the New EU Forest Strategy for 2030, which is a flagship initiative of the EGD. The strategy not only sets a vision and concrete actions to improve the quantity and quality of EU forests but also looks toward strengthening their protection, restoration and resilience by overcoming biotic and abiotic challenges which EU forests are facing. It aims to adapt Europe's forests to the new conditions, weather extremes and high uncertainty brought about by climate change. This is a precondition for forests to continue delivering their socio-economic functions, and to ensure vibrant rural areas with thriving populations, sustainable forest management being mentioned throughout the text and seen as the value chain based on the sustainable supply of wood and other goods and services from the forest.

Even though some of the objectives and commitments expressed in Table 2 are interconnected with other EU policy instruments (e.g. EU Biodiversity strategy and the Renewable Energy Directives), most of them are formulated without specifying how progress towards achievement should be monitored. This critical aspect is also mentioned in the strategy itself, urging the need to identify "additional indicators as well as thresholds or ranges for sustainable forest management concerning forest ecosystem conditions, such as health, biodiversity and climate objectives".

Table 2 EU Forest strategy 2030 commitments and objectives

Goals/Targets/Commitment	Specific objectives
Supporting the socio-economic functions of forests for thriving rural areas and boosting forest-based bioeconomy within sustainability boundaries	Promoting the sustainable forest bioeconomy for long-lived wood products Ensuring sustainable use of wood-based resources for bioenergy including new criteria and cascading principle

	Developing skills and empowering people for sustainable forest-based bioeconomy
Protecting, restoring and enlarging EU's forests to combat climate change, reverse biodiversity loss and ensure resilient and multifunctional forest ecosystems	Protecting EU's last remaining primary and old-growth forests Ensuring forest restoration and reinforced sustainable forest management for climate adaptation and forest resilience. Re- and afforestation of biodiverse forests Financial incentives for forest owners and managers for improving the quantity and quality of EU forests
Strategic forest monitoring, reporting and data collection	Proposal on EU Forest Observation, Reporting and Data Collection to ensure a coordinated EU forest monitoring, data collection and reporting system Strategic Plans for forests and the forest-based sector, in Member States Strengthen the existing monitoring of climate effects and other natural or human-induced disturbances on forests Prepare and publish regular reports and lay summaries on the forests in the EU. European forest science partnership, with a view to support the development of new indicators based on remote sensing and the latest research results
A strong research and innovation agenda to improve our knowledge on forests	"Planning our Future Forests" research and innovation agenda to identifying research gaps and future priorities Evidence-based design and implementation of forest restoration strategies Research and Innovation partnership on forestry, including flagships for testing and demonstrating solutions on selected key strategic domains Complementary actions in support of Disaster Risk Reduction policies (including forest fires) Citizens' science Programme for forest biodiversity

4. OptFor-EU Response to EGD and New EUFS

OptFor-EU has a highly significant impact and contribution to achieving the goals of the EGD and, the New EU Forest Strategy, by extending the knowledge, modelling capabilities and carbon sink estimates to end-users outside the traditional forest sector target group. Creating a platform for modelling and analysing synergies and trade-offs between the decarbonisation potential of forest resilience through biodiversity and area management planning, the project addresses gaps between science and practice and informs the adoption of sustainable forest management practices and economic strategies.

4.1. European Green Deal

OptFor-EU contributes to the EGD objective of climate neutrality by providing the prerequisites for maintenance and enhancement of biodiversity, sustainable bioeconomy, and Nature-based solutions (NBS), considering the EU main objectives and strategies and adapting the current FMP on maximising forest GHG mitigation potential, while aligned to the biodiversity and soil conservation-related principles.

Therefore, by developing in WP1 a set of Essential Forest Mitigation Indicators (EFMIs), OptFor-EU help forest managers to understand and quantify the carbon sink capacity of their forests over the recent, past and current period. The inclusion of these indicators in the OptFor-EU DSS, links with the 'Climate Neutrality' objective of the EGD in the sense that it provides the scientific basis and background knowledge of GHGs emitted and absorbed by different types of forests across the eight case study areas (CSA). These indicators help and improve the OptFor-EU DSS in providing evidence of the multiple socio-economic and environmental impacts of NBS on FES and the associated decarbonisation potential e.g.: '*growing stock*', measures changes in the live and growing biomass of the forest. An increase in this index implies a rise in the carbon sequestration of the forest and vice versa). By understanding the current GHG flows of their forests managers can better adopt measures for more efficient carbon sinks. Such scientific estimations at the continental scale can help to develop a better understanding of the potential of EU forests in achieving climate neutrality and their role in achieving climate goals.

Going further, the modelling activities in WP2 contribute towards achieving climate neutrality by giving scientific evidence regarding the role of different physical processes and forest-climate interactions related to the GHGs cycles. The application of forest, land surface and regional climate models are essential to quantify forest-climate interactions. WP2 advances the contribution to climate neutrality by extending the FMP options (e.g.,

changes in tree species composition and extreme events) and by implementing the OptFor-EU DSS. In this situation, forest managers are provided with novel and more effective carbon mitigation measures. However, the OptFor-EU DSS not only provides support to the forest managers and other end-users (e.g., policymakers, business sector, environmental protection and ecological restoration) but it also incorporates scientific results from the other WPs and provide evidence-based solutions, with the aim of capturing the complexity of climate vegetation and socio-ecological interactions in the context of a changing climate. The management options provided will be tailored to the requirements of forest managers. So, by selecting favourable FMP to optimise the sustainable provision of FES, OptFor-EU facilitates knowledge transfer and putting science into practice while maximising the benefits of FES and contributing to climate neutrality.

As by deploying a stakeholder engagement plan in WP3, OptFor-EU raises awareness about the climate neutrality objective of the EGD. Moreover, it enables the identification of relevant stakeholders and groups with similar interests, power, concerns, and capabilities, strengthening cooperation towards achieving climate neutrality. Constant collaboration is achieved by a stakeholders database that will be used for engaging stakeholders over the entire lifetime of the project and facilitate the exchange between the science and local stakeholders. In each CSAs, local data are collected through physical and/or online meetings where relevant forest managers are being interviewed to explore their perception on CC, FES, and most importantly, their intended forest management. These collaborative meetings are also fruitful opportunities for disseminating scientific results and conflict mitigation. The interviews are focused on cognitive, social, dispositional and context factors that influence forest managers' decision-making and their preferences. Ultimately, the results will define the current perspectives at the European level as well as the needs to improve the forest capacity in contributing to climate change mitigation and neutrality which will be integrated in the DSS development.

To complement the data collection process across CSAs, OptFor-EU makes use of expert surveys to enquire institutional gaps, potential policy barriers and possible solutions for climate change mitigation and adaptation at different governance levels (EU, national, regional, local). Mapping of institutional frameworks and governance mechanisms (T5.2) will identify the most important knowledge gaps and factors affecting decision making and co-development for the adoption and long-term use of the DSS. This analysis will assess the integration of mitigation and adaptation measures into the way forests are managed, having the potential to promote SFM while contributing to the climate change adaptation process in a cost-effective way. Highly important, OptFor-EU analysis the forest managers' perception on CC, FES and FMP in WP3 while the activities in WP5 provides policy recommendations towards climate mitigation by analysing the trade-offs between forest managers and EU policy objectives. Finally, the project communicates the need of being more ambitious in its dissemination and communication activities,

ensuring to transfer the knowledge coming from solid data to support its statements and thus raise awareness on the urgency to support and increase EU targets for climate neutrality (WP6).

As OptFor-EU provides appropriate and optimal forest management options aligned with Nature-Based Solutions (NBS) and validated by stakeholders, the EGD objective of reducing greenhouse gas emissions is achieved with high considerations through a diversity of actions. The quantification of key forest-climate interactions and their influences on EFMIs are the base for a range of forest management, socioeconomic and high-resolution climate scenarios.

The model simulations for FMP, socioeconomic and climate scenarios (WP2) specifically capture the differences between carbon sequestration in managed and unmanaged forests. Therefore, the OptFor-EU DSS provides forest managers with optimal solutions for decarbonisation of the European forests under different CC and management scenarios. To this matter, the 'outcome- oriented' approach, including the co-development of the DSS-based solution in a multi-actor approach (MAA) facilitate the trade-offs and optimisation of FES.

Integrating the results from forest, land surface, and climate model simulations into a comprehensive DSS enhances the ability to quantify both present and future forest-climate interactions, enabling informed decision-making through detailed, scenario-based insights on GHG emissions and forest growth. It provides progressive monitoring of how different management strategies will impact forests and the climate regarding GHG variation and forest growth, allowing for timely adjustments and actions as needed.

In this respect, the DSS (WP4) coupled with policy recommendations (WP5) will support the forest managers and policymakers to select favourable FMP and other options to optimise the FES and maximise forests GHG mitigation potential. Hence, the DSS will be able to evaluate future trends in decarbonisation capacity, highlighting the risk of decline in carbon trends and identifying the hotspots. Likewise, OptFor-EU DSS aims to facilitate spatially explicit reporting of the Greenhouse Gas (GHG) Inventory for Forest Land Use since it uses advanced remote sensing for forest area estimation which is harmonized across European Forest Types (EFT) in an easy-to-use tool for end-users.

Reducing emissions is not only a matter of technical advances but also of engagement. Thus, the workshops organised in WP3 aim to informs the stakeholders regarding the contribution of forests and their management towards reducing greenhouse gas emissions and increasing carbon stocks. Also, through questionnaires and bilateral meetings with forest managers and experts, OptFor-EU raises awareness regarding the importance of forests to reduce GHG emissions and the policies that hinders the application of effective measures to increase carbon storage and promote SFM practices that reduce GHG emissions.

As policy frameworks usually drives the management practices, the analysis on institutional factors and governance mechanisms developed in task T5.2, contributes to

monitoring progress towards current climate objectives and actions by observing the end-user uptake of project strategies for climate change mitigation in forest management. Undoubtedly, this analysis informs about the pathway for developing the further actions needed to increase the decarbonisation capacity of forests in line with the objectives of the European Climate Law.

Whether the up-take of project strategies are taken or not, decreasing reliance on fossil fuels and subsequently, decreasing emissions, can only be achieved through scientific-based knowledge on the benefits of SFM in the case of forestry and smart resource use. To this extent, OptFor-EU exploits data and knowledge from eight case study areas in Europe, covering all EFT and bioclimatic regions, as well as the plurality of FMP to provide the prerequisites of achieving and contributing to the EGD objective of sustained clean energy transition. Different management approaches and their impact on achieving climate neutrality are analysed. Not only it covers the clean energy transition, but it also aims at informing stakeholders about the forest growth scenarios and how the increase in woody biomass could generate energy as a substitute for fossil fuels.

Whereas the modelling work in WP1 and WP2 provides biomass estimates and data regarding the associated risks of climate change, natural disturbances and hazards, the DSS enables projections and trends of forests characteristics. Such data contributes to the scientific-based knowledge of decarbonisation capacity of forests and its products, allowing for re-distributive future policies that promote the transition to renewable, low-carbon energy sources.

By creating the scene for dialogue among stakeholders, including the private sector, OptFor-EU supports and facilitates the development of future, if possible, collaboration networks that will enable access to wood-based and other renewable sources markets. To add on, engaging with stakeholders has also increased the awareness of current energy spread and energy transition measures around forests, providing solutions for low-productive forested area or lands (e.g.: CSA in UK has developed wind power production inside forest).

Being one of the key pillars of the EGD and closely related to the clean energy transition, the circular economy is addressed in various ways by the OptFor-EU project. OptFor-EU provides projections and analysis of current and future FES under various climate conditions and at different geographical scale which could facilitate the establishment of multi-functional forestry or any other SFM. The co- developed DSS in each CSA quantifies forest and climate processes, their interaction and influences on FES, and their dynamics for a range of FMPs. This approach generates the framework for managers to find the optimal solutions to boost the circular economy having forests at its core.

For instance, the optimization of modelling tools in WP2 integrates climate and forest models for improved accuracy in accounting the dynamics of circular economy processes in forests. By doing so, we can better capture the impacts of forest growth on the circular

economy and clean energy transition, mainly through the substitution characteristics of woody biomass and its contribution to climate neutrality and GHG emission reduction.

Furthermore, the stakeholder engagement activities carried out by WP3 and WP5 raises awareness and provides knowledge on the circularity of forests, notably, in all the main forest types in EU. Hence, integrating the modelling results with the multi-actor approach, WP5 formulates future policy recommendations for SFM solutions that looks to satisfy all user needs.

Strongly related to the circular economy and its related action plan, biodiversity preservation and sustainable use foresees reducing pressure on natural resources and providing sustainable growth, all for achieving the EU's 2050 climate neutrality target while halting biodiversity loss. To this extent, OptFor-EU bridges the gap between different EU strategic priorities, robust science, forest and biodiversity, considering also the pillars and objectives of the EU Biodiversity Strategy for 2030. In this case, a European-level map of all forest types has been established within WP1, highlighting the complexity and diversity of the forest landscape. The forest types analysed were according to the spatial distribution of different European forest types and thus, based on many variables reflecting different ecological features and tree species compositions, 14 forest types were defined as such: (1) boreal forest, (2) hemi boreal and nemoral coniferous and mixed broadleaved – coniferous forest, (3) alpine forest, (4) acidophilous oak and oak-birch forest, (5) mesophytic deciduous forest, (6) beech forest, (7) mountainous beech forest, (8) thermophilus deciduous forest, (9) broadleaved evergreen forest, (10) coniferous forests of the Mediterranean, Anatolian and Macaronesian regions, (11) mire and swamp forest, (12) floodplain forest, (13) non-riverine alder, birch or aspen forest, and last but not least,(14) introduced tree species forest. Such an approach provides an overview of the vegetation diversity at European level and through the modelling and analysis activities, OptFor-EU leverages existing data and extends the understanding of the regional impacts of climate change and developing policies on various services, including biodiversity.

By and large, OptFor-EU DSS supports effective, science-based climate adaptation and mitigation measures to preserve and enhance local and regional biodiversity. Its supportive activities come because of stakeholder engagement in WP3 and WP5 and high-resolution model simulations which, based on optimal management solutions and policy recommendations, act towards preserving and improving biodiversity across all CSAs. Moreover, through the scientifically based data and stakeholders' perception on climate change and its associated risks, OptFor-EU facilitates informed decisions under different management scenarios for different decision-making situations that recognizes the critical role of biodiversity in sustaining life and providing essential services to society, identifying at the same time the socio-economic conditions for the extension of protected areas.

As Clean energy transition focuses on mainly socio-economic aspects such as affordability, integration and efficiency, the just transition pillar of the EGD reflects the same principles, highlighting that the transition towards a climate-neutral economy

should happen in a fair way while leaving nobody behind, ultimately alleviating the socio-economic impact of the transition itself. To this end, OptFor-EU not only facilitates the just transition objective through the MAA across the entire lifetime of the project but also seeks to include all users, granting access to any actor interested, ensuring that no one is left behind. Moreover, WP3 activities foresees the actual training of forest managers in using and understanding the necessity of a decision-support system which could provide them a sense of security and preservation that their forest is kept for the next generations. Since the OptFor-EU DSS offers multiple perspectives and applied scientifically based forest management options that satisfies both recreational and commercial forests, it can only be considered that the just transition objective of the EGD is integral part of the overall project, supporting businesses and forest owners on the one hand and vulnerable communities on the other hand, all under a circular economy.

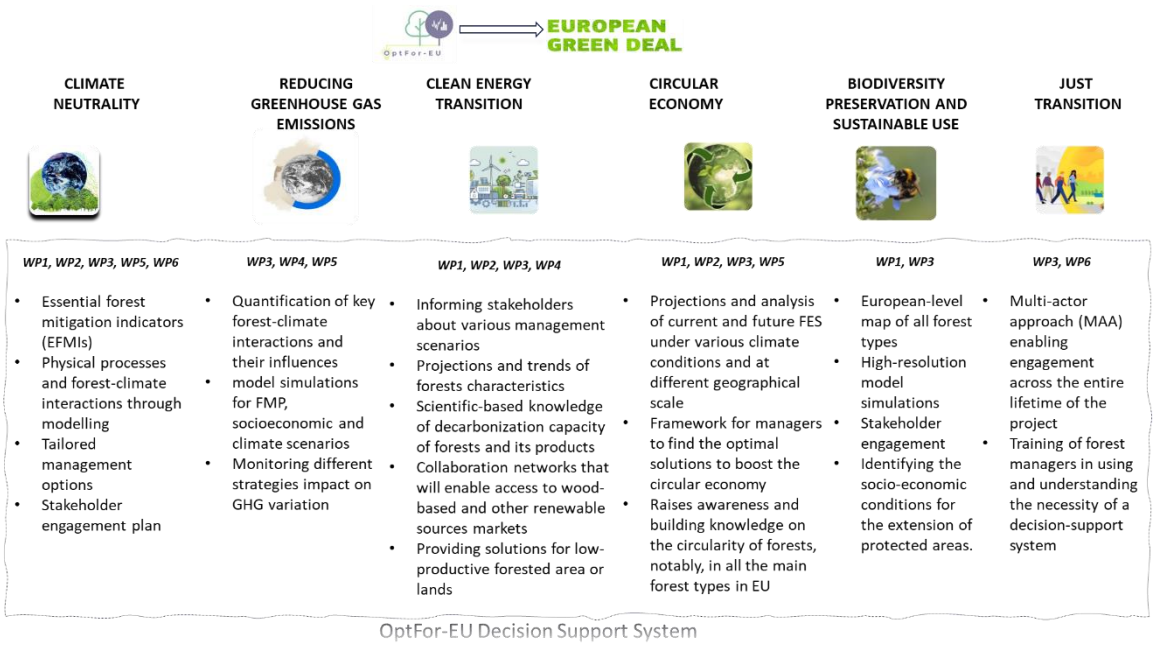

Figure 2 OptFor-EU contributions to European Green Deal

4.2. New EU Forest Strategy 2030

OptFor-EU contribution to the overall goal and related objectives on supporting the socio-economic functions of forests for thriving rural areas and boosting forest-based bioeconomy within sustainability boundaries goes beyond the project through especially WP3 and its specific MAA, breaking the gaps between cultural and language barriers and build trustful relationships between science and practitioners through dialogue and participation. Moreover, through the evaluation of the stakeholder engagement across the CSAs, the MAA provides validated ways of engagement with stakeholders, highly necessary for a thriving rural area and awareness raising on sustainability across the forest-based value chain.

Moreover, by modelling the F-C Nexus in WP2 short-, medium- and long-term carbon stock dynamic of different forest types under a changing climate, including the carbon release through in-situ decomposition, damages, disturbances and wood product disposal contributes to the research gaps in modelling the environment and natural capital, aiming to facilitate the transition to sustainable FMP and the use of long-lived wood products.

Since forests comprise of complex ecosystems and diverse functions, WP5 uses a Lean Startup approach accompanied by a set of appropriate templates. These templates address the requirements from a variety of forests, including managed and unmanaged, and variables such as forest types, climate, production, biodiversity and their associated trade-offs and benefits. In cooperation with WP4, WP5 actively involves forest managers and provide the prerequisites for developing new knowledge. The co-design approach of OptFor-EU DSS in WP4 is highly valuable for supporting the socio-economic functions of forests due to providing a system that gives knowledge-based optimal solutions for forest growth while at the same time, helping businesses in the first stage of sourcing sustainably grown wood. Hence the participatory approach develops skills in people which will ultimately empower them to recognize and move forward with sustainable forest-based bioeconomy while promoting long-lived wood products coming from climate-resilient adaptation and mitigation options.

Since forestry is a social-bargaining in essence with diverse actors with various needs, WP5 provides a policy analysis regarding institutional frameworks and their approach, coupled at the same time with a factual-based judgement on governance and external factors which will facilitate the acknowledgement of drivers that either hinder or support the up-take of strategies for climate change mitigation in forestry and its related activities.

Protecting, restoring and enlarging EU's forests to combat climate change, reverse biodiversity loss and ensure resilient and multifunctional forest ecosystems is at the core of OptFor-EU through monitoring of current resources in WP2. Monitoring and reporting routines established can be robust and repeatable for the foreseeable future by using satellite products (e.g., ESA CCI - ESA Biomass, ESA Fire; MODIS - Global Forest Cover Change, Leaf Area Index, Evapotranspiration (8-day synthesis; Sentinel-1 SAR for Forest Monitoring, Sentinel-2 for Tree Logging). This combined with common ground data input format and integration workflow, provides a both flexible and rigorous approach. These two aspects together results in a harmonisation and monitoring workflow capable of solving issues of different ground data standards, whilst providing a top-down, landscape-scale analysis for large-scale assessment, facilitating smart use of resources.

OptFor-EU not only provides sound, scientifically based data but also makes use of citizen science through WP3, engaging stakeholders in building new knowledge regarding the role of forests to halt biodiversity loss and fight climate change. It also integrates and facilitates socially acceptance of primary and old-growth forests to mitigate global challenges. Promoting and raising awareness on EUs forests going beyond the ecological

aspects and tackles financial issues by informing all users across the forest-based value chain about certification schemes and close-to-nature forest system, stressing the benefits of payments for ecosystem services. The relation between WP3 and WP5 is highly given by the user-specific optimization of the DSS developed in WP4, which facilitates informing forest managers about the trade-offs and benefits in various management scenarios that implies either re- and afforestation as well as the financial incentives due to adhering to a sustainable forest management for climate adaptation and forest resilience.

Besides the management scenarios provided through modelling, WP1 establish EFMIs, a set of novel indicators that assess and characterize FES and contributes to end-user requirements with its overall goal to protect, restore and enlarge EU's forests by making them resilient, carbon- and biodiversity-rich as well as providing various functions.

Through the co-development of the DSS in WP4 and the EFMIs, OptFor-EU contributes to the Strategic Forest monitoring, reporting and data collection, especially by building a database in WP1 of harmonised forest-climate and EFMI data which will also include a gridded map of EFT. Also, the combination of remote sensing and latest research results has facilitated the EFMI developed in WP1 which supports the development of useful and proper indicators that could assist the evaluation of various EU forest strategy objectives (e.g. forest carbon; forest damage; forest degradation) but it also brings together a European forest science partnership for excellence.

To ensure a coordinated EU forest monitoring, data collection and possibly a reporting system, WP2 provides an up-to-date European integrated harmonised land cover datasets and user-derived forest management planning through an improved applicability of the global and regional models on European forests, namely 3D-CMCC-FEM and PICUS.

One of the main rationales of OptFor-EU has always been to contribute to building a strong research and innovation agenda and to improve our knowledge on forests providing a just and fair transition for all in the face of a changing climate. OptFor-EU identifies the gaps in research and knowledge while prioritising future needs and requirements of users across the entire forest-based value chain through WP3 and WP5, focusing not only on user-based knowledge but also on the relationship between institutions and governance and its subsequently impact on forest management. The applied modelling of the F-C Nexus in WP2 and stakeholders' engagement from WP3, provides evidence-based solutions for the up-take of forest restoration measures contributing to the recently adopted Nature Restoration Law ecosystem-specific measures, especially enhancing stock of organic carbon in cropland mineral soils with high diversity landscape features while making sure there is no net loss on tree canopy cover until end of 2030. OptFor-EU contributes to and promotes at the same time other EGD flagships initiatives such as ETS and the importance of certification schemes as it looks toward a sustainable, resilient and more productive future. The use of citizen science methods such as MAA in WP3 provides future incentives for the Citizens science

Programme for forest biodiversity, as it not only gives a voice to various stakeholders but also brings a useful database on stakeholder mapping across countries in Europe, documenting their needs and requirements associated with the F-C Nexus. Finally, it gives incentives for future improvements of the project approach by assessing the level and impact of collaboration between the parties involved in the project but also, important for project success, the degree of response of the project outcomes to the stakeholders need. Thus, improving knowledge on forests through WP6 has its basis on the levels of engagement and representation, the up-take and use of project outputs and ultimately, collaboration, which will be assured through workshops, bilateral meetings and surveys.

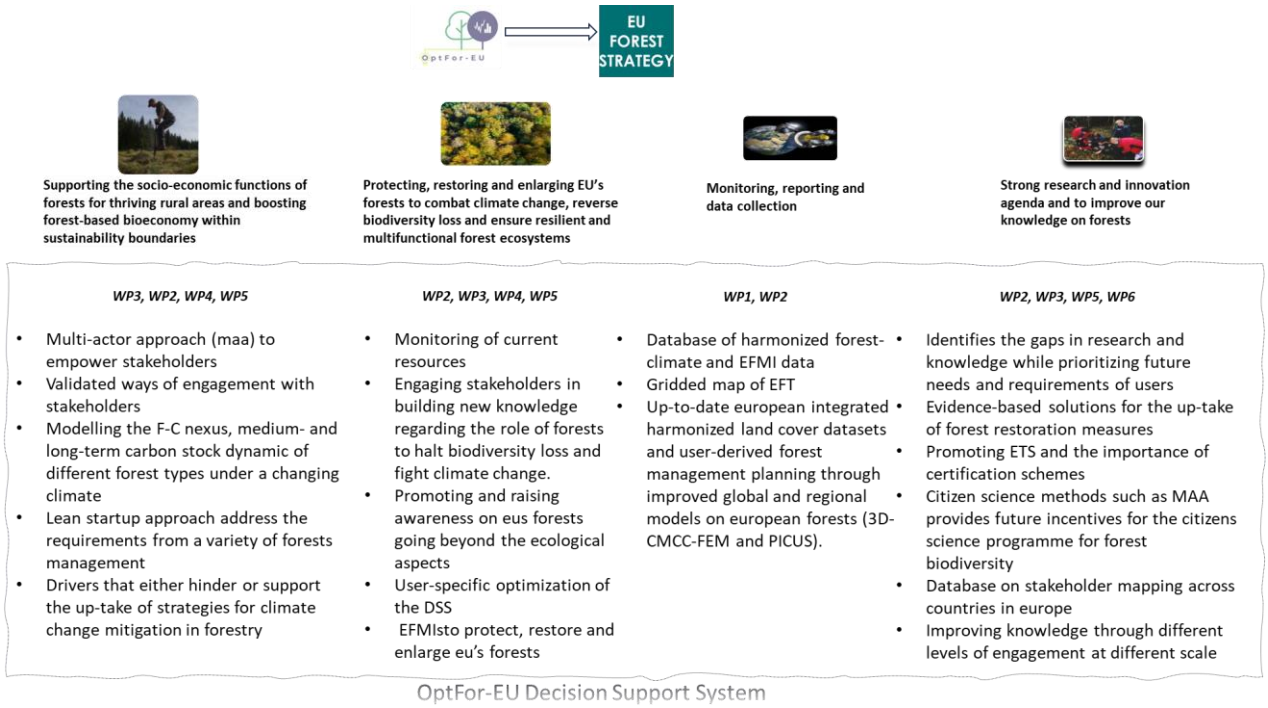

Figure 3 OptFor-EU contribution to EU Forest strategy

5. Networking activities – FORWARDS project and other topic-related Horizon Europe projects

This section syntheses the most relevant networking activities conducted by the OptFor-EU project team with other Horizon Europe projects between M1 (January 2023) and M18 (June 2024) of the project implementation period.

5.1. Networking with FORWARDS project

In the context of the call text, a collaboration between the OptFor-EU project with the projects financed in the call HORIZON-CL6-2022-CLIMATE-01-05: Forestry - European observatory of climate change impacts and demonstration network of climate smart restoration pilots, is required. This is the case of the project FORWARDS (*ForestWard Observatory to Secure Resilience of European Forests* - https://forwards-project.eu/). The general information about the FORWARDS project is provided below:

- Project start date: November 1, 2022; Project end date: October 31, 2027
- Funding programme: HORIZON 2.6 - Food, Bioeconomy Natural Resources, Agriculture and Environment (HORIZON-RIA - HORIZON Research and Innovation Actions)
- Topic: HORIZON-CL6-2022-CLIMATE-01-05 - Forestry - European observatory of climate change impacts and demonstration network of climate smart restoration pilots
- Coordinator: SVERIGES LANTBRUKSUNIVERSITET (Sweden)
- Project objectives: FORWARDS aims to develop a prototype of the ForestWard Observatory which will provide: (a) timely and detailed information on European forests' vulnerability to climate change impacts, (b) science-based knowledge to guide management using the principles of climate-smart forestry, ecosystem restoration, and biodiversity preservation (CSF & Restoration), and (c) stakeholder engagement and public participation in decision-making processes. FORWARDS aims to capitalize on data from existing networks (e.g. ICP Forests) and expand this with a Network of Pilot sites through 5 FORWARDS Demo cases plus ~50 trials established via grants to third parties.

As both projects are oriented towards optimising climate-oriented forest management, but focus on different levels, they can complement each other in questions of forest management, modelling and planning. It will be useful to exchange on the used indicators for measuring climate-oriented forest management as well as on the political-institutional frameworks and stakeholder views. The exchanged information, e.g. on research results, - which will mostly be on larger scale in FORWARDS and on local scale in OptFor-EU - can re-enforce each other.

To connect the results, generate synergies and seek for ways of future collaboration with the FORWARDS project, a future OptFor-EU_FORWARDS bilateral meeting (online) was scheduled on July 11, 2024 (12-13 CEST). The foreseen discussions will address topics related to the networks of climate-smart forestry and biodiversity restoration pilot sites (tackled by FORWARDS in WP3), the collaboration on forest management and monitoring, ways of effective stakeholder engagement (aspects tackled by both projects) and potential collaborations on future events and other communication and dissemination activities. The tentative agenda of the bilateral OptFor-EU_FORWARDS project is presented below:

1. Short intro to FORWARDS (Rubén Valbuena, Swedish University of Agricultural Sciences, coordinator of the FORWARDS project)
2. Intro to CSF networks from FORWARDS WP3 (Pieter Johannes Verkerk, Forest Institute, Finland)
3. Intro about OptFor-EU (Sorin Cheval, National Meteorological Administration of Romania, coordinator of the OptFor-EU project)
4. Collaboration opportunities – open discussions (all participants).

Before this call, already some collaboration activities were established with the FORWARDS project: in addition to mutual support on social media, the project contributed with its news in the first edition of the OptFor-EU newsletter.

5.2. Networking with other projects

The networking activities of the OptFor-EU project considered other topic-related research projects, funded within HORIZON EUROPE programme in the same call as the OptFor-EU project (HORIZON-CL6-2021-CLIMATE-01-09 - Enhancing science-based knowledge on EU forests', including old-growth forests, capacities to mitigate climate change) and in other forest-related calls.

A full list of identified projects was compiled by IEECP and is now available under the Dissemination and communication monitoring file. Between these projects with similar topics, everal ongoing projects are the following: CLIMB-FOREST (*Climate Mitigation and Bioeconomy pathways for sustainable Forestry* - https://www.climbforest.eu/), INFORMA (*Science-based Integrated Forest Mitigation Management made operational for Europe* - https://informa-forests.eu/), ForestNavigator (N*avigating European forests and forest bioeconomy sustainably to EU climate neutrality* -

https://www.forestnavigator.eu/), ForestPaths (*Co-designing holistic forest-based policy pathways for climate change mitigation* - https://forestpaths.eu/), FOREST4EU (*European innovation partnership network promoting operational groups dedicated to forestry and agroforestry*) (www.forest4eu.eu).

In addition to establish a regular communication with these projects to update them on the relevant project outputs, IEECP invited all projects to contribute to the OptFor-EU newsletter, featuring a section fully dedicated to the news from sister projects. Also, OptFor-EU partners organised a session during EGU 2024, where many of the sister projects contributed with their research outputs.

A full list of sister projects with whom we established a contact is available in a dedicated page under the OptFor-EU website at this link: https://optforeu.eu/sister-projects/

The list features now 26 projects, of which 21 are currently ongoing.

5.2.1. CLIMB-FOREST

Joint OptFor-EU_CLIMB-FOREST meeting

About the event

On May 20, 2024, Adam Knistensson (coordinator of the CLIMB-FOREST project) organized a joint meeting to have a preliminary networking discussion between CLIMB-FOREST, FORWARDS, OptFor-EU and ForestPaths Horizon Europe projects. The meeting took place between 14:00 to 15:00 (CEST), online. The participants to this meeting were Adam Knistensson (Lund University, Sweden, coordinator of the HE CLIMB-FOREST project), Paul Miller (Lund University, Sweden, member in the HE CLIMB-FOREST project), Sorin Cheval (National Meteorological Administration, Romania, coordinator of the OptFor-EU project), Monica Paraschiv (National Meteorological Administration, Romania, member in the research team of the OptFor-EU project) and Dana Micu (National Meteorological Administration, member in the research team of the OptFor-EU project).

Objectives

The discussions within this meeting have been focused on the need of (i) initiating a new shared portal for communicating project outcomes and policy messages in large EU projects within forestry, and (ii) facilitating shared and synthesized outcomes between projects towards stakeholders, policy makers and other researchers. The discussions also referred to some initial ideas developed in other projects or initiatives. The idea of the new forest knowledge sharing portal will be built on previous initiatives such as CANOPY portal developed in the framework of the ForestPaths project (https://forestpaths.eu/canopy-platform). An Application Programming Interface was proposed to be further developed in this purpose, using the CANOPY platform as a catalyst for maximizing the spread of relevant knowledge in the science and forest communities. Other ideas were related to the use of the Forest Information System for

Europe (FISE) (https://forest.eea.europa.eu/), which is a reference tool for forest knowledge base in support of the EU Forest Strategy.

Main outcomes

The meeting facilitated the presentation of the CLIMB-FOREST and OptFor-EU projects' key outcomes that would become available through the new forest knowledge platform. The discussions foreseen other categories of information that could be shared through the new portal such as: (i) common forest terminology, (ii) showcase of the case studies, (iii) a concept paper for developing the new portal in support of sharing forest knowledge resulting from the ongoing CLIMB-FOREST, FORWARDS, OptFor-EU and ForestPaths Horizon Europe projects.

5.2.2. ForestNavigator

The Forest Navigator project assesses the climate mitigation potential of forests and forest-based sectors by modelling robust policy pathways aligned with medium (2030) and long-term (2050) climate goals. It supports EU and national decision-makers by applying integrated approaches that combine observational data, policy expertise, and advanced modelling tools to develop a Policy Modelling Toolbox. This toolbox provides efficient decision-making tools for climate action, like the proposed OptForEU outcome of developing the Decision Support System. The project is coordinated by Fulvio Di Fulvio, PhD, from IIASA.

Joint OptForEU-ForestNavigator Knowledge on Forest Modeling

About the Event

On June 19-20, 2034, Raul Radu, a partner of the OptForEU project, actively participated in the Forest Navigator stakeholder meeting held at Schlosspark Laxenburg, Austria. His involvement extended to the first policy modelling forum, where he contributed to describing forest management practices. As an expert, he contributed to harmonizing management practices for modelling purposes across both projects. The collaboration with Forest Navigator was instrumental in facilitating the exchange of knowledge on initializing forest stand parameters for modelling activities.

Objectives

The shared objective of the Forest Navigator and OptForEU projects is to establish a key discussion platform. This platform will serve as a space for iterative and continuous exchange of ideas between the two projects. It will also be a forum to share expected outputs and their relevance for different stakeholder categories. The aim is to foster further collaboration, particularly in understanding stakeholders' views and perceptions regarding forest management options and implications for decarbonization.

Main outcomes

Improved understanding of the forest modelling potential under different forest management options and climate scenarios and the consideration of challenges in the modelling of forest stand data.

5.2.3. FOREST4EU

The OptFor-EU project has established a collaborative partnership with the FOREST4EU project, highlighting their shared objectives and complementary strengths. Both initiatives address critical issues such as climate change adaptation and decarbonization, which are essential for sustainable forestry and environmental conservation.

OptFor-EU is dedicated to developing strategies for climate change adaptation and advancing decarbonization efforts. These objectives align closely with those of the FOREST4EU project, particularly within the Innovation Hubs (ITHUBs) focused on Climate Change Mitigation and Forest Ecosystem Services. Recognizing these common goals, OptFor-EU and FOREST4EU have decided to collaborate in the next years to enhance the impact and outreach of their initiatives through a series of joint activities. The collaboration was possible trough interaction between Sorin Cheval Project coordinator of OptFor-EU and Davide Travaglini and Francesca Giannetti (University of Florence) coordinator and project managers of FOREST4EU. The cooperation between OptFor-EU and FOREST4EU was initiated by presenting both projects at each other's kick-off meetings. This mutual engagement has established a strong foundation for ongoing collaboration, ensuring that both teams stay informed about each other's progress and can leverage their combined strengths for greater impact.

In the next years the two projects will collaborate for Joint Stakeholder Events. A central aspect of this collaboration is the organization of joint events for stakeholders. These events aim to provide an overview of the results and achievements of both projects, fostering a deeper understanding and support for climate change adaptation and decarbonization within the forestry sector.

Objectives of the collaboration

Enhanced Knowledge Sharing: Through this partnership, OptFor-EU and FOREST4EU can exchange best practices, research findings, and innovative approaches to climate change mitigation and ecosystem service enhancement.

Stakeholder Engagement: The joint events serve as a platform to engage a diverse range of stakeholders, including policymakers, researchers, and industry professionals, promoting a collaborative approach to addressing climate challenges.

Integrated Approaches: The collaboration facilitates the integration of various strategies and solutions, increasing the effectiveness of both projects in achieving their climate adaptation and decarbonization goals.

Main outcomes

This partnership is expected to significantly contribute to advancing sustainable forestry practices and achieving broader objectives related to climate change mitigation and ecosystem service improvement. Both projects are committed to continuing their collaboration and sharing their results with stakeholders and the wider community.

5.3. Other networking activities

5.3.1. Policy Session - Forest resilience, Genetic resources and Climate Change mitigation

About the event

The European Research Executive Agency (REA) organized on March 30th, 2024, an online event dedicated to HORIZON EUROPE projects contributing to enhanced knowledge in support of forest policy, climate change mitigation and forest resilience. The event took place from 09:00 to 11:00 (CET). Participants to the event included George Predoiu (REA), the organizer of the event and the Project Officer of the OptFor-EU project, Nicolas Faivre (REA), Michael Wolf (AGRI) and project coordinators and members in the research teams of FORWARDS and other forest topic-related projects such as CLIMB-FOREST, Eco2Adapt, INFORMA, OPTFOR-EU, ForestPaths and OptFORESTS.

Objectives

The specific objectives of the meeting were to discuss and exchange information on forestry policy developments and needs (e.g. info & message from DG AGRI and discussion on possible cooperation aspects). The meeting included short presentations of the invited projects (FORWARDS, CLIMB-FOREST, Eco2Adapt, INFORMA, OptFor-EU, ForestPaths and OptFORESTS) and discussions on their contributions to forest policy aspects and foreseen results relevant for policy.

Main outcomes

The proposed focuses of the discussions were climate change mitigation (in relation to HE call topic - HORIZON-CL6-2021-CLIMATE-01-09: Enhancing science-based knowledge on EU forests', including old-growth forests, capacities to mitigate climate change – i.e., CLIMB-FOREST, OPTFOR-EU and INFORMA projects), forest resilience (HORIZON-CL6-2021-CLIMATE-01-10: EU-China international cooperation on increasing the resilience of forests – i.e., Eco2Adapt project) and genetic resources (HORIZON-CL6-2022-BIODIV-01-07: Protection and sustainable management of forest genetic resources of high interest for biodiversity, climate change adaptation, and forest reproductive materials – i.e., OptFORESTS). Discussing the role of the Joint Research Centre and modalities of collaboration between projects was also an outcome of the meeting.

5.3.2. The 2024 European Geosciences Union General Assembly

About the event

The European Geosciences Union (EGU) General Assembly is one of the biggest scientific event events dedicated to connecting the representatives of the geoscience community at the European level. The 2024 edition of EGU took place between April 14-19, in Vienna (Austria). This event gathered over 20,000 on-site participants from 116 countries and over 2,500 online attendees from 109 countries. Within EGU2024, on April 15th, the Biogeosciences (BG) division hosted the session titled "Enhancing science-based knowledge on forests' capacities to mitigate climate change". This session welcomed forest scientists and experts working in other related disciplines, such as climatology, biophysical, and socio-economic modelling, who shared their findings for improving the science-based knowledge on the environmental benefits, the social acceptability and the economic value of forest-based mitigation actions.

The session took place on April 15th, between 16:15 to 18:00 (CEST) at PICO Spot 3 and had a hybrid format (both on site participation and online participation). This session was organised by Sorin Cheval (National Meteorological Administration, Romania), coordinator of the OptFor-EU project and was co-convened together with other OptFor-EU partners, including Francesca Giannetti (Bluebiloba, Italy), José-Vicente Oliver-Villanueva (Universitat Politècnica de València, Spain), Alessio Collalti (National Research Council, Italy) and Mathias Neumann (University of Natural Resources and Life Sciences, Austria), Alice Ludvig (University of Natural Resources and Life Sciences, Austria). The networking between OptFor-EU and other forest-related topic Horizon Europe projects was ensured through the attendance of José-Vicente Oliver-Villanueva (the coordinator of the INFORMA project) and Mathias Neumann (member of both OptFor-EU and FORWARDS project teams) in this session, in quality of co-conveners.

Objectives

The presentations within this session highlighted the forests' capacities to mitigate climate change while considering the broad range of other forest values and ecosystem services in the context of bioeconomy and rural development. The contributions presented in the session revealed the latest advances from multi- and interdisciplinary studies (e.g. advanced ICTs, modelling, climatology, hydrology, soil science, or ecology). The session included 16 presentations, out of which seven disseminated scientific results from the OPTFOR-EU project:

Giannetti, F., Zorzi, I., Linser, S., Neumann, M., Cheval, S., Collalti, A., Vangi, E., Grieco, E., Travaglini, D., Chirici, G., and Barbati, A.: European Forest Type Map, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-3418, https://doi.org/10.5194/egusphere-egu24-3418, 2024.

Neumann, M., Pichler, J., and Lexer, M. J.: Contrasting carbon storage with timber production in managed and unmanaged Oak forests in Austria based on simulations and observations, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-1560, https://doi.org/10.5194/egusphere-egu24-1560, 2024.

Georgiadis, T., Cremonini, L., Matteucci, G., Rossi, F., Giannetti, F., Zorzi, I., Collalti, A., D'andrea, E., and Cardoni, S.: Enhanced precipitation events and forests stability: a case study in Emilia-Romagna and Tuscany (Italy)., EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-3090, https://doi.org/10.5194/egusphere-egu24-3090, 2024.

Asmus, C., Buntemeyer, L., Knutzen, F., Pietikäinen, J.-P., and Rechid, D.: Assessing the effects of heat and droughts on forest-climate interactions in Europe using a regional climate model with an interactively coupled vegetation module , EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-10675, https://doi.org/10.5194/egusphere-egu24-10675, 2024.

Cheval, S., Gianetti, F., Collalti, A., Dumitrescu, A., Neumann, M., and Tudose, N. C.: Changes in climate extremes over the European Forest Types (1991-2050), EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-14753, https://doi.org/10.5194/egusphere-egu24-14753, 2024.

Radu, R. G., Neumann, M., Tudose, N. C., Marin, M., Ungurean, C., and Cheval, S.: Assessing the Forest Management Impact on Forest Carbon Dynamics in Romanian Forests, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-16649, https://doi.org/10.5194/egusphere-egu24-16649, 2024.

Tudose, N. C., Asmus, C., Cheval, S., Georgiadis, T., Mitter, H., Inácio, M., Johannessen, M. R., Anand, J., Knutzen, F., Linser, S., Marin, M., Matteucci, G., Neumann, M., Pereira, P., Radu, R. G., Spiegelhalder, M. R., and Ungurean, C.: Co-developing a Decision Support System for climate adaptation and mitigation of European forests: lessons learnt from the stakeholder engagement, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-16389, https://doi.org/10.5194/egusphere-egu24-16389, 2024.

Ludvig, A.: How to tackle climate-related restoration in the forest-based sector? A focus on policy trade-offs, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-16649, https://doi.org/10.5194/egusphere-egu24-1568

Main outcomes

The session supported the networking activities of the OptFor-EU through showcasing findings from different projects and initiatives, modelling studies and practice at various spatial scales. The session promoted exchange of knowledge and best practices between specialists and researchers involved in the research and management of forest ecosystems' and with interests in the forest responses to future climatic conditions and evolving management techniques.

6. Conclusions

The road towards 2030 and 2050 environmental objectives and targets indirectly started around 1970 with the Brundtland report and has faced several changes and foregone complex negotiations to get to UN SDGs and ultimately EU Green deal soft law and sets of actions and initiatives. As complex as it seems, OptFor-EU comes with a strategic integrated framework that goes on contributing and support not only to the EU Green Deal objectives but to the New EU Forest strategy 2030 commitments and objectives.

Fundamentally, OptFor-EU's aim is to develop and introduce a forest DSS that is based on collated knowledge up-take at user-scale which ensures that forest managers and other stakeholders are empowered, and their voices are heard, and opinions taken into consideration by decision-makers when they formulate certain policy documents.

As such, various elements of OptFor-EU contribution points to the success of EU Green Deal implementation and the New EU Forest strategy 2030, advancing the green transition in response to the polycrisis posed by climate change. It not only contributes to climate neutrality through the scientifically improvement of the science-based characterisation of FES but also to reducing greenhouse gas emissions by developing a scalable modelling framework that assess e.g. carbon stocks and sinks among other variables.

While the EU makes progress in its move to clean energy, OptFor-EU provides the opportunity for transition to clean energy and circular economy, contributing to the EGD and EUFS by enabling forest managers and practitioners to identify optimal FMP and provisioning of sustainable FES through the co-developed DSS and with the help of the multi-actor approach (MAA), facilitating energy savings, energy efficiency measures and new renewable capacity as not only the sole guarantee for a clean energy future, but equally as a geopolitical tool to minimise the opportunity cost for EU climate goals when facing trade-offs with other objectives.

Since the Commission constantly looks to find a way to keep the Green Deal alive and tackle fundamental challenges, OptFor-EU contributes to such effort and mainly to the triple planetary crisis at the same time (environmental pollution, climate change and biodiversity loss). In this regard, the project looks towards halting biodiversity loss, but also preserving it and using it in a sustainable manner through a European-level map of all forest types that provides an overview of the vegetation diversity at European level considering the different ecological features and tree species compositions using a scalable modelling framework.

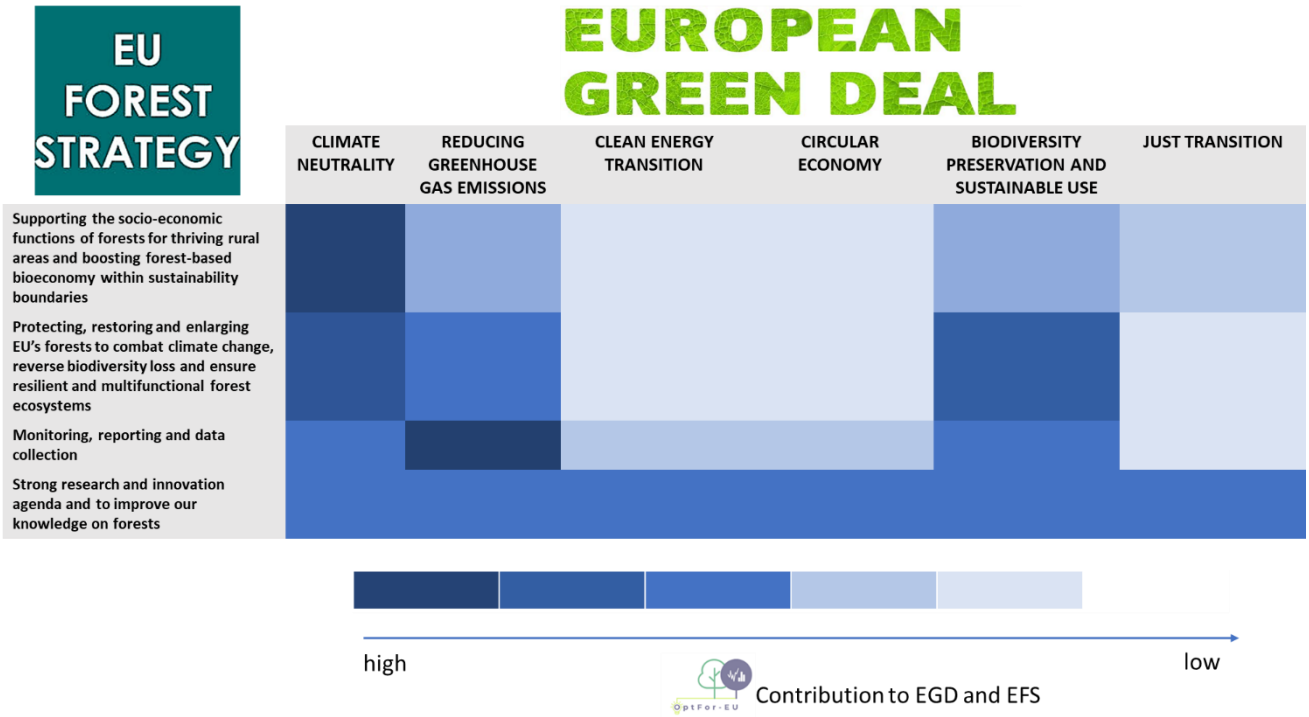

Figure 4 OptFor-EU contributions to EGD and EU FOREST STRATEGY 2030.

Thus, OptFor-EU demonstrates the practical benefits derived from the complex approach proposed by the project, namely a co-developed solution (i.e. OptFor-EU DSS) leading to a significant reduction in net emissions of greenhouse gases related to FES, support the biodiversity conservation efforts ,boost sustainable use of forest resources (including the long-lived wood products), and smooth integration of different economies and societal values at European scale, facilitating the just transition principle of the EGD and its constituencies under the New EU Forest strategy 2030. The interconnectivity of the DSS with all other work packages makes it a comprehensive science-based tool contributing to the adoption of sustainable management practices in European forests in line with the objectives of the European strategies. The DSS is currently being operationalised and it will initially provide the first results of the analyses carried out within the project. Stakeholder and user interaction with it will provide the necessary feedback and will more clearly define its impact in achieving the EGD and EUFS targets.

During the next project implementation period, the networking activities will continue and be intensified, giving priority to the engagement with the FORWARDS project, and secondary with other forest-related projects, funded under the Horizon Europe programme such as CLIMB-FOREST, INFORMA, ForestNavigator, ForestPaths, FOREST4EU.

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ANNEXES

Table 1 OptFor-EU response and contribution to European Green Deal goals

EGD GOALS	WP 1 RESPONSE	WP2 RESPONSE	WP3 RESPONSE	WP4 RESPONSE	WP5 RESPONSE	WP6 RESPONSE	MULTI-WPs RESPONSE
Climate Neutrality	A set of Essential Forest Mitigation Indicators including Essential Climate Variables to assess the mitigation potential is being developed (T1.2), to be fed in a DSS. A database is set up containing harmonised forest-climate data at various levels from Essential Climate Variables (T1.3).	The application of forest, land surface and climate models is performed and essential to quantify forest-climate interactions and to enhance the representation of Forest Management Practices (T2.2&T2.3). The results generated from user-specific model simulations will be incorporated into the Decision Support System (DSS). Integrating the results from forest, land surface, and climate model simulations into a comprehensive Decision Support System (DSS) enhances the ability to quantify both	Identification of forest owners and relevant forest managers in CSA of the project to raise awareness on the importance of achieving climate neutrality and how forests can contribute to this (T3.1&T3.2). By consulting an increased number of people involved in forest management, the most appropriate measures will be identified to minimise the effects of climate change on the forest environment (T3.2&T3.3) Analysis and identification together with the	The developed DSS will provide forest managers with useful information and tools to achieve the EU climate neutrality objectives. The tools available to forest managers and other interested categories will provide the necessary predictions for the effective management of carbon-capturing objectives.	Forest managers from the CSA (as identified by T3.1) will be interviewed to explore their perceptions of Carbon Capture and FES, and to analyse their intended forest management. The interviews will focus on cognitive, social, dispositional and context factors that influence forest managers' decision-making and their preferences (T5.3). The governance analysis will identify the most important knowledge gaps and factors affecting decision-making and co-develop for long-term uptake and usage of DSS (T5.2).	OptFor-EU communicates the urge to be more ambitious in its dissemination and communication activities, also ensuring to transfer the knowledge from solid data to support its statements and thus raise awareness of the need to increase those EU targets (T6.2&T6.4). OptFor-EU with its digital channels and outreach, raises awareness of climate-change-related threats and gives ways and solutions to address them (an example was the Instagram posts from the IEECP account to prevent and/or react to forest fires) (T6.4).	Ready-to-use forest DSS that will support forest managers and other end-users (e.g., policymakers, business sector, ecological restoration) to select favourable FMP, for both soil and vegetation, to optimize the sustainable provision of FES (including decarbonisation) and other forest values under CC pilot areas relevant for the European forest ecosystems, including old-growth forests. (WP2, WP3, WP4, WP5). OptFor-EU Project engages stakeholders,

		present and future forest-climate interactions. This integrated approach supports more informed decision-making by providing detailed, scenario-based insights. It enables progressive monitoring of how different management strategies will impact forests and the climate, allowing for timely adjustments and actions as needed (T2.3).	stakeholders of the most relevant FMI and FES to quantify the various forest management measures under various climate scenarios across Europe (T3.3).		WP5 will investigate the trade-offs between forest managers and EU policy targets, but also among FES when managing a forest (T5.4). The policy recommendations will be submitted for peer review and target various stakeholders for optimal policy dissemination (T5.5).		including decision-makers and practitioners over its entire lifetime through an array of different means (through surveys, interviews, bilateral meetings, and engagement workshops) and collaborates closely with them to collect their needs and understand current management practices. (WP3, WP6).
Reducing Greenhouse Gas Emissions	A set of Essential Forest Mitigation Indicators to assess the mitigation potential is being developed in (T1.2), to be fed in a DSS.	Reduction of GHG emissions could be also achieved with appropriate and optimal forest management options aligned with Nature-Based Solutions (NBSs). The quantification of key forest-climate interactions and their influences on Essential Forest Mitigation Indicators (EFMI) is the base for a range of forest	The organised workshops aim to inform the stakeholders regarding the contribution of forests and their management in the direction of reducing greenhouse gas emissions and increasing carbon stocks (T3.3). Through questionnaires and bilateral meetings	The DSS provides support for the adoption of sustainable forest management options that improve specific FES under future CC scenarios and increase the carbon sink capacity of European forests.	Stakeholders mapping for mitigation strategies in forest management (T5.2). Research of institutional factors for end-user uptake of the project strategies for mitigation in forest management, especially of governance mechanisms that mainly hinder		The DSS and policy recommendations will support the forest managers and policymakers in selecting favourable forest management practices and options to optimise the FES and maximise forests' GHG mitigation potential. The DSS will be able to evaluate future trends in decarbonisation

		management, socioeconomic and high-resolution climate scenarios (T2.2). One of the objectives of the WP2 is the assessment of optimal forest management options, associated with NBSs, for preserving and enhancing carbon stocks and sinks while supporting other FES and forest resilience in the future (T2.3).	with forest managers, are identified policies that hinder the application of effective measures to increase carbon stocks, but also ways to promote management measures to reduce GHG emissions (T3.3). The set of Essential Forest Mitigation Indicators is being discussed and validated with CSA stakeholders to ensure a broad coverage of all the local contexts under study in this project (T3.3).		(monitoring) progress (T5.2).		capacity, to highlight the risk of the decline in carbon trends, and to identify the hotspots. The OptFor-EU Decision Support System (DSS) aims to facilitate spatially explicit reporting of the Greenhouse Gas (GHG) Inventory for Forest Land Use as the OptFor-EU DSS uses advanced remote sensing for forest area estimation, harmonised across European Forest Types and provides an easy-to-use tool for end-users (WP1, WP2, WP4, WP5).
Circular Economy	A set of Essential Forest Mitigation Indicators to assess the Carbon mitigation potential is being developed, to be fed into the DSS to help forest managers in their decision-making on how to manage their forests towards	The optimization of modelling tools, by the integration between them (i.e., climate and forest models), involves improving their accuracy to account for the dynamics of circular economy processes. By doing so, we can better	The continuous involvement of stakeholders in the process of co-creation and usage of the DSS leads to the continuous improvement of its functionality (T3.2, T3.3, T3.4).		The governance and policy analysis will identify the most important knowledge gaps and factors affecting decision-making and co-develop for long-term uptake and usage of DSS (T5.2)		

	mitigating carbon. Indicators on restoration of ecosystems, forest protection, afforestation and sustainable forest management practices are part of the preliminary indicator collation (T1.2).	capture the effects of circularity across various sectors and assess their cumulative greenhouse gas emission reductions (T2.2). The model simulations for FMP, socioeconomic and climate scenarios will specifically capture the differences between carbon sequestration in managed and unmanaged forests. OptFor-EU DSS will provide forest managers with optimal solutions for decarbonisation of the European forests under different CC and management scenarios. The 'outcome-oriented' approach, including the co-development of the DSS-based solution in a MMA will facilitate the trade-offs and optimisation of FES	Permanent communication with stakeholders allows the identification of the most suitable solutions, acceptable from an economic point of view, but also ecologically, to achieve the goals of decarbonization and protection of forest ecosystems (T3.2, T3.3).				

		both in managed and unmanaged forests (T2.3).					
Biodiversity Preservation		Integrating data from different modelling platforms empowers decision-makers with comprehensive insights into the complex interplay between forests and the climate scenario. These insights are pivotal for formulating effective strategies to mitigate climate change and adapt to its impacts. Specifically, the DSS enables stakeholders to identify optimal forest management practices that contribute to carbon sequestration, biodiversity conservation, and resilience enhancement in the face of shifting climatic conditions (T2.2).	Identifying together with the stakeholders in the workshops and planned meetings, the impact of climate change on biodiversity and the measures to maintain it in the conditions of the new climate challenges (T3.3). Consultation with forest administrators to identify sustainable and efficient forest management measures under future climate challenges (T3.3). Identifying with the help of interested parties the factors that prevent the expansion of protected areas and the impact of conservation measures on the FES. Identification of trade-offs and necessary policies to	The DSS supports the decision-making process for selecting climate-resilient adaptation and mitigation measures based on the project's database (WP1) and simulations of several forest management options (WP2) addressing different FES under current and future CC and supporting biodiversity in all European forest types.	The governance analysis will identify the most important knowledge gaps and factors affecting decision-making and co-develop for long-term uptake and usage of DSS (T5.2).	OptFor-EU with its digital channels and outreach, raises awareness of climate-change-related threats and gives ways and solutions to address them (an example was the Instagram posts from the IEECP account to prevent and/or react to forest fires) (T6.4).	OptFor-Eu Project supports forest managers and other relevant stakeholders to implement FMP based on scientifically informed decisions that enhance FES, maintaining and enhancing regional biodiversity. By providing different scenarios for different decision-making situations under current and future climate change, and collecting stakeholder perspectives, this project simulates and evaluates a range of management options while supporting forest biodiversity (WP2, WP3, WP4, WP5).

			encourage the expansion of protected/conserved areas (T3.3).				
Clean Energy Transition		The assessment of the impact of single and combined scenarios and forest management practices on forest ecosystem services informs the options of using biomass more effectively and sustainably (T2.2).	Stakeholder workshops aim at informing stakeholders about the forest growth scenarios and how the increase in woody biomass could generate energy as a substitute for fossil fuels (T3.4).				OptFor-EU exploits data and knowledge from eight case study areas in Europe, covering all EFT and bioclimatic regions, as well as the plurality of FMP (WP1, WP2, WP3, WP5).
Just Transition			Training of forest managers in using and understanding the necessity of a decision-support system which could provide them with a sense of security and preservation that their forest is kept for the next generations (T3.4).		The policy recommendations will be submitted for peer review and target a just transition and an inclusive process of enhancing forest climate resilience (T5.5).		

Table 2 OptFor-EU response and contribution to New EU Forest Strategy goals

NEW EU FOREST STRATEGY GOALS	WP 1 RESPONSE	WP2 RESPONSE	WP3 RESPONSE	WP4 RESPONSE	WP5 RESPONSE	WP6 RESPONSE	MULTI-WPs RESPONSE
Supporting the socio-economic functions of forests for thriving rural areas and boosting forest-based bio-economy within sustainability boundaries	Indicators on wood products are part of the Essential Forest Mitigation indicators and are supporting the economic functions of forests (T1.2).	The short-, medium- and long-term carbon stock dynamic of different forest types under a changing climate, including the carbon release through in-situ decomposition, damages, disturbances and wood product disposal, is a key feature of the OptFor-EU modelling framework, which aims to facilitate the transition to sustainable FMP and the use of long-lived wood products (T2.1, T2.2, T2.3).	Involving and interacting with various forest end-users and other stakeholders across each Case study area over the lifetime of the project promotes the utilisation of wood products, sustainable use of woody resources and its quality among the value-based chain (T3.2, T3.3, T3.4). Involvement of users across the entire forest-based value chain, will facilitate the creation of new knowledge and a better understanding of the F-C Nexus and its related trade-offs and benefits (T3.4).		"Using a Lean Startup approach and a set of templates, WP 5 addresses requirements from a variety of forests, incl. managed, unmanaged, forest types, climate, production, etc. The forest managers will co-create these templates in cooperation with WP4. The task will also seek ways to market and implement the use of the DSS in the target group (T5.3). Task 5.2. will identify and analyse how institutional frameworks and governance mechanisms (external factors) hinder and/or support the uptake of strategies for climate mitigation		

					in forest management.		
Protecting, restoring and enlarging EU's forests to combat climate change, reverse biodiversity loss and ensure resilient and multifunctional forest ecosystems	Afforestation is an indicator considered within the Draft set of Essential Forest Mitigation indicators providing relevant information on the status and trends of forests and biodiversity (T1.2).	Protection of primary and old-growth forests passes through monitoring the current resources. Monitoring and reporting routines established can be robust and repeatable for the foreseeable future by using satellite products (e.g., ESA CCI - ESA Biomass, ESA Fire; MODIS - Global Forest Cover Change, Leaf Area Index, Evapotranspiration (8-day synthesis; Sentinel-1 SAR for Forest Monitoring, Sentinel-2 for Tree Logging). This combined with common ground data input format and integration workflow, is both flexible and rigorous. The combination of these two aspects will result in a	Through WP3, data are collected on primary and old-growth forests from various areas of Europe, including information on their management, obstacles in the direction of their preservation, but also measures for their promotion (T3.2, T3.3). By consulting the stakeholders are identified the obstacles to the adoption of active climate management measures, the political initiatives necessary to promote the certification schemes and ways to enhance forest owners' revenue through values of FES recognition (T3.3).				

		harmonisation and monitoring workflow capable of solving issues of different ground data standards, whilst providing a top-down, landscape-scale analysis for large-scale assessment (T2.2, T2.3).					
Strategic forest monitoring, reporting and data collection, and Research and innovation agenda	A set of Essential Forest Mitigation Indicators to assess the mitigation potential is being developed in T1.2, to be fed in a Decision Support System DSS (WP4). In T1.4 a gridded map of the 14 European Forest types was elaborated (D1.1) A database is set up containing harmonized forest-climate data at various levels. The results could contribute to this Forest Observation and the Data	Building on stakeholder requirements and priorities in the case study regions, the impacts of management scenarios on local forest structure, carbon pools and fluxes, including potential EFMI will be modelled. Two detailed forest models are used: 3D-CMCC-FEM and PICUS. FMP already considered in the forest models (e.g. thinning intensity or tree species selection) will be extended with additional options (e.g. changes in tree	By consulting stakeholders from different regions of Europe, collecting data on forest management for various EFTs and future expectations regarding FES, WP3 contributes to the knowledge of the current state of forestry management and to the development of sustainable forest management measures (T3.3). By consulting stakeholders from different regions of Europe, WP3 puts different forest management models in contact		The analysis will identify the most important knowledge gaps and factors affecting decision-making and co-develop for long-term uptake and usage of DSS (T5.2) The resulting innovative knowledge from this project will feed into the EIP-AGRI (The agricultural European Innovation Partnership) website for broad dissemination to practitioners. End-user material will be produced in the form of several		

	Collection Framework (T1.3).	species composition) and events like damage and large-scale disturbance, thus extending the so-called 'Business-as-Usual' FMP, undertaken by European forest managers, into broad and climate-adapted future management options aiming at assessing optimal management solutions (T2.1). Deliverable 2.5 (Report on improved representation of forests in models: Report on how the new representation of forests and forest management in land-surface models will improve their performance in future global climate studies) will enable pull-through of knowledge from OptFor-EU into land-surface modelling and	and allows their comparative analysis. Through the permanent consultation of stakeholders, they actively participate in the development of new methods and models of sustainable forest management (T3.3, T3.4).		summaries for practitioners in the EIP common format (""practice abstracts""). The project details will also be submitted to the platform with the first deliverable submission. Guidance and templates for practice abstracts are available on the EIP-AGRI website: http://ec.europa.eu/eip/agriculture/en/content/eip-agri-common-format. A total target number of 3 practice abstracts is foreseen for the project" (T5.2).		

		earth system modelling, as used to calculate global carbon budgets and climate projections.					
Dialogue and stakeholder engagement			OptFor-EU project partners identify and involve forest end-users and other relevant stakeholders across each CSA in 8 European countries (Norway, Lithuania, UK, Germany, Austria, Romania, Spain, Italy). The dialogue with the stakeholders is outcome-oriented for a better understanding of the Forest-Climate Nexus to produce robust knowledge and serviceable results with a focus on co-benefits and trade-offs between mitigation and adaptation measures in forest management. This engagement process ensures that relevant		By establishing a close dialogue between OptFor-EU scientists and forest managers, and applying an iterative ""Lean Startup"" approach, WP5 will support the development of the DSS and ensure a long-term user-adoption (T5.2).		OptFor-EU Project engages stakeholders over its entire lifetime and facilitate the information exchange between scientists and local stakeholders. It ensures an effective way to transfer the knowledge from science to practice, between researchers and stakeholders (through surveys, interviews, bilateral meetings, and engagement workshops). Using the project website and other digital channels during the communication and dissemination activities, the information are provided and the dialogue is conducted in local

			stakeholders are directly involved in developing a DSS that meets their actual needs. In addition, their perspectives and expertise are used in the analysis of the current policy framework and the development of policy recommendations. To improve dialogue and effective stakeholder involvement, five levels of participation were used: information, consultation, advice, co-creation and co-decision. This structural participation is based on stakeholder relevance and facilitates the dissemination of results and the collection of feedback and input (T3.2, T3.3, T3.4).				languages in order to build a trustful relationship and avoid any potential barrier. OptFor-EU involves several stakeholder groups (government, civil society, industry, academia, similar projects and initiatives) and collaborates closely with them to collect their needs and understand current management practices. This involvement will focus the results into the OptFor-EU Decision Support System (DSS), which will create an important user community. (WP3, WP4, WP6)

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