Reviewing the Contribution of the Land Use, Land-use Change and Forestry Sector to the Green Deal

Final Study

July 2021

EUROPEAN COMMISSION

Directorate-General for Climate Action
Directorate C — Climate Strategy, Governance and Emissions from non-trading sectors
Unit C.3 — Land Use and Finance for Innovation

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LULUCF review study

2021

Manuscript completed in July 2021

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PDF ISBN 978-92-76-38968-2 doi: 10.2834/201100 ML-02-21-775-EN-N

Luxembourg: Publications Office of the European Union, 2021

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Abstract

The study, "Reviewing the contribution of the Land use, Land-use Change and Forestry to the European Green Deal" informed the European Commission's DG Climate and Action in their development of an impact assessment for the revision of the LULUCF Regulation. The study consisted of several key inputs and outputs with the backbone being the analysis of seven fundamental topics within the LULUCF sector. These topics were extended into short, informative notes that laid out the main problem drivers, problems, and goals within the context of improving the LULUCF sector's capacity to remove CO_2 from the atmosphere. They covered the forest and soil sink in the EU, the state of accounting and reporting, flexibilities between the LULUCF and the Effort Sharing Regulation (ESR), market mechanisms, and a forward look towards 2050. Alongside these topic notes, four workshops were conducted, the results of the open public consultation (OPC) on the LULUCF Regulation were analysed, and a synthesis of the Member States' policies and measures related to LULUCF (submitted pursuant to Article 10 of the LULUCF Decision) was completed. All of these outputs then allowed for a holistic examination of the LULUCF sector by providing views from experts and civil society through research as well as collaboration through workshops and the OPC.

Abstract

L'étude « Examen de la contribution du secteur de l'utilisation des terres, du changement d'affectation des terres et de la foresterie au Green Deal Européen » a aidé la DG Climat et Action de la Commission Européenne dans son développement d'une évaluation d'impact pour la révision de la Réglementation du secteur UTCATF. L'étude a consisté en plusieurs contributions et résultats principaux, la base étant l'analyse de sept thèmes fondamentaux dans le cadre du secteur UTCATF. Ces thèmes ont été exprimés à l'aide de brèves notes informatives qui présentaient les principaux facteurs problématiques, les problèmes et les objectifs dans le contexte d'une amélioration de la capacité du secteur UTCATF à éliminer le CO_2 de l'atmosphère. Ils portaient sur la forêt et les sols en tant que puits de carbone au sein de l'UE, l'état de la comptabilité et de l'établissement des rapports, les flexibilités entre le secteur UTCATF et la Réglementation concernant la répartition des efforts (ESR), les mécanismes du marché et une prospective pour 2050. En plus de ces notes thématiques, quatre ateliers ont été conduits, les résultats de la consultation publique ouverte (CPO) sur la réglementation du secteur UTCATF ont été analysés et une synthèse des politiques et des mesures des États Membres liées au secteur UTCATF (soumises conformément à l'Article 10 de la Décision UTCATF) a été effectuée. Tous ces résultats ont ensuite permis un examen holistique du secteur UTCATF en fournissant des points de vue d'experts et de la société civile à travers une recherche ainsi qu'une collaboration à travers des ateliers et la CPO.

1. Executive Summary

1.1. Introduction

The European Union's target to achieve climate neutrality by 2050 is an ambitious target that surpasses the goals set out by any other global entity. Following the 2015 Paris Agreement and the subsequent steps taken by the European Council and the European Parliament, the path has been set towards reaching a net-zero EU where any residual emissions are fully balanced by CO_2 removals. Yet this cannot be done without an effective and robust Land Use, Land-Use Change and Forestry (LULUCF) sector. Figure 1 shows the projections for the EU in achieving climate neutrality with a key progress point being in achieving 55% emission reductions by 2030. It is clear that LULUCF is key to balance the remaining EU emissions towards 2050 and beyond.

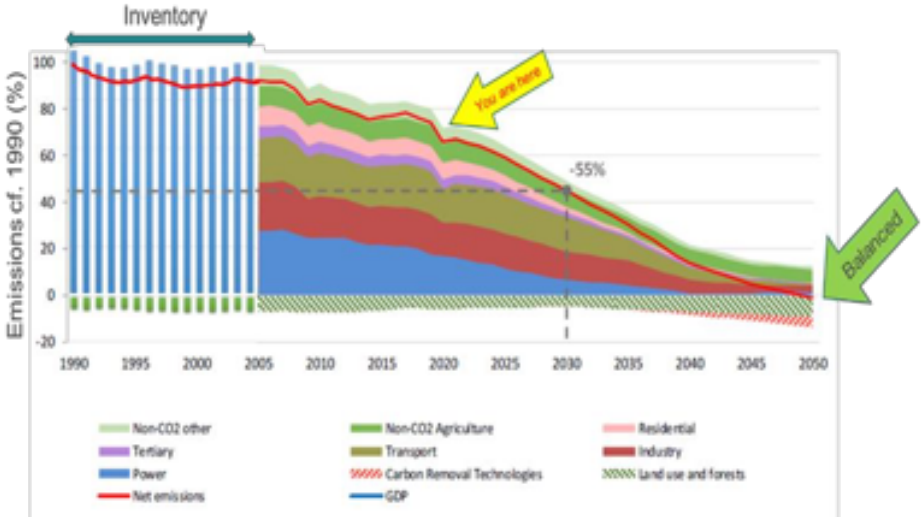


Figure 1: GHG pathways for sectors towards 2050.

As part of the newly established reduction targets, DG Climate Action (DG Clima) has initiated the process of revising the LULUCF regulation through a legislative proposal, which is expected to be adopted in July 2021. In parallel, the European Commission has initiated the revision of other climate change-related policy acts. The Impact Assessment (IA) accompanying the legislative proposal amending the LULUCF Regulation will explain the problems addressed by the revision, its objectives, the available policy options, and their impacts. The revision is necessary to find the most effective set of policy tools required for achieving the higher net emission reduction target. In parallel with the works on the impact assessment, an open public consultation was undertaken to support this process. Figure 2 depicts a brief timeline for the EU policy regarding the revision of the LULUCF Regulation, within the context of the present project.

Figure 2. Timeline of EU policy after the Green Deal leading to the revision of the LULUCF Regulation.

The project "Reviewing the contribution of the Land Use, Land-use Change and Forestry sector to the Green Deal" was designed to support DG Clima in the process of developing the impact assessment. The study delivered arguments and knowledge to inform the preparation of the impact assessment of the revision of the LULUCF Regulation. The project experts provided factual input and policy analysis within specific pathways to support the Commission's work; while these inputs have been thoroughly discussed with the Commission, the views expressed in the final study do not represent the views of the Commission but only those of the authors.

The project covered a total of four tasks. Task 1 involved selecting seven key topics areas to explore within the LULUCF sector, mainly focussing on the problems, problem drivers and the goals. These topics were selected through a heavy ideation process and in consultation with the Commission. Task 2 undertook the organisation of four online workshops on thematics related to the LULUCF context, in order to gather ideas and solutions from relevant stakeholders to possible key barriers. Within this task, a summary of the feedback to the Inception Impact Assessment and a statistical analysis and overview of the Open Public Consultation for the LULUCF Regulation were also conducted. Task 3 summarized the third and final submission of Member States' reports under Article 10 of the LULUCF Decision; in total, 24 reports were analysed. Task 4 provided a presentation that integrated the conclusions across the three tasks and specifically along the seven topic areas presented in Task 1.

1.2. Analysis of key topic areas

The main aim of the seven topic notes covered in Task 1 (sections 2 – 9) was to provide expertise for the development of the impact assessment as well as create an overview of the main roadblocks affecting the LULUCF Regulation. The topic notes were discussed in detail with the Commission during the onset and duration of the project in order to deliver the best possible support and necessary information to the development process of the impact assessment.

The need for an increasing carbon sink in the LULUCF sector is clearly presented in the projections towards 2050 (Figure 1). While the Commission's projected scenarios see a potential to increase the carbon sink, there are still few obstacles to increasing the contribution of the LULUCF sector to the overall EU reduction target. These problems are evaluated across the seven topic notes developed under Task 1 of this study. The identified problems are:

1. Current accounting rules only require a preservation of the carbon sink at the same level as they would be under management practices applied before 2009. Due to the general ageing of forests, the rules create space for the MS to report reductions of the carbon sink without incurring any debits.
2. Within the current framework of climate change policies, it is possible to use LULUCF allowances to comply with Effort Sharing Regulation (ESR) obligations. Flexibilities in their current state do not create a strong incentive for more measures to be established by MS to increase the carbon sink as it is.
3. The state of policy on agriculture covers emissions from fertilisers, animal production and land within different pieces of legislation, creating a confusing policy framework. On the other hand, the CAP is a far-reaching piece of legislation that affects the whole agriculture sector. A more integrated approach would be useful to link emissions caused by land management to other emissions released by agriculture production.
4. Monitoring Reporting and Verification (MRV) of greenhouse gas (GHG) emissions is not yet granular enough in most MS to pick up the effect of major carbon storing practices (e.g. wetland restoration, agroforestry, …), let alone the impacts of measures taken at the individual level, which undermines effective monitoring and policy-making.

These main challenges led to an assessment of seven main topics to cover the problems addressed above. The seven topics fit into four broad themes and provided different goals and solutions to address the problems presented above. These sub-groups are presented in Table 1 below.

Table 1: Topic Notes and their sub-groups as covered under Task 1 of this study.

Themes	Topic Note	Description
Problem Oriented	Forests	Explores the drivers behind the recent decline in forest carbon sinks, which is identified as one of the main problems that the design and implementation of LULUCF policies must address.
	Soils	Presents the current trends in soil carbon changes in the EU, how they are reported in national GHG inventories and the potential of best management practices to protect and enhance soil carbon stocks in the EU.
Reporting & Accounting	Reporting	Sets out options to improve the LULUCF inventories of the MS.
	Accounting	Proposes a set of accounting solutions, some of which would constitute a radical shift in accounting practices whereas others would be improvements within the current system, thus being able to be implemented short-term.
Policy Framework	Missing markets	Indicates potential areas of improvement for introducing market-based incentives linked to land-based carbon removals.
	Flexibilities	Discusses EU flexibility approaches on land use, land-use change and forestry (LULUCF) that could help trigger a list of short-term actions to enhance the long-term contribution from the sector towards achieving the climate neutrality target for 2050.
Vision	Vision 2050	Explores the potential for LULUCF's contribution to the European Green Deal's target of net neutrality by 2050.

The topic notes outlined above cover the entire scope of the LULUCF sector including its strengths and challenges. The topic notes under Task 1 underpinned the study in its entirety and acted as the backbone to the other tasks, in particular the analysis of the Art. 10 reports.

As regard the **first** theme, the analysis identified the drivers of the declining sink in both forests and soils in the EU, highlighting that this problem needs to be addressed rapidly in order to prevent its further exacerbation.

With regard to the **second** theme, the analysis pointed at ways in which current LULUCF Monitoring, Reporting and Verification systems could be improved. In the case of soil carbon, for example, proper monitoring should lead to a more realistic view of the land sectors. In addition, ways to simplify the LULUCF accounting rules were proposed.

Within the **third** theme, as regards the policy framework, the presence of market externalities highlight the need for robust incentives for landowners to engage in climate action. The structural changes presented involve significant future research and development in order to remove the current barriers (e.g. monitoring individual performance). As there are not many substantial price signals already in place for the carbon market, there is room for improvement in this regard.

With regard to flexibilities with the ESR, there are several key considerations that will have an impact on future flexibility mechanisms. The experts presented sixteen different options, including : offsetting sector-specific emissions from LULUCF within MS; creating an Agriculture, Forestry and other Land-use (AFOLU) flexibility; both seller and buyer side solutions regarding compliance conditionality and emissions trajectory; strategic use of ESR and ETS proceeds; creation of a project-based incentive mechanism and compliance and crediting for livestock farming.

Finally, as regards the **fourth** theme, the vision towards 2050 provides a key forward-looking view within the wider EU climate policy framework, explaining how the climate policy arena will encompass in the coming years a three-fold climate purpose:

- Reducing GHG emissions to the absolute minimum

- Producing biomass as biomaterial substitute and as feedstock to generate bioenergy
- Generating sufficient carbon sink capabilities and “land mitigation units” (LMUs)

The main conclusion from this part of the study is that by the end of 2050, the overall policy approach to the LULUCF sector could substantially change. By strengthening data availability as well as by creating incentives for climate action among landowners, the sector can reach its full potential. The study suggests an array of short-term and long-term options delivered within the topic notes to support the role of the LULUCF sector in the achievement of the climate neutrality target by 2050.

1.3. Workshops

Over the course of the project period, four workshops (sections 10 – 13) were undertaken within Task 2 in order to allow for stakeholders to communicate and collaborate on topics related to land use policies in the EU. The four workshop topics were planned out with the Commission in order to gather key insights that can help to inform future policies related to LULUCF as well as the regulation itself. The four topics and their objectives are presented in the table below.

Table 2: Overview of topics covered in workshops.

Workshop	Description
LULUCF Reporting & Accounting approaches	The objective was to introduce and initiate discussions on future policy design in the LULUCF sector, in the context of the impact assessment.
The role of agriculture and land use sectors in a climate neutral EU in 2050	The objective was to extract information on the role of the land-use sectors in contributing to a climate neutral EU in 2050. The main topics were the vision for 2050 and the role of farmers, private markets, and data and technology.
Gathering ideas on the next steps for carbon farming	The goal of this workshop was to gain information on the next steps for carbon farming. The topics in the workshop were linkages between biodiversity and carbon removals, monitoring carbon removals, and policy framework.
Carbon farming in the CAP Strategic Plans	The objective of the workshop was to explore design options for Carbon Farming schemes within the CAP Strategic Plans.

The main takeaways from the workshops were focused on the financial aspects of the sector, among other things. The first workshop concluded that there need to be more stringent targets for the LULUCF sector, particularly in proportion to MS capacity to increase the sink cost efficiently. The second workshop advocated for an EU wide carbon farming initiative as well as better financial incentives. The third workshop suggested to bring down costs of monitoring of soil organic carbon as well as to make sure farmers are well supported in terms of advisory services. The last workshop presented numerous options for carbon farming within the CAP Strategic Plans, highlighting its potential also based on existing projects.

1.4. Open Public Consultation

The analysis of the replies to the Open Public Consultation (OPC) (section 15) on the revision of the LULUCF Regulation was also part of Task 2. The OPC brought about several insights from stakeholders and relevant actors across the EU. 235 responses were evaluated across 22 MS with a majority being from EU citizens, followed by business associations and NGOs. The OPC covered 13 questions split up into four sub-categories:

5. Mobilisation of the mitigation and business potential of the land sector
6. The overall policy approaches

7. Setting more ambitious rules for the LULUCF sector
8. Links between land use and agriculture

Some interesting conclusions can be drawn from the OPC. However, it is important to note that the open comments provided by stakeholders are highly correlated to their affiliation. In this regard, the replies to the questions are presented below, but many more open comments were submitted with additional suggestions and conclusions.

The main drivers for the decline in the land-based carbon sink were identified in the conversion of carbon-rich land (deforestation, draining of wetland or peatland), land take and soil sealing (expansion of built-up and artificial areas). The policy approach which was most frequently selected as either important or very important was an improved EU framework on monitoring, reporting, and verifying emissions and removals. This is in line with findings from other deliverables of this study. The most frequently selected areas in which the EU should focus on efforts to enhance the carbon sink were afforestation, reforestation and forest restoration.

With regard to policy and finance, respondents stressed the importance of subsidies to improve climate action in the sector. This is also in line with the conclusions from the other deliverables within this project. For the policy approach, a strengthened LULUCF Regulation in line with the 2030 Climate Target Plan had the most responses. In addition, when asked if there should be more stringent targets than the current "no-debit" rule, 52% of the respondents were in favour, although differences emerged across stakeholder groups. The private sector was split nearly in half on whether more stringent targets should be imposed while academic institutions and environmental organisations were clearly in favour.

The last interesting conclusion from the OPC was on the Forest Reference Level (FRL): while most respondents proposed to discontinue the use of FRL, some replied that they would continue its use with some modifications regarding the harmonisation of the methodology for MS.

1.5. Policies and Measures related to LULUCF in Member States until 2020

The Art. 10 reports (section 16) submitted by 24 MS[1] provide a window into the state of LULUCF action within the EU. Knowing these actions can then help to direct policy approaches and help to harmonise and create consistency with regard to data, for example. Many MS have highly effective and innovative LULUCF policies and measures (PaMs), yet there is still room for improvement as the EU rules for the sector could be strengthened significantly. Five main challenges were presented by MS in their reports that can be used to inform further LULUCF policy actions:

1. Decreasing sink or increasing emissions in a given LULUCF sector over significant period (DK, AT, BG, CY, FI, HU, IE, LV, LT, MT, NL, SK and ES)
2. EU's maturing and ageing forests sequester carbon but at a decreasing rate (EE, IE, LV, SI, DK and SK)
3. Data fluctuations and gaps (BE, FI, EL, LU, MT, PL, SI, and FR)
4. Abandoned land (particularly in Central and Eastern European countries) (EE, LV, MT, HR and LT)
5. Nutrient management problems leading to unproductive soils (EE, MT, PL, and ES)

[1] Portugal and the Czech Republic did not submit their third Art. 10 reports and Germany submitted past the deadline to be included into the synthesis report.

There are several ways in which the Art. 10 reports can set the path for a continued focus on LULUCF. One of the main conclusions from the reports is the importance of the post-2020 Common Agricultural Policy that will be in effect starting in 2023. The CAP covers a majority of the agricultural PaMs cited across the MS and is a vital source of finance. With the new CAP's objectives of increasing the climate ambition, there could be a distinct change in the way that MS manage their land. Figure 3 shows the breakdown of policy instruments from 398 PaMs presented in the 24 reports.

Figure 3. Main policy instruments from per the MS PaMs.

Focussing on the types of actions that have the most uptake across the EU can help paint a picture for the sector going forward. Nutrient, tillage and water management, forest management, and biodiversity/conservation measures were the most common type of intervention among MS. Forest management interventions typically were cited within the scope of improving timber production and sustainable harvest, indicating a strong tie between economic objectives as well as environmental ones. *Nutrient, tillage, and water management* PaMs were almost entirely financed under the CAP, most often through the Rural Development Programmes. The connection between improving rural or landowner incomes and climate action is an clear pathway to effective policies at both national and EU level. This confirms also a conclusion from the OPC, as subsidies and a carbon farming were both mentioned as necessary to build on an effective and sustainable carbon sink.

What can be gleaned from the analysis of the Art. 10 reports is that through specific consideration of the challenges mentioned above, the LULUCF sector will effectively help balancing the emissions by and potentially before 2050. It is clear that there is expertise on the sector across MS, yet policy measures and support need to be improved for landowners to feel supported financially. Through short-term actions such as strengthening data collection as well as through the implementation of focused PaMs in certain areas (i.e. Central and Eastern European countries) the sector can reach its full potential.

1.6. Conclusions

The complexities of the LULUCF sector should not be ignored and each of the sections of the study attempted to examine the state of the sector from a different angle. While many stakeholders with different affiliations (i.e. experts, public authorities, private actors, etc.) were involved through each step of the process, there were some points of consensus. Wrapping up the variety of deliverables and analyses conducted within this study and combining it into key policy advice is a difficult task. Nevertheless, there are some conclusions that can be drawn from each deliverable that overlap in the long run. The table below presents a short list of conclusions from the deliverables and analyses that were covered by the scope of this project.

Table 3: Solutions based on the deliverables within the context of this study.

Solution	Expert Analysis	Public Feedback	Member State Art. 10 Reports
Better MRV	√	√	√
Simplification of accounting	√	√	
Prioritise mitigation potential of forests	√	√	√
Importance of CAP		√	√
Alter rules regarding flexibilities in ESR	√	√	
Support to landowners	√	√	√

To properly track land removals and emissions, the MRV system must be improved. The Art. 10 reports were highly differentiated in their reporting methods and showed that consistency is needed to see the whole picture. In addition, a large part of the first workshop was dedicated to MRV, and the debate showed the importance of this topic. From the OPC, one suggestion was to use high resolution and wall-to-wall imagery as a way to create a more homogenous level of tracking land-use changes. The expert views even concluded that the monitoring of soil organic carbon is the "most critical blind spot of land-related climate policy." In addition, the analysis of accounting methods highlighted the need to re-evaluate the accounting approach and perhaps implement a gross-net accounting approach where there is no baseline (in other words, targets would be based on all emissions and removals reported in the inventory). Both the OPC and the expert analysis discussed this topic at great length and there is no one-size-fits-all solution. A combination of approaches (net-net and gross-net) is one option to allow for more elasticity.

The mitigation potential of forests is intertwined into all parts of the study and both the magnitude of PaMs in the Art. 10 reports related to forest management as well as the responses in the OPC show how necessary it is to preserve and improve the forest sink capacity. It was mentioned in the final workshop as well that the amount of forestland that is outside managed or productive forests is minimal in some MS. The pressure from forest-based bioenergy is one of the main causes of the decreasing sink and is a highly important topic to consider in policy discussions going forward.

One of the workshops was entirely dedicated to the CAP Strategic Plans and the future for a carbon farming initiative, because there is a clear path forward under the new CAP. It is of utmost importance to create a future CAP that has a strong focus on climate action alongside financial incentives for landowners to act. The CAP has been a central tool for the EU since its implementation, and its overall objective of rural income support has and will shift towards a 'greener' focus. While rural development is still vital, there is a way to ensure both that livelihoods are valued, and environmental practices are encouraged.

One of the policy options presented in the Inception Impact Assessment and in the OPC (following the options outlined in the Climate Target Plan Communication) presented a strengthening of the flexibility in the ESR, which is one of the main topics within Task 1 of this

project. In the OPC, this option received significant criticism with some stakeholders wanting to fully remove flexibility with the ESR and establish a separate LULUCF target. Many voiced the concern that this would lead to inaction in the ESR through enabling offsetting, ultimately encouraging emissions in the long run. Regardless, the current flexibility in the ESR needs to be reconsidered carefully.

Support to landowners should be carefully designed to avoid perverse incentivise. In that regard, the EU Carbon Farming initiative should be seen as mechanism to encourage climate-friendly nature-based solutions. Carbon farming in relation to the design of the CAP starting in 2023 was the theme covered by the final workshop. The high attendance to this workshop highlighted the key interest in the interaction between the existing and future possibilities to provide incentives to land managers.

To conclude, this project arrived at three main conclusions:

1. The LULUCF sector has great potential for contributing to the achievement of a 2050 climate neutral economy. However, there are two main areas where the sink needs to be improved: in forests and soils. There is strong evidence that the carbon sink in EU forests is decreasing, and this trend won't reverse. This is mainly due to a higher reliance on forest-based bioenergy as well as ageing forest stands. It is clear that without intensive measures like reforestation and afforestation as well as active forest management, the amount of available removals will decrease in the next 20 years. It should also be underlined that carbon removals in soils are expensive to monitor. Further, in the absence of strong policy incentives to monitor and increase soil carbon storage, there is an important shortfall of soil carbon data, both at the EU and MS level.
2. There are possible solutions in simplifying the accounting methodologies that will allow for a more accurate and fair allocation of the carbon removals in the MS accounts. Similarly, there are clearly available solutions aimed at improving the reporting accuracy, however this would require, among other things, additional involvement from the research community. This will help MS to improve the accuracy and transparency of reported values.
3. There are appropriate actions available to increase carbon storage in the land sector. The recently published technical Handbook on Carbon Farming[2] as well as an existing interest in the topic provides a good starting point for further upscaling and uptake of carbon farming initiatives leading to carbon sequestration and storage.

[2] EU Commission. (2021). Setting up and implementing result-based carbon farming mechanisms in the EU: Technical guidance handbook. https://op.europa.eu/en/publication-detail/-/publication/10acfd66-a740-11eb-9585-01aa75ed71a1/language-en

1.7. Introduction

L'objectif de l'Union Européenne d'atteindre la neutralité climatique d'ici à 2050 est un objectif ambitieux qui dépasse les objectifs imposés par d'autres entités globales. Suite à l'Accord de Paris de 2015 et aux étapes suivantes mises en œuvre par le Conseil Européen et le Parlement Européen, le chemin a été tracé en direction d'un zéro net de l'UE, lorsque toutes les émissions résiduelles seront entièrement compensées par des éliminations de CO_2. Cependant, cela ne peut pas être fait sans un solide secteur d'utilisation des terres, de changement d'affectation des terres et de foresterie (UTCATF). La Figure 4 montre les projections pour la réalisation par l'UE de la neutralité climatique, un jalon important consistant à atteindre 55 % de réduction des émissions d'ici 2030. Il est clair que le secteur UTCATF est crucial pour compenser les émissions résiduelles de l'UE d'ici à 2050 et au-delà.

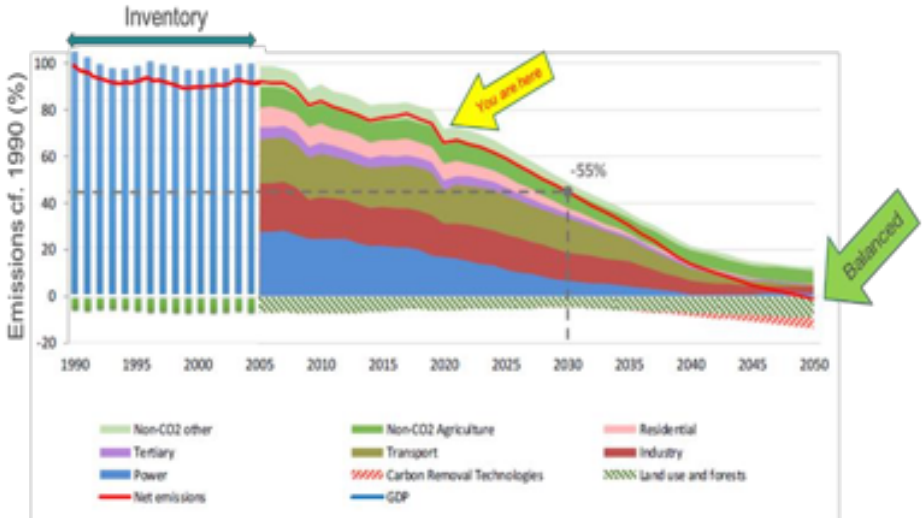


Figure 4: Trajectoires GES pour les secteurs d'ici 2050.

Dans le cadre des objectifs de réduction nouvellement établis, la DG Climate Action (DG Clima) a initié le processus de révision de la réglementation du secteur UTCATF à travers une proposition législative qui devrait être adoptée en juillet 2021. En parallèle, la Commission Européenne a initié la révision d'autres lois d'orientations relatives au changement climatique. L'évaluation d'impact (IA) accompagnant la proposition législative amendant la réglementation du secteur UTCATF expliquera les problèmes abordés par la révision, ses objectifs, les options politiques disponibles et leurs impacts. La révision est nécessaire pour trouver l'ensemble d'outils politiques le plus efficace permettant d'atteindre l'objectif de réduction d'émissions net le plus élevé possible. Parallèlement aux travaux sur l'évaluation d'impact, une consultation publique ouverte a été entreprise pour soutenir de processus. La Figure 5 représente une brève chronologie de la politique de l'UE concernant la révision de la réglementation du secteur UTCATF dans le contexte du présent projet.

Figure 5. Chronologie de la politique de l'UE après le Green Deal menant à la révision de la réglementation du secteur UTCATF.

Le projet « Examen de la contribution du secteur de l'utilisation des terres, du changement d'affectation des terres et de la foresterie au Green Deal » a été conçu pour soutenir la DG Clima dans le processus de développement de l'évaluation d'impact. L'étude a donné des arguments et permis d'acquérir des connaissances permettant la préparation de l'évaluation d'impact de la révision de la réglementation du secteur UTCATF. Les experts du projet ont fourni des données factuelles et une analyse des politiques dans le cadre de trajectoires spécifiques pour soutenir le travail de la Commission; bien que ces données aient été discutées en détail avec la Commission, les opinions exprimées dans l'étude finale ne représentent pas les opinions de la Commission mais uniquement celles des auteurs.

Le projet a couvert un total de quatre tâches. La Tâche 1 a impliqué la sélection de sept thématiques principales dans le secteur UTCATF, se concentrant principalement sur les problèmes, les facteurs problématiques et les objectifs. Ces thématiques ont été sélectionnées à l'aide d'un processus exigeant d'idéation et en consultation avec la Commission. La Tâche 2 a consisté à entreprendre l'organisation de quatre ateliers en ligne sur des thématiques relatives au contexte du secteur UTCATF, afin de collecter des idées et des solutions d'intervenants importants concernant les principaux obstacles. Dans le cadre de cette tâche, un résumé du retour à l'évaluation d'impact de lancement et une analyse statistique et une vue d'ensemble de la consultation publique ouverte pour la réglementation du secteur UTCATF ont également été réalisés. La Tâche 3 a permis de résumer la troisième et dernière soumission des rapports des États Membres selon l'Article 10 de la Décision du secteur UTCATF ; au total, 24 rapports ont été analysés. La Tâche 4 a fourni une présentation qui intégrait les conclusions des trois tâches et plus spécifiquement les sept thématiques présentées lors de la Tâche 1.

1.8. Analyse des thématiques

Le principal objectif des sept notes thématiques concernées par la Tâche 1 était de fournir une expertise pour le développement de l'évaluation d'impact ainsi que d'obtenir une vue d'ensemble des principaux obstacles affectant la réglementation du secteur UTCATF. Les notes thématiques ont été discutées en détail avec la Commission pendant la mise en place et la durée du projet afin de fournir le meilleur soutien possible et les informations nécessaires pour le processus de développement de l'évaluation d'impact.

La nécessité d'un puits de carbone plus important dans le secteur UTCATF est clairement présenté dans les projections jusqu'à 2050 (Figure 4). Bien que les scenarii prévus par la Commission voient un potentiel d'augmentation du puits de carbone, il existe encore quelques obstacles à l'augmentation de la contribution du secteur UTCATF à l'objectif général de réduction de l'UE. Ces problèmes sont évalués dans les sept notes thématiques développées lors de la Tâche 1 de cette étude. Les problèmes identifiés sont :

1. Les règles de comptabilité actuelles nécessitent seulement une préservation du puits de carbone au même niveau que selon les pratiques de gestion appliquées avant 2009. Du fait du vieillissement général des forêts, les règles permettent aux EM de rapporter des réductions du puits de carbone sans encourir aucun débit.
2. Dans le cadre actuel des politiques de lutte contre le changement climatique, il est possible d'utiliser les compensations du secteur UTCATF pour être conforme aux obligations de la Réglementation de la répartition des Efforts (ESR). Les flexibilités dans leur état actuel n'incitent pas fortement les EM à appliquer plus de mesures afin d'augmenter le puits de carbone tel qu'il est.

3. L'état de la politique agricole couvre les émissions provenant des fertilisants, de la production animale et des terres dans le cadre de différents textes de lois, créant ainsi un cadre politique confus. D'autre part, la PAC est un texte de loi d'une grande portée qui affecte tout le secteur agricole. Une approche plus intégrée serait utile pour relier les émissions causées par la gestion des terres à d'autres émissions produites par la production agricole.
4. Le système de surveillance, d'établissement de rapports et de vérification (MRV) des émissions de gaz à effet de serre (GES) n'est pas encore assez détaillé dans la plupart des EM pour profiter de l'effet des principales pratiques d'agriculture carbonée (par exemple la restauration des zones humides, l'agroforesterie…), sans parler des impacts des mesures prises individuellement, qui empêchent la mise en place d'une surveillance et d'une action politique efficaces.

Ces principaux problèmes ont conduit à une évaluation de sept thématiques principales afin de couvrir les problèmes mentionnés ci-dessus. Les sept thématiques s'intègrent dans quatre thèmes larges et ont permis de fournir différents objectifs et solutions afin de résoudre les problèmes présentés ci-dessus. Ces sous-groupes sont présentés dans le Tableau 4 ci-dessous.

Tableau 4: Notes thématiques et leurs sous-groupes telles que couvertes selon la Tâche 1 de cette étude.

Thèmes	Note thématique	Description
Axe problème	Forêts	Explore les facteurs derrière la diminution récente des puits de carbone forestiers, qui est identifiée comme un des principaux problèmes que la conception et la mise en œuvre de politiques UTCATF doit résoudre.
	Sols	Présente les tendances actuelles des changements du carbone du sol dans l'UE, comment ils sont rapportés dans les inventaires GES nationaux et le potentiel des meilleures pratiques de gestion afin de protéger et d'augmenter les stocks de carbone des sols dans l'UE.
Établissement de rapports & Comptabilité	Établissement de rapports	Expose des options pour améliorer les inventaires UTCATF des EM.
	Comptabilité	Propose un ensemble de solutions comptables dont certaines constitueraient un changement radical des pratiques de comptabilité tandis que d'autres seraient des améliorations dans le cadre du système actuel, tout en pouvant être mises en place à court terme.
Cadre politique	Marchés manquants	Indique des domaines potentiels d'amélioration pour l'introduction d'incitations basées sur le marché, relatives aux éliminations terrestres du carbone.
	Flexibilités	Discute des approches de flexibilité de l'UE concernant l'utilisation des terres, le changement d'affectation des terres et la foresterie (UTCATF) qui pourrait aider à déclencher une liste d'actions à court terme afin d'augmenter la contribution à long terme du secteur, afin de parvenir à la neutralité climatique d'ici à 2050.
Vision	Vision 2050	Explore le potentiel de la contribution de l'UTCATF à l'objectif du Green Deal européen d'une neutralité nette d'ici à 2050.

Les notes thématiques mentionnées ci-dessus couvrent toute l'étendue du secteur UTCATF, y compris ses forces et ses difficultés. Les notes thématiques de la Tâche 1 ont soutenu l'étude dans son ensemble et ont agi comme une ossature pour les autres tâches, en particulier l'analyse des rapports selon l'Art. 10.

En ce qui concerne le **premier** thème, l'analyse a identifié les facteurs de la diminution du puits à la fois dans les forêts et les sols dans l'UE, en soulignant que ce problème doit être résolu rapidement afin d'empêcher sa future aggravation.

En ce qui concerne le **deuxième** thème, l'analyse a fait ressortir des façons dont les systèmes actuels de surveillance, d'établissement de rapports et de vérification du secteur UTCATF pourraient être améliorés. Dans le cas du carbone du sol, par exemple, une surveillance

appropriée permettrait d'obtenir une vision plus réaliste des domaines fonciers. En outre, des façons d'améliorer les règles de comptabilité du secteur UTCATF ont été proposées.

Dans le cadre du **troisième** thème, en ce qui concerne le cadre politique, la présence d'externalités du marché souligne la nécessité d'inciter fortement les propriétaires à engager une action climatique. Les changements structurels présentés impliquent de la recherche et du développement significatifs dans l'avenir afin d'éliminer les obstacles actuels (par exemple la surveillance des performances individuelles). Comme il n'existe encore pas beaucoup de signaux de prix déjà mis en place pour le marché du carbone, il existe une marge d'amélioration à cet égard.

En ce qui concerne les flexibilités avec l'ESR, il y a plusieurs considérations importantes qui auront un impact sur les futurs mécanismes de flexibilité. Les experts ont présenté seize options différentes, y compris : la compensation des émissions spécifiques au secteur par le secteur UTCATF dans les EM ; la création d'une flexibilité du secteur de l'agriculture, de la foresterie et autre utilisation des terres (AFOLU) ; des solutions des deux côtés, vendeur et acheteur, concernant les conditions de conformité et la trajectoire des émissions ; une utilisation stratégique des revenus ESR et ETS ; la création d'un mécanisme d'incitation basé sur un projet, la conformité et l'attribution de crédits pour l'élevage de bétail.

Enfin, en ce qui concerne le **quatrième** thème, la vision d'ici à 2050 fournit une vision prospective dans le cadre plus large de la politique de l'UE concernant le climat, en expliquant comment la politique climatique prendra en compte, dans les prochaines années, un objectif climatique triple :

- réduction des émissions de GES au minimum absolu
- production de biomasse en tant que substitut au biomatériau et en tant que matière première pour générer de la bioénergie
- génération de capacités de captage de carbone suffisantes et « d'unités d'atténuation des terres » (LMU)

La principale conclusion de cette partie de l'étude est que, d'ici à la fin de 2050, l'approche politique globale du secteur UTCATF pourrait changer substantiellement. En renforçant la disponibilité des données ainsi qu'en créant des incitations pour une action climatique de la part des propriétaires terriens, le secteur peut réaliser tout son potentiel. L'étude suggère un ensemble d'options à court terme et à long terme fournies dans le cadre des notes thématiques pour renforcer le rôle du secteur UTCATF dans la réalisation de l'objectif de neutralité climatique d'ici à 2050.

1.9. Ateliers

Au cours de la période du projet, quatre ateliers ont été entrepris dans le cadre de la Tâche 2 afin de permettre aux intervenants de communiquer et de collaborer sur des thématiques liées aux politiques d'utilisation des terres dans l'UE. Les quatre thématiques d'ateliers ont été planifiées avec la Commission afin d'obtenir des idées cruciales pouvant aider à concevoir de futures politiques liées au secteur UTCATF ainsi que la réglementation elle-même. Les quatre thématiques et leurs objectifs sont présentés dans le tableau ci-dessous.

Table 5 : Vue d'ensemble des thématiques couvertes lors des ateliers.

Atelier	Description
Approches d'établissement de Rapports & Comptabilité du secteur UTCATF	L'objectif était d'introduire et d'initier des discussions sur la conception d'une future politique dans le secteur UTCATF, dans le contexte de l'évaluation d'impact.
Le rôle des secteurs de	L'objectif était d'obtenir des informations sur contribution des secteurs

l'agriculture et de l'utilisation des terres dans une UE climatiquement neutre en 2050	de l'utilisation des terres à une UE climatiquement neutre en 2050. Les principaux thèmes étaient la vision pour 2050 et le rôle des agriculteurs, des marchés privés, des données et de la technologie.
Collecte d'idées concernant les étapes suivantes pour l'agriculture carbonée	Le but de cet atelier était d'obtenir des informations sur les étapes suivantes pour la culture carbonée. Les thèmes de l'atelier étaient les liens entre la biodiversité et les éliminations du carbone, la surveillance des éliminations du carbone et le cadre politique.
Agriculture carbonée dans les Plans Stratégiques de la PAC	L'objectif de l'atelier était d'explorer des options de conception de programmes d'Agriculture Carbonée dans le cadre des Plans Stratégiques de la PAC.

Les points importants à retenir des ateliers étaient concentrés sur les aspects financiers du secteur, parmi d'autres choses. Le premier atelier a conclu qu'il était nécessaire d'avoir des objectifs plus stricts pour le secteur UTCATF, particulièrement en proportion de la capacité de l'EM à augmenter la rentabilité du puits. Le deuxième atelier a plaidé pour une large initiative d'agriculture carbonée ainsi que pour de meilleures incitations financières. Le troisième atelier a suggéré de réduire les coûts de la surveillance du carbone organique du sol et de s'assurer que les agriculteurs sont bien soutenus en termes de conseils. Le dernier atelier a présenté de nombreuses options pour l'agriculture carbonée dans le cadre des Plans Stratégiques de la PAC, soulignant son potentiel, également sur la base de projets existants.

1.10. Consultation Publique Ouverte

L'analyse des réponses à la Consultation Publique Ouverte (CPO) sur la révision de la réglementation du secteur UTCATF faisait également partie de la Tâche 2. La CPO a apporté plusieurs idées des intervenants et des acteurs importants dans toute l'UE. 235 réponses ont été évaluées dans 22 EM, une majorité provenant de citoyens de l'UE, suivies d'associations professionnelles et d'ONG. La CPO comprenait 13 questions divises en quatre sous-catégories :

1. Mobilisation du potentiel d'atténuation et d'activité du secteur foncier
2. Les approches politiques globales
3. L'imposition de plus de règles ambitieuses pour le secteur UTCATF
4. Liens entre l'utilisation des terres et l'agriculture

Quelques conclusions intéressantes peuvent être tirées de la CPO. Cependant, il est important de noter que les commentaires ouverts fournis par les intervenants sont fortement corrélés avec leur affiliation. À cet égard, les réponses aux questions sont présentées ci-dessous, mais de nombreux commentaires ouverts ont été soumis avec des suggestions et conclusions supplémentaires.

Les principaux facteurs du déclin du puits de carbone basé sur les terres ont été identifiés comme étant la conversion de terres riches en carbone (déforestation, drainage des zones humides ou des tourbières), l'artificialisation et l'imperméabilisation des sols (expansion des zones construites et habitées). L'approche politique qui a été la plus fréquemment choisie comme étant soit importante soit très importante était un meilleur encadrement européen concernant la surveillance, l'établissement des rapports et la vérification des émissions et des éliminations. Cela est conforme aux conclusions d'autres parties de cette étude. Les zones les plus fréquemment choisies dans lesquelles l'UE devrait concentrer ses efforts pour renforcer le puits de carbone étaient le boisement, le reboisement et la restauration des forêts.

En ce qui concerne la politique et les finances, les personnes interrogées ont souligné l'importance des subventions pour améliorer l'action climatique dans le secteur. Cela est également conforme aux conclusions des autres parties de ce projet. Pour l'approche politique, une réglementation du secteur UTCATF renforcée conforme au Plan des Objectifs

Climatiques 2030 a obtenu le plus de réponses. En outre, lorsqu'on leur a demandé s'il devait y avoir des d'objectifs plus stricts que l'actuelle règle « pas de débit », 52 % des personnes interrogées ont répondu oui, bien que des différences aient émergé parmi les groupes d'intervenants. Le secteur privé était divisé en deux parties presque égales sur le fait que des objectifs plus stricts devaient ou non être imposés tandis que les institutions académiques et les organisations environnementales étaient clairement pour.

La dernière conclusion intéressante de la CPO était sur le niveau de référence pour les forêts (FRL) : tandis que la plupart des personnes interrogées ont proposé d'arrêter l'utilisation du FRL, certaines ont répondu qu'elles continueraient de l'utiliser avec certaines modifications concernant l'harmonisation de la méthodologie pour les EM.

1.11. Politiques et mesures relatives au secteur UTCATF dans les États Membres jusqu'en 2020

Les rapports selon l'Art. 10 soumis par 24 EM[3] fournissent un aperçu de l'état de l'action du secteur UTCATF dans l'UE. Connaître ces actions peut ensuite aider à orienter les approches politiques et permettre d'harmoniser et de créer une cohérence en ce qui concerne les données, par exemple. Plusieurs EM ont des politiques et mesures UTCATF hautement efficaces et innovantes, mais il y a toujours une marge d'amélioration, car les règles de l'UE pour le secteur pourraient être renforcées significativement. Cinq défis majeurs ont été présentés par les EM dans leurs rapports, qui peuvent être utilisés pour documenter d'autres actions politiques concernant le secteur UTCATF :

1. Puits en diminution ou émissions en augmentation dans un secteur UTCATF donné sur une période significative (DK, AT, BG, CY, FI, HU, IE, LV, LT, MT, NL, SK et ES)
2. Les forêts matures et vieillissantes de l'UE capturent le carbone mais à un taux en diminution (EE, IE, LV, SI, DK et SK)
3. Fluctuation des données et lacunes (BE, FI, EL, LU, MT, PL, SI, et FR)
4. Terres abandonnées (particulièrement dans les pays d'Europe Centrale et de l'Est)(EE, LV, MT, HR et LT)
5. Problèmes de gestion de nutriments conduisant à des sols improductifs (EE, MT, PL, et ES)

Il existe plusieurs manières dont les rapports selon l'Art. 10 peuvent tracer le chemin vers un focus permanent sur le secteur UTCATF. Une des principales conclusions des rapports est l'importance de la Politique Agricole Commune post-2020, qui entrera en vigueur en 2023. La PAC couvre une majorité des politiques et mesures citées par les EM et il s'agit d'une source vitale de financements. Avec les nouveaux objectifs de la PAC de renforcer les ambitions climatiques, il pourrait y avoir un net changement dans la manière dont les EM gèrent leurs terres. La Figure 6 montre la répartition des instruments politiques à partir des 398 politiques et mesures présentés dans les 24 rapports.

3 Le Portugal et la République tchèque n'ont pas soumis leurs rapports selon l'Art. 10 et l'Allemagne l'a soumis après l'échéance et son rapport n'a donc pas pu être inclus dans le rapport de synthèse.

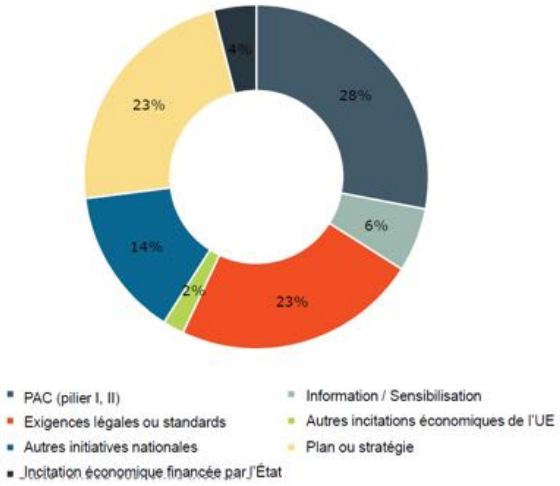


Figure 6. Principaux instruments politiques provenant des politiques et mesures des EM.

Le fait de se concentrer sur les types d'actions qui permettent l'absorption la plus importante dans l'UE peut aider à obtenir un aperçu de l'avenir du secteur. La gestion des nutriments, des labours et de l'eau, la gestion des forêts et les mesures de préservation de la biodiversité ont été le type d'intervention le plus courant parmi les EM. Les interventions de gestion des forêts ont souvent été citées pour l'amélioration de la production de bois et une exploitation durable, ce qui indique un fort lien entre les objectifs économiques et les objectifs environnementaux. Les politiques et mesures de gestion des nutriments, des labours et de l'eau ont été presque entièrement financées dans le cadre de la PAC, le plus souvent par l'intermédiaire des Programmes de Développement Ruraux. Le lien entre l'amélioration des revenus ruraux et des propriétaires terriens et l'action climatique est clairement une voie vers des politiques efficaces tant au niveau national et que de l'UE. Cela confirme également une conclusion de la CPO indiquant que des subventions et une agriculture carbonée étaient mentionnées comme nécessaires pour établir un puits de carbone efficace et durable.

Ce qui peut être conclu de l'analyse des rapports selon l'Art. 10 est que, en considérant spécifiquement les problèmes mentionnés ci-dessus, le secteur UTCATF permettra de compenser efficacement les émissions d'ici à 2050 et potentiellement avant. Il est clair qu'il existe une expertise dans ce secteur dans les EM, mais les mesures politiques et le soutien doivent être améliorés afin que les propriétaires terriens se sentent soutenus financièrement. Des actions à court terme telles que le renforcement de la collecte des données ainsi que la mise en place de politiques et mesures focalisées sur certaines régions (par exemple les pays d'Europe Centrale et de l'Est) permettront au secteur de réaliser pleinement son potentiel.

1.12. Conclusions

Les complexités du secteur UTCATF ne doivent pas être ignorées et chacune des sections de l'étude a tenté d'examiner l'état du secteur sous un angle différent. Bien que de nombreux intervenants avec différentes affiliations (par exemple des experts, des autorités publiques, des acteurs privés, etc.) aient été impliqués à chaque étape du processus, il y a eu quelques points de consensus. Récapituler la grande variété de résultats et d'analyses conduites dans le cadre de cette étude et les combien avec des conseils de politiques est une tâche exigeante. Néanmoins, certaines conclusions peuvent être tirées de chaque résultat, qui se superposent à la longue. Le tableau ci-dessous présente une courte liste de conclusions des résultats et des analyses qui ont été effectuées dans le cadre de ce projet.

Table 6. Solutions basées sur les résultats dans le contexte de cette étude.

Solution	Analyse des	Retour du	Rapports des États

	experts	public	Membres selon l'Art. 10
Un meilleur système MRV	√	√	√
Simplification de la comptabilité	√	√	
Priorisation du potentiel d'atténuation des forêts	√	√	√
Importance de la PAC		√	√
Modification des règles concernant les flexibilités dans l'ESR	√	√	
Soutien aux propriétaires terriens	√	√	√

Afin de suivre correctement les éliminations et les émissions des terres, le système MRV doit être amélioré. Les rapports selon l'Art. 10 étaient fortement contrastés en ce qui concerne les méthodes d'établissement de rapports et ont montré qu'une cohérence était nécessaire pour avoir une vue d'ensemble. En outre, une grande partie du premier atelier a été dédiée au système MRV et le débat a montré l'importance de cette thématique. Dans la CPO, une suggestion était d'utiliser une imagerie à haute résolution et en continu afin de créer un niveau plus homogène de suivi des changements d'affectation des terres. Les experts ont même conclu que la surveillance du carbone organique des sols était « le point aveugle le plus critique de la politique climatique liée aux terres ». En outre, l'analyse des méthodes de comptabilité a souligné la nécessité de réévaluer l'approche de comptabilité et peut-être de mettre en place une approche de comptabilité brut-net où il n'y aurait aucune ligne de base (en d'autres termes, les objectifs seraient basés sur toutes les émissions et éliminations rapportées dans l'inventaire). La CPO et l'analyse des experts ont permis de discuter longuement de cette problématique et il n'y a pas de solution universelle. Une combinaison d'approches (net-net et brut-net) est une option afin de permettre plus d'élasticité.

Le potentiel d'atténuation des forêts est mentionné dans toutes les parties de l'étude et l'amplitude des politiques et mesures dans les rapports selon l'Art. 10 relatifs à la gestion des forêts ainsi que les réponses dans la CPO montrent combien il est nécessaire de préserver et d'améliorer la capacité du puits forestier. Il a également été mentionné, dans l'atelier final, que la quantité de terres forestières hors des forêts gérées ou productives est minimale dans certains EM. La pression de la bioénergie basée sur les forêts est une des causes principales de la diminution du puits et est une thématique importante à prendre en compte dans la suite des discussions concernant les politiques.

Un des ateliers était entièrement dédié aux Plans Stratégiques de la PAC et l'avenir d'une initiative d'agriculture carbonée, car il existe clairement une voie qui est la nouvelle PAC. Il est d'une extrême importance de concevoir une future PAC avec un focus important sur l'action climatique et des incitations financières pour les propriétaires terriens. La PAC est, depuis sa mise en place, un outil central pour l'UE et son objectif global de soutien aux revenus ruraux s'oriente et s'orientera vers un focus « plus vert ». Bien que le développement rural soit toujours vital, il existe un moyen de s'assurer à la fois que la subsistance soit garantie et que les pratiques environnementales soient encouragées.

Une des options politiques présentées dans l'évaluation d'impact de lancement et dans la CPO (suite aux options soulignées dans la Communication du Plan des Objectifs Climatiques) était un renforcement de la flexibilité dans l'ESR, qui est une des principales thématiques de la Tâche 1 de ce projet. Dans la CPO, cette option a obtenu d'importantes critiques, certains intervenants voulant supprimer complètement la flexibilité avec l'ESR et établir un objectif séparé pour le secteur UTCATF. De nombreux intervenants ont exprimé leur préoccupation qui cela conduirait à l'inaction dans le cadre de l'ESR du fait que la compensation est autorisée, ce qui encouragerait finalement les émissions à long terme. Quoi qu'il en soit, la flexibilité actuelle dans l'ESR doit être reconsidérée avec attention.

Le soutien aux propriétaires terriens doit être conçu avec soin afin d'éviter des effets pervers. À cet égard, l'initiative d'agriculture carbonée de l'UE doit être vue comme un mécanisme

permettant d'encourager des solutions naturelles bénéfiques pour le climat. L'agriculture carbonée en lien avec la planification de la PAC démarrant en 2023 était le thème abordé par l'atelier final. La forte participation à cet atelier a montré l'intérêt pour l'interaction entre les possibilités existantes et futures d'incitations pour les gestionnaires fonciers.

Pour conclure, ce projet est parvenu à trois conclusions principales :

1. Le secteur UTCATF a un grand potentiel pour une contribution à la réalisation d'une économie climatiquement neutre en 2050. Cependant, il existe deux domaines principaux où le puits doit être amélioré : les forêts et les sols. Des signes forts montrent que le puits de carbone dans l'UE est en diminution et cette tendance ne s'inverse pas. Cela est dû principalement à une dépendance plus forte à la bioénergie basée sur les forêts ainsi que sur le vieillissement des forêts. Il est clair que, sans des mesures intensives comme la reforestation et le boisement ainsi qu'une gestion active des forêts, la quantité d'éliminations disponibles diminuera dans les 20 prochaines années. Il convient également de souligner que les éliminations de carbone dans les sols sont coûteuses à surveiller. En outre, en l'absence de fortes politiques d'incitation pour surveiller et augmenter le stockage du carbone dans le sol, il y a un manque de données concernant le carbone dans le sol, à la fois dans l'UE et au niveau des EM.
2. Les solutions possibles incluent la simplification des méthodologies de comptabilité qui permettra une allocation plus précise et plus juste des éliminations du carbone dans les comptes des EM. De manière similaire, il existe des solutions clairement disponibles visant à améliorer l'exactitude des rapports, cependant cela nécessiterait, entre autres choses, une implication supplémentaire de la communauté des chercheurs. Cela aidera les EM à améliorer la précision et la transparence des valeurs présentées.
3. Il existe des actions appropriées disponibles pour augmenter le stockage du carbone dans le secteur foncier. Le Manuel Technique sur l'agriculture carbonée[4], récemment publié, ainsi qu'un intérêt déjà existant pour cette thématique, fournissent un bon point de départ pour le renforcement et l'adoption d'initiatives d'agriculture carbonée permettant la séquestration et le stockage du carbone.

4 Commission UE. (2021). Élaboration et mise en œuvre de mécanismes d'agriculture carbonée basés sur les résultats dans l'UE: manuel d'assistance technique.
https://op.europa.eu/en/publication-detail/-/publication/10acfd66-a740-11eb-9585-01aa75ed71a1/language-en

2. Synthesis Report on Topic Notes

Abbreviations

AFOLU	Agriculture, Forestry and Other land-use
CAP	Common Agriculture Policy
ESR	Effort Sharing Regulation
EU ETS	European Union Emissions Trading Scheme
FRLs	Forest Reference Levels
GHG	Greenhouse Gas
IA	Impact Assessment
LULUCF	Land Use, Land-use Change and Forestry
MRV	Monitoring, Reporting and Verification
NECPs	National Energy and Climate Plans
PA	Paris Agreement
TN	Topic Note

2.1. Introduction

Over the course of the last decade, the European Union (EU) took a global lead on action to combat climate change. The evolution of policy architecture and science-based evidence revealed the need for urgent action towards reducing the global temperature to below 2˚C as well as reducing greenhouse gases (GHGs) in all sectors of the economy.

First, the complex climate change policy package adopted in 2009 sets the target for a 20% GHG reduction to be achieved until 2020. In 2015, a global stimulus, the Paris Agreement (PA), urged parties to act more ambitiously regarding the reduction of CO_2 as it is the only way to mitigate the climate change crisis; it set out an objective to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century. The PA set out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.

The EU response was the introduction of the 2030 climate and energy package that sets up a reduction target of -40% in 2030 compared to 1990. In December 2019, the newly elected President of the European Commission presented an even more rigorous policy initiative with an overarching objective to make Europe climate neutral in 2050. The European Green Deal set a minimum target of reductions of GHG emissions to at least 50% and toward 55% by 2030 compared to 1990.

As part of the newly established reduction targets, DG Climate Action has initiated the process of revising the Land Use Land-use Change and Forestry (LULUCF) regulation, which is expected to be published in June 2021. In parallel, the European Commission has initiated the revisions of other climate change-related policy acts. The Impact Assessment (IA) accompanying the revision of the LULUCF Regulation will explain the problems addressed by the revision, its objectives, the available policy options and their objectives. The revision is necessary to find the most effective set of policy tools required for achieving the higher net emission reduction target. During the legislative procedure, an open public consultation was undertaken to support this process. The four legal acts subject to these consultations are:

- EU Emissions Trading System (EU ETS) Directive
- Effort Sharing Regulation (ESR)
- LULUCF Regulation
- CO_2 standards for cars and vans Regulation (light-duty vehicles)

The purpose of this study is to focus on the LULUCF Regulation and ultimately provide factual input as well as policy analysis within specific pathways to inform the Commission's work. As part of Task 1, the study developed a set of seven topic notes (TNs) with a deep analysis of the current situation in the LULUCF sectors starting with problems of the decreasing carbon sink in two main carbon pools: forests, and soils (TN1 and TN2). The next two topic notes cover the connection between LULUCF and currently available market-based incentives (TN3) and the vision for LULUCF towards 2050 (TN4). Experts also thoroughly analysed all of the elements of the reporting and accounting of the emissions from the sector and looked for options for improvements. These topic notes (TN5 and TN6) were also supported by the findings from the first of a series of four workshops conducted under Task 2 of this study. TN7 focuses on options for the governance of flexibilities for LULUCF under the ESR. These seven topic notes can be treated as standalone documents.

Table 7: Topic Notes and their respective scope.

Topic Note	Scope
TN1: The Decline in the Forest Sink and its Drivers	Explores the drivers behind the recent decline in forest carbon sinks, which is identified as one of the main problems that the design and implementation of LULUCF policies must address.
TN2: Soil Carbon: Current Trends and Challenges	Presents the current trends in soil carbon changes in Europe, how they are reported in national greenhouse gas inventories (GHGs) and the potential of best management practices to protect and enhance soil carbon stocks in the EU.
TN3: Externalities and Missing Markets	Sets out options to improve the LULUCF inventories of the MS.
TN4: Vision for 2050	Proposes a suite of accounting solutions, some of which would constitute a radical shift in accounting practices whereas others are merely improvements within the current system, which could be implemented short term.
TN5: Improve Reporting	Indicates potential areas of improvement for introducing market-based incentives linked to land-based carbon removals.
TN6: Amend the LULUCF Accounting Rules to make the No-Debit Rule More Stringent	Discusses EU flexibility approaches on land use, land-use change and forestry (LULUCF) that could help trigger a list of short-term actions to enhance the long-term contribution from the sector towards achieving the climate neutrality target for 2050.
TN7: Governance of LULUCF Flexibilities	Explores the potential for LULUCF's contribution to the European Green Deal's target of net neutrality by 2050.

2.2. Background

The LULUCF sector is gaining increasing importance in the political context, as it is slowly becoming the key sector to provide the carbon removals needed to achieve the long-term target of climate neutrality until 2050. There is a desire to capitalise on the phenomena of removing CO_2 from the atmosphere and storing it in biological tissue. Since 1990, the base year for all GHG estimates, the EU has been absorbing more CO_2 than emitting in this sector - positioning the EU as a carbon sink. However, the tendency is showing a negative direction and based on projections from the Member States (MS) this negative trend is set to continue for the next decade.

The obvious interest for policymakers is for the current carbon sequestration to be maintained and increased for the sake of mitigating climate change but also in supporting the strategic direction of the EU. Therefore, there is an urgent need for the carbon sink to be significantly increased by 2030 to be on track for climate neutrality in 2050. Unfortunately, the actual performance of the LULUCF sector is strongly led by natural forces, which human activities can only support and steer.

Thus, the capacity of the land-use sector to sequester carbon cannot be taken for granted. Effective policy incentives and action on the ground are needed.

The European Commission and the MS agree on a common effort to transform the EU economy to become climate neutral until 2050. However, such an ambitious objective has elements that need to be taken into consideration. One such element is the fact that, even if emissions from many economic processes are reduced or become zero, there would still be certain amounts of emissions, e.g. from fertilizers, some natural processes occurring for example in the cement manufacturing or other leaks in the climate change policy regime. Therefore, a key solution to mitigate such emission outputs would be the removals that are reported in the LULUCF sector.

Figure 7 below visualizes the trajectory of change towards 2050 and clearly shows to what extent the carbon removal is expected to be achieved and by which measure. It is also safe to expect the demand for removal units to grow after 2050.

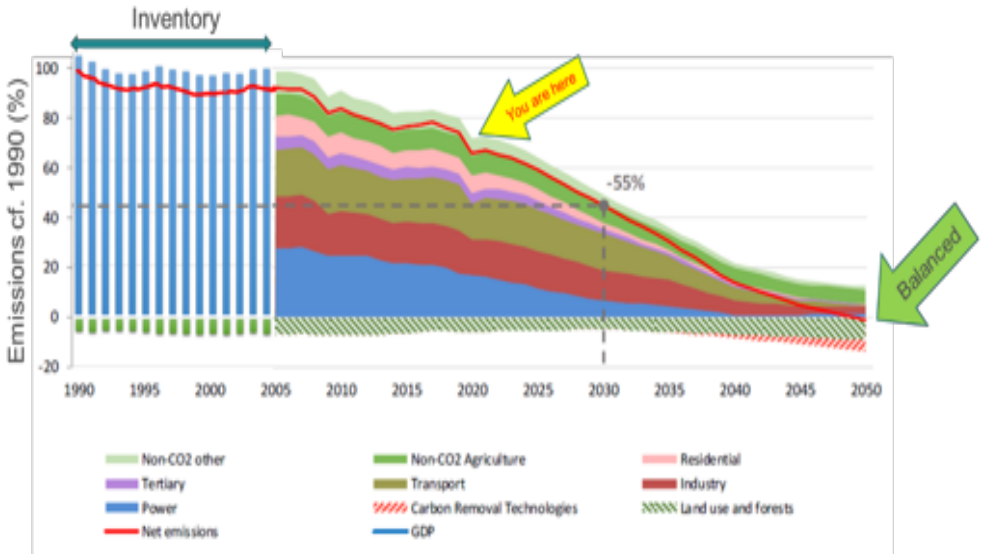


Figure 7: Pathway to climate neutrality; Source: European Commission, 2021

The projections quite clearly illuminate the need for an effective carbon sink in the LULUCF sector. While the Commission's projected scenarios estimate the potential to increase the reported carbon sink, there are still a few problems blocking the increase of the contribution of the LULUCF sector to the overall EU reduction target. These identified problems are further evaluated across the seven topic notes developed under Task 1 of this study. The identified problems are:

- The current LULUCF accounting rules only require MS to preserve the carbon sink at the same level as it would be if the management practices applied before 2009 were continued. As a consequence of the general ageing of forests, the current rules create space for MS to report reductions of the carbon sink without incurring any debits.
- The current architecture of climate change policies creates a possibility to use the LULUCF allowances surplus to comply with the obligations set by the ESR. Nevertheless, such flexibility does not create a strong incentive for additional measures to be implemented by MS to increase the carbon sink.
- The agriculture sector is a source of emissions from different areas of its activity, like land-based emissions but also the emissions caused by fertilisers and animal production. The current climate policy framework covers those emissions under different pieces of legislation. On the other hand, the CAP is a far-reaching piece of legislation that affects the whole agriculture sector. Therefore, the aim is to propose a more integrated climate approach for the land sector by linking the emissions caused by land management and other emissions released by agriculture production. This could lead to the establishment of a climate-neutral land sector already in 2035.
- Climate change policy is based on proper, consistent and transparent Monitoring Reporting and Verification (MRV) of GHG emissions. Currently, the MRV system is not yet granular enough in most MS to pick up the effect of major carbon storing practices (eg. wetland restoration, agroforestry, …), let alone the impacts of measures taken at the individual actor, which undermines effective monitoring and policy-making.

These main points led to initiating the process of investigations into all the identified problems through an in-depth analysis. It was agreed to assess sevem main topics to cover the problems addressed above (see Table 7).

2.3. Topic Note Overview

The main aim of the topic notes was to deliver the arguments and knowledge to inform the preparation of the impact assessment. The topic notes were developed during the whole duration of the project and were discussed in detail with the Commission in order to deliver the best possible support and necessary information to the IA development process. The description of the topic notes can be found in Table 7 and they are further grouped together in the following figure.

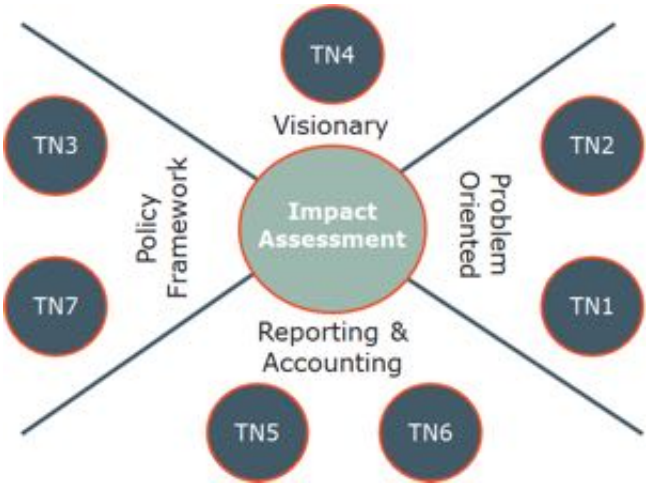


Figure 8: Grouping of Topic Notes into four themes.

From Figure 8 the seven topic notes were classified into three groupings, namely Problem-Oriented (1, and 2), Reporting & Accounting (5 and 6), Policy Framework (3, and 7) and Vision (4). Topic notes also can be grouped into short term (5, 6) and long-term (4) actions. Where

the proposed solution for reporting and accounting and on market is a short-term action and assessment of flexibilities between other climate change policies, the vision towards 2050 would be a long-term action. Each of the topic notes was designed to be able to stand alone as a short but very comprehensive document that serves as a basis for inputs to the legislative documents together with a sound scientific background. Each of the topic notes outlines the main problems and drivers and, in some of them, proposes a set of potential solutions, both short and long-term. Also, the topic notes were designed to serve as a comprehensive report as they are linked altogether, creating a all-inclusive picture of the LULUCF sector and its peculiarities and challenges.

2.3.1. Problem Oriented – Forests

Based on the recent LULUCF inventories, the project team developed the first two topic notes under soils (TN2) and forestry (TN1). The two main carbon reservoirs namely forests and organic soils were taken under evaluation for two reasons:

4. These carbon pools are the largest and
5. recent projections show the sink in these reservoirs is decreasing.

In TN1, experts looked into the forestry sector in the whole EU. Based on the review of the available literature evaluating the current conditions of the forests stands, age class structure, the changes caused by climate change, and harvesting rates, the note concluded that since about 2013, the annual sink on forest land remaining forest land in European forests has been decreasing at roughly 12,000 kt CO_2 / year. This is occurring even though the area of forests within the EU is stable or even slightly growing; with the exception of Sweden, Slovenia and Portugal, the forest area in all of the EU MS has increased by a net increase of nearly 10% from 1990 to 2019.[5]

The majority of this change is due to the increasing harvests for bioenergy. The trends in bioenergy have shown rather sporadic patterns but the harvests can still be linked to a decreasing sink. Emissions from afforestation and deforestation play less of a role in the total of the LULUCF sink in comparison to the forest lands remaining forest lands category. Yet, afforestation has decreased since 2010, most prominently in the Atlantic and Mediterranean regions of the EU with the largest agricultural areas. The last main contribution to the decreasing sink has been a decrease in the living gains for forests such that forest capacity for absorbing carbon has become lower, partially due to ageing EU forests.

TN1 identified four main problem drivers based on the trends outlined above: (1) ageing of forests; (2) sensitivity to droughts and fires and storms due to climate change; (3) forest management practices and (4) a decline in afforestation. In particular, it should be underlined that forests are put under more stress due to the changing climatic conditions. A higher frequency of droughts, fires, storms, and floods can exacerbate the already sensitive forests and make them even more sensitive. These changes are partly beyond human control, however, adaptation action in forests should be an immediate priority.

Both TN1 and the referenced scenario studies suggest that if nothing happens, or if less than substantial improvements happen, then the situation will only worsen over the next 30 years. Only comprehensive regulatory changes can reverse this trend. The root causes of the trends in sinks essentially can be traced back to a lack of financial incentives for landowners to prioritize climate friendly forest management and afforestation/reforestation activities. More sustainable alternatives to short-term bioenergy need to be developed to restore and improve the forest carbon sink.

[5] Forests in the EU, (2019). https://ec.europa.eu/eurostat/statistics-explained/index.php/Forests,_forestry_and_logging#Forests_in_the_EU

2.3.2. Problem Oriented – Soils

The second largest carbon pool is organic soil, yet this carbon reservoir is given less attention in studies and research than the forest carbon pool. It must be highlighted that most stock changes in European soils are currently not being monitored, which is the most critical blind spot of land-related climate policy as reported by the authors of TN2.

According to the analysis in TN2, if soil carbon was properly monitored all over the EU, additional emissions of the order of 70 $MtCO_2$/yr could appear in croplands, and additional removals of the same order of magnitude could appear in grasslands and forests. Drained organic soils are better monitored than mineral soils but there is still significant room for improvement; drained organic soils report emissions of 100 $MtCO_2$/yr concentrated in only 5% of total land area.

There are several problems that climate change policies need to address urgently with regard to soil carbon and its on-site measurement. First, reported data has large gaps and large uncertainty. MS based on their national research and estimation publish data that are on the different level of granularity to present the current condition of soil carbon. In addition, different tiers of reporting are applied by Member states. The uncertainty is due to different levels/tiers that MS use while estimating the carbon content in the soils. The Tier 1 method ignores carbon stock changes in mineral soils. The Tier 2 method generally applies an appropriate emission factor (depending on the soil type and climate region) to estimate the stock changes resulting from conversions between pre-defined management types. Tier 3 includes either soil inventories[6] or a soil model (e.g. Yasso, C-Tool). Tier 3 turns out to be largely inaccurate in the case of soils, as demonstrated in TN2.

In mineral soils, the area that is properly reported is estimated to be at most around 37% of EU cropland. For grassland and forest soils, the reporting gaps are even larger. In organic soils, many MS are using Tier 1 methods, yet the best potential for proper estimations according to the authors of TN2 is developing a country-specific measurement-based emission factor (Tier 2 approach).

While many large carbon gains and losses go unreported, TN2 also brings some analyses of potential measures that support protecting and increasing the carbon content in soils. Many of these measures are not captured by most GHG inventories. Those measures are:

- Agroforestry
- Cover crops
- Substituting maize with grass
- Wetland/peatland restoration

The conclusion for this TN is that soil carbon is expensive to monitor in the absence of strong policy incentives. Incentives should be created to encourage increasing carbon storage through key measures (e.g. agroforestry, cover crops) being mindful that there is a critical shortfall on data, both at the EU and MS level. As a result, reporting of soil carbon is the blind spot of current EU LULUCF policy. Further solutions to this blind spot can be found in TN5 on reporting as well as in TN6 on accounting.

2.3.3. Short-term solution – Reporting

The topic notes in the Reporting & Accounting category (TN5 and TN6) represent short-term solutions to the problems set out within TN1 and TN2 on forests and soils. These are short-

[6] Meaning in detail: soil carbon content is repeatedly measured over a large number of sample plots across the country or a soil model which is often based on half-decay factors and carbon transfers between different organic matter pools

term solutions as they can result in positive impacts in the short-term and if the solutions presented within are implemented results will be seen rather quickly.

The first topic note (TN5) focuses on the analysis of the current GHG reporting process. Information about emissions is provided by MS in the form of reports that are concluding the work of experts who calculated emissions based on very detailed data on yield and productivity in forests and crops and observed variability. The reporting is done based on strict international guidelines[7] that are in line with the UNFCCC process. In other words, the EU system of reporting of the LULUCF is aligned with the one under UNFCCC. However, this process has some challenges that can be addressed in the context of the revision of the LULUCF Regulation.

Even though the current reporting framework is constantly improving and adapting, many gaps have an unquantified impact on overall LULUCF estimates. The LULUCF reporting is highly dependent on field data, a lot of which is collected autonomously by MS with limited EU coordination. The result is data that is heterogeneous and incomplete. TN5 describes the current state of reporting and points out problem drivers such as lack of resources, lack of incentives for better reporting, and lack of direct connection between reporting and the political and economic sectors.

The main problem drivers in reporting are that LULUCF MRV is very resource intensive and MS do not have a strong enough incentive to improve the quality of the LULUCF reporting. In addition, the scarcity of data creates a distinct blind spot in LULUCF reporting (as highlighted in TN2). The authors of TN5 proposed 20 different solutions and ideas to mitigate the identified problems. They grouped them into four categories: (1) common requirements for soil reporting; (2) reporting-based solutions; (3) non-technical solutions (process, mandate and skills) and (4) communication-related ones. These concrete solutions provide options for the Commission to address and potentially overcome the challenges currently in place.

The proposed ideas were also discussed during the first workshop organised under Task 2 of the project and held in November 2020.

2.3.4. Short-term solutions – Accounting

Under the current EU legislation, adopted in May 2018, the MS are subject to the "no-debit" rule, meaning that accounted emissions from LULUCF must be balanced by an equivalent amount of accounted removals of CO_2 from the atmosphere in the 2021 to 2030 period. In TN6, experts investigated the possible options for amending the LULUCF accounting rules to make the no-debit rule more stringent. The accounting is the process where the reported data are compared against benchmarks for compliance with the legal obligations.

The current accounting approach for the LULUCF sector is the result of years of negotiation under the UNFCCC and serves the basic purpose of regulating how a sector excluded from the economy-wide targets can contribute to target compliance under certain conditions. The system is complicated and represents several political compromises on integrity and completeness. Due to its purpose and history, the sector offers very few incentives for increasing sinks, and only at the level of parties or in the case of the EU at MS level. The current system with its shortcomings was furthermore designed for incremental, i.e. 5-10 year emission reduction targets. With the goal for the EU to be climate neutral by 2050, a different accounting practice for the LULUCF sector is possible, where target compliance, understood as annual balance between emissions and removals, is based on reported numbers for all land categories in the sector.

The authors of TN6 have come to the conclusion that the current system is not ready for such a drastic change. Therefore, the two options that were investigated were to improve the current

[7] IPCC Guidelines for National Greenhouse Gas Inventories.

system in view of increased ambition for 2030 and describe a radical change in accounting framework that could potentially work in 2050.

Experts have looked into possibilities to strengthen the current rules aiming for more removals to be accounted from the LULUCF Sector to be achieved even before 2030. The most thought-provoking solution presented in the TN was focused on the establishment of national targets. This however would require agreeing on a set of indicators to ensure that all MS can contribute equally in a fair manner.

Experts also looked into the potential of setting a national removal target as well as the quantitative potential for the net-storage of carbon in Harvested Wood Product (HWP) use. The last solutions that were examined were improvements on Forest Reference Levels (FRLs) to be implemented already before 2030. Based on previous experience, however, this would require extensive time and resources.

With the 2050 goal of climate neutrality, the EU should strive for target-based accounting for all LULUCF categories. This is the simplest accounting system and is similar to what is applied to other sectors. It is fully transparent and allows for the clear establishment of EU-wide targets for LULUCF and the evaluation of MS' (and eventually landowner) progress towards specified targets.

2.3.5. Policy Framework – Externalities

The three topic notes related to the broader policy framework are TN3 on externalities and missing market forces, TN7 on strengthening the linkages between the ESR and LULUCF.

The first of these topic notes (TN3) presents a set of large-scale drivers that are related to landowner's willingness and ability to respond to climate incentives. The current incentives within the EU for uptake of environmental measures are not strong enough, resulting in the problems highlighted in TN1 and TN2. Many barriers still in place prevent the transformation of the EU land-based sector into a market-based one such that landowners can be compensated for their removals.

The main issue presented in several of the problem drivers within the TN is the lack of clear, common price signals that promote climate action. In creating both pre-2030 policy proposals and looking forward towards the long-term 2050 policy visions, the drivers then culminate in several problems that need to be addressed. The topic note defined eight problem drivers related to the lack of internalisation of externalities and pricing of the climate mitigation benefits at the level of the individual landowner. The most important problem drivers were a) no revenue from climate mitigation (or other ecosystem services); b) no value assigned to carbon assets, and hence no incentive to protect and c) no clear price signals from consumers and other end users. Also, the authors pointed out the fact that forest rotations range from 40 to 150 years, which confers substantial inertia to forest management and its responsiveness to price signals.

From these drivers, the main problems identified include the fact that past technology adoptions have resulted in significant GHG emission reductions but remain costly and prohibitive to farmers in the long-term and prior to adoption. High debt levels, absence of carbon revenue streams, increasing costs of climate risks and limitations in responsiveness to certain incentives make structural change difficult. Landowners are resistant as a consequence of their business constraints, not their values. The ramifications needs to be understood and addressed by future EU land use policies for the 2050 to succeed.

These problems presented can be further addressed through a combination of short- and long-term policy action, alongside research and development. There are five main solutions to both structural barriers (two proposed solutions) and to the risk-oriented problems (three proposed solutions):

1. Research into carbon assets in agriculture and forestry
2. CAP support and result based incentives

3. More and better MRB and data on soil carbon
4. Removing barriers for Carbon Farming
5. Test Carbon Removal Certificates early

2.3.6. Policy Framework – Governance of flexibilities

In TN7, experts investigated the linkages between LULUCF Regulation and the ESR. The authors focused on the overall governance of the LULUCF Flexibilities.

The flexibility in this context is understood as the transfer of accountable mitigation outcomes (removals) or allowances across MS and between sectors with different GHG targets, which can reduce compliance costs. From this understanding of flexibility also follows that for actors under the same target, flexibility is assumed to be full and unrestricted unless specifically restricted. Flexibility can be classified on a scale from full-unrestricted liquidity on the one end to compartmentalized and ring-fenced sectors on the other. The MS-based system creates the obligation for a MS level target with no transfer allowed. Between the two extremes, there is a wide range of possible restricted flexibility options, and the TN considers which types of flexibility will be appropriate in a 2030 LULUCF governance system.

In the topic note, experts identified four main problems of the current mechanisms, which are:

1. Variability of sinks and sources makes certain types of flexibility unattractive. In other words, currently, the LULUCF sector is only a potential supplier of mitigation gains but is not fully utilized due to fluctuation and lack of certainty of data.
2. Uncertainty around accounting rules for compliance overrules incentives for use of flexibility as it is a serious barrier for planning.
3. Absence of demand and use of mitigation outcomes limits potential of intra-sector flexibility. The given limits and conditions to use the removals undermines the inter-sector and MS flexibility.
4. Land use mitigation outcomes have low credibility and trust. This option is often considered as a perverse incentive.

From these problems, the authors analysed the potential solutions and ways to govern the flexibilities among the climate-change-policy pillars. Sixteen different options were presented that attempt to address the overarching problems. These solutions include among others: offsetting sector-specific emissions from LULUCF within MS; creating an Agriculture, Forestry and other Land-use (AFOLU) flexibility; both seller and buyer side solutions regarding compliance conditionality and emissions trajectory; creation of a project-based incentive mechanism and compliance and crediting for livestock farming. These solutions and problems presented are highly technical but increased flexibility tied to conditions on quality would create an incentive to invest in and improve quality and transparency of reporting.

2.3.7. Vision

TN4 could be treated as the most inspirational as it contains a collection of visionary views on the future of climate change policy and LUUCF sector. It is based on the current set of information available for the future of LULUCF. The key importance lies in the capability for the AFOLU sector to enhance its capacity to remove carbon from the atmosphere. The climate policy arena will in the coming years shift its attention to (i) boosting biomass production and negative emissions and (ii) providing a sustainable system delivering carbon removals where needed.

The TN attempted to provide a sweeping look towards the future of climate policy and was structured by trends and drivers, climate governance and policy design and then the road towards 2050 taking into account the enablers and the barriers in place. One of the potential

scenarios from the topic note was the possibility for a split sector such that AFOLU could be separated from EU ETS and ESR. The TN also explores the transfer of responsibility in target setting as well as the elements that would be required under specific targets. In general, TN4 aims to show a future where financial incentives for carbon sequestration would be significant such that the some of the current market-based problems outlined in TN3 could be eliminated. The need for improving technology as well as data is highlighted here, but there is significant promise with regard to the LULUCF sector as long as the regulatory framework is strong enough.

2.4. Conclusion

The topic notes outlined above cover the entire breadth of the LULUCF sector including its strengths and challenges. The assessment of which the topic notes are part of, initiated by the Commission, aims to provide a clear overview in order for the LULUCF Regulation to reach its full potential and pave the way towards the 2050 target of climate neutrality. These topic notes present the most recent updates as well as a high-level of knowledge on the current LULUCF policy construction as well as the peculiarities of the LULUCF sector. These options were researched and thoroughly discussed through close collaboration between experts as well as with the Commission in order to come up with tangible actions.

First and foremost, a declining sink for both forests and soils in the EU needs to be addressed as quickly as possible to prevent exacerbation of the problem, but the topic notes, for this reason, provide both short and long-term policy options for the EU and the MS. The first two topic notes simply present the state of the sector and set the scene for the other six and the conclusions they present.

As is clear from the data on a decreasing sink presented in TN1 and TN2, current LULUCF MRV might need to be adjusted. In the case of soil carbon, for example (TN2), proper monitoring can lead to a realistic view of the land sectors. New emissions and removals in the order of 70 Mt CO_2/year in croplands and grasslands/forests, respectively, could appear. The solutions outlined in TN5 and TN6 from improving reporting and then further, accounting, are the first step towards a robust and effective LULUCF sector.

Topic notes 3 and 7 present highly technical policy-related problem drivers, problems, goals and solutions. Across these, a common theme is the need for robust incentives towards landowners such that their capacity for climate action is improved. For TN3, the structural changes presented involve significant future research and development in order to remove the current barriers. As there are not many substantial price signals already in place for the carbon market, there is room for improvement in this regard. For TN7, increasing flexibilities within the ESR might have positive potential for LULUCF, yet there are still several key barriers identified that will have an impact on future flexibility mechanisms. These barriers, though, correspond to multiple solutions presented by the experts that may improve the future of flexibilities offered to MS.

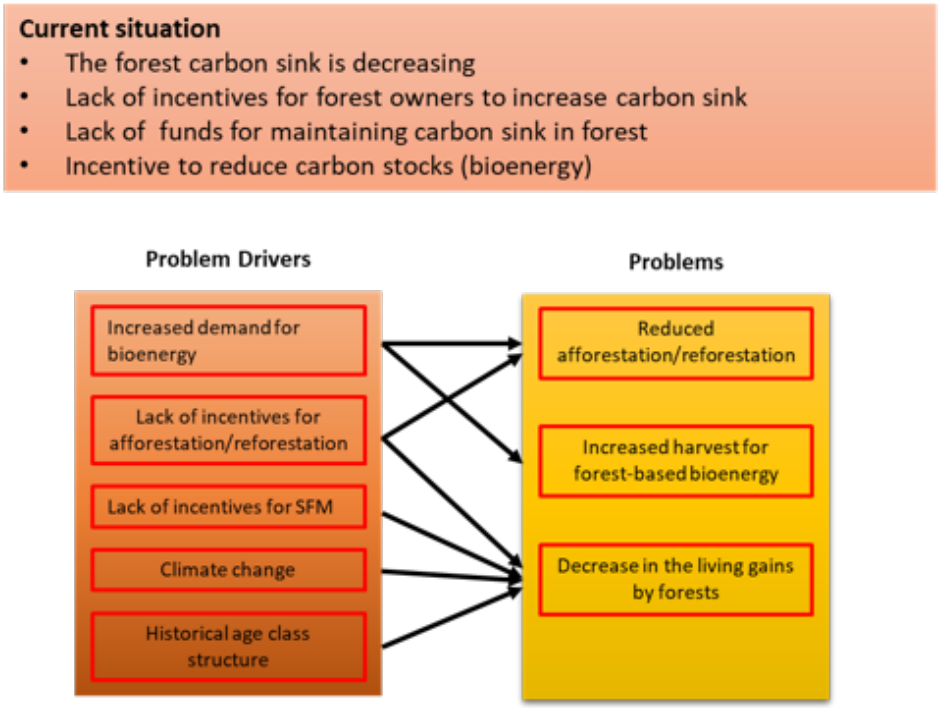
TN4 gives a forward-looking view within the wider EU climate policy framework and how the AFOLU sector could be factored in. The Commission foresees that the new AFOLU sector could "become rapidly climate-neutral by around 2035 in a cost-effective manner, and subsequently generate more removals than greenhouse gas emissions."[8] In order to achieve this, though, the authors of the TN stress the importance of a functional monitoring and certification process, which also will support the potential for a carbon removal certification system where landowners can be compensated for their removals. This topic note was speculative and presented multiple scenarios that could occur towards 2050.

[8] COM(2020) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0562

The main conclusion from this task and the topic notes presented is that by the end of 2050, the overall logistics of the policy-approach to the LULUCF sector could substantially change. Through strengthening the data in the sector as well as the incentives for climate action among landowners, the sector can reach its full potential. The LULUCF potential as a key sink within the European Green Deal's target of climate neutrality by 2050 can be realized, with the array of short-term and long-term options delivered within the seven topic notes.

3. Topic Note #1: The Decline of the Forest Carbon Sink and its Drivers

Schematic diagram of the topic note 1 - The decline in the forest carbon sink, its drivers and possible management practices to reverse the trend



Glossary

Term	Definition
Afforestation	Planting of new forests on lands that historically have not contained forests. In the UNFCCC national inventory, this is category 4.A.2. UNFCCC (2021)
Carbon sink	Any process, activity or mechanism, which removes carbons from the atmosphere. Forests and other vegetation are considered sinks because they remove carbon dioxide through photosynthesis. UNFCCC (2021)
Carbon stock	The absolute quantity of carbon held within a pool at a specified time. The units of measurement are mass. (Karsenty et al., 2003)
Deforestation	Conversion of forest to non-forest. In the UNFCCC national inventories, this appears as an entry in each land category (e.g. forest land to cropland) UNFCCC (2021)
fast-out, slow-in paradigm	The concept that a forest disturbance generally creates an emission, or loss of carbon stocks, in the year of the disturbance and that the emission is recovered over many years through net primary productivity (NEP)
forest land remaining forest land (FL-FL)	In the UNFCCC national inventories, this is category 4.A.1. It is the net emissions from forestland. It is includes living losses minus living gains plus net changes in carbon stocks in dead organic matter and soils
Harvest residues	The unused portion of forest removals that remains in the forest after harvest
Harvested wood products (HWP)	The products that result from forest harvesting. In the UNFCCC national inventories, distinctions are made between paper, particleboard and solid wood products due to their different lifetimes. Biomass used for energy purposes is not a harvest wood

	product
HWP gains	The increase in the HWP pool due to new HWP. They are equivalent to removals from forests (see living losses) for HWP.
HWP losses	The decrease in the HWP pool due to the decay of existing HWP
Living gains, net ecosystem productivity (NEP)	the gross uptake of biomass by the forest minus respiration (FAO, 2012)
Living losses	The losses of living forest biomass dues to mortality, harvest. Harvest includes losses for bioenergy and harvest wood products. The latter is recorded in the UNFCCC national inventories as HWP gains.
LULUCF sector	A greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities. UNFCCC (2021)
National forest action plans (NFAP)	
Necromass, dead organic matter	Forest biomass that is in the process of decomposition. It includes dead wood, litter and soil organic carbon
Net primary productivity (NPP)	the gross uptake of biomass by the forest minus losses due to mortality. (FAO, 2012)
Removals	Biomass removed from the forest for harvested wood products and bioenergy
Roundwood	Wood in its natural state as felled, with or without bark. It may be round, split, roughly squared or in other forms.
Steady-state, sink saturation	Biological sinks will eventually level-off and subsequently declined to zero (hereafter referred as “sink saturation”) whereby no further C will be removed from the atmosphere. (Canadell et al., 2007)

Abstract

The note focuses on the current situation of the forest carbon sink in the EU, the causes of the recent sink decrease. The regrowth period from 1960-2005 started to reverse in 2005 due to a combination of problems. Since about 2013, the annual sink on forest land remaining forest land (FL-FL) has been decreasing at roughly 12 000 kt CO2 / year. In general, all regions show this trend to varying amounts. The majority of the change in living losses since 2013 is due to increasing removals for bioenergy. Emissions from afforestation and deforestation play less of a role in the total LULUCF sink than FL-FL. Afforestation has, however, also decreased since 2010.

Both this topic note and referenced scenario studies suggest that only comprehensive regulatory changes can reverse these trends. If nothing happens, or if less than substantial improvements happen, then the situation will only worsen the next 30 years.

3.1. Introduction

This topic note explores the potential for making the design and implementation of LULUCF policies more effective by increasing the CO_2-absorption by forests – also called forest carbon sinks. The note focuses on the current situation of forest carbon sink in the EU and the causes of the recent sink decrease. This exploration is a part of the Commission's investigation into how climate, energy, transport and other sector-specific policies could interact to achieve an increased GHG reduction target.

The analysis is carried out and presented in accordance with the Better Regulation Guidelines conditioning the need to (newly) regulate on necessity and proportionality and focusing on clear and specific results suitable as input to a possible future impact assessment to support a possible revision of the LULUCF implementation. In Chapter 3, we discuss the trend of the declining forest carbon sink (problem). In Chapter 4, we identify the drivers for this adverse trend. In Chapter 5, future opportunity scenarios are presented.

3.2. Current situation

The importance of limiting deforestation, engaging in reforestation and afforestation, and of enabling sustainable forest management for long-term climate action is widely understood. However, it is less known that the overall forest carbon sink across the EU is shrinking and that efforts to enhance forest carbon sinks are met with obstacles. This chapter gives an overview of the most significant trends.

Historically, the EU's forest carbon sink had grown alongside net ecosystem productivity (NEP) and net primary productivity (NPP) (Bellassen et al. 2011) throughout the second half of the 20th century (see Figure 9 below). This long growth period had followed a period where the post-war reconstruction took a large toll on the forest reserves (Nabuurs et al. 2013).

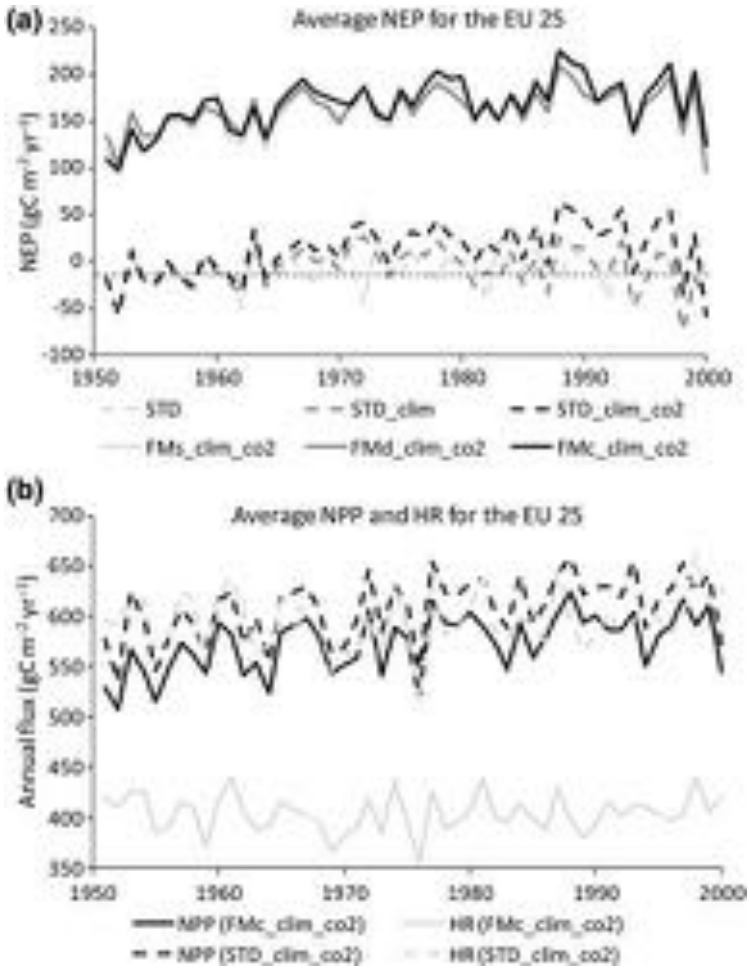


Figure 9: Simulated reconstruction of net ecosystem productivity (NEP), net primary productivity (NPP) and heterotrophic respiration (HP) in the EU 25. Six scenarios are presented for NEP simulation (a) and two only for NPP and HR (b). Source: Bellassen et al. 2011.

The regrowth period from 1960-2005 started to reverse in 2005 due to a combination of problems and drivers. These problems and drivers will be further described in this chapter 3.

3.3. The greenhouse gas inventory

Since 1990, the changes in the LULUCF sector, including the carbon sink, have been captured in the EUl greenhouse gas inventory. For the entire LULUCF sector (Figure 10), it provided a roughly constant annual sink of 360 000 kt CO_2 from 2000 to 2013. However, since 2013 the sink has diminished in strength to 304 000 kt CO_2 by 2018.

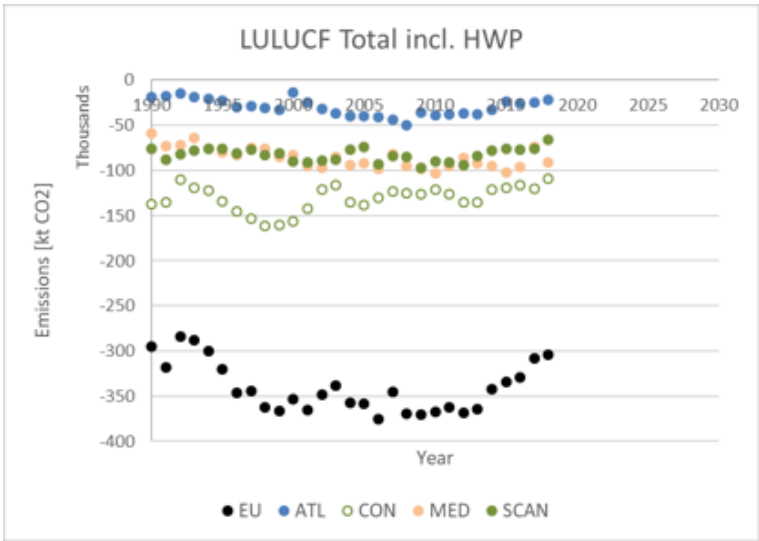


Figure 10: Annual greenhouse gas emissions (1990 – 2018) from LULUCF. Source: Self-calculation based on MS GHGI-data extracted from the 2020 reporting at UNFCCC.

ATL - Atlantic: Belgium, Denmark, France, Ireland, Netherlands
CON – Continental: Austria, Bulgaria, Czech Republic, Germany, Hungary, Poland, Romania, Slovakia, Slovenia
MED - Mediterranean: Croatia, Greece, Italy, Portugal, Spain
SCAN - Scandinavia: Estonia, Finland, Latvia, Lithuania, Sweden

1. The emissions come from five broad categories:
2. Forest land remaining forest land (FL-FL),
3. Afforestation and deforestation (ARD),
4. Wetland draining and rewetting (WL),
5. Cropland remaining cropland (CL-CL), and
6. Grassland remaining grassland (GL-GL).

In this section, a brief description of the trends in the first two categories will be made. The last three categories are covered in topic note 2.

3.3.1.1. Forest land remaining forest land

Forestland remaining forestland (FL-FL) Figure 11 contributes the most of all land categories to the LULUCF sink. It provides the EU with an annual sink of between 350 000 and 400 000 kt CO_2. However, since about 2013, the FL-FL annual sink has been decreasing at roughly 12 000 kt CO_2 / year. In general, all regions show this trend to varying amounts.

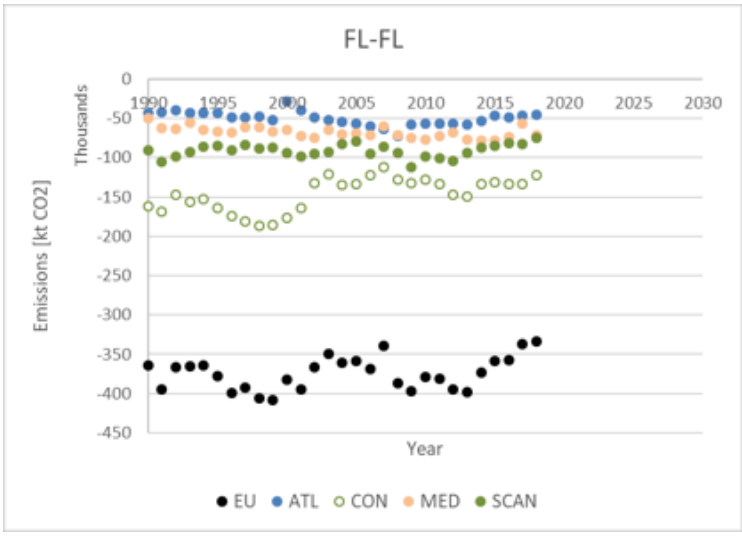


Figure 11: Annual greenhouse gas emissions (1990 – 2018) from forestland remaining forestland. EU: Total in the EU. ATL: Atlantic. CON: Continental. MED: Mediterranean. SCAN: Scandinavian. Source: Self-calculation based on MS GHGI-data extracted from the 2020 reporting at UNFCCC.

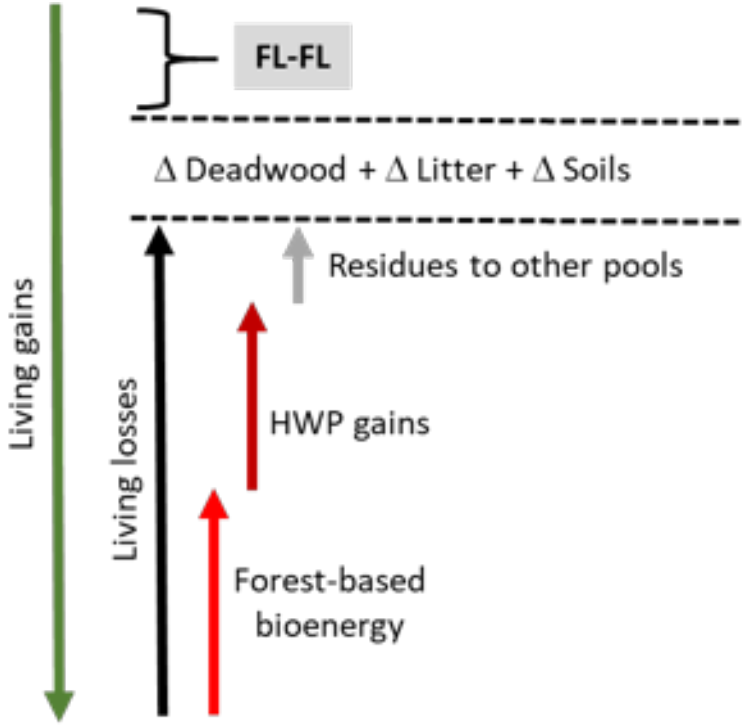


Figure 12: The relationship of emissions for FL-FL to gross annual increment and emissions from bioenergy and HWP gains.

Using the terminology of the national inventory one can approximate that the carbon stock changes in FL-FL equal the living gains of the forest minus the losses due to the fraction of biomass removed for bioenergy from solid biofuels , HWP and harvest residues entering other forest pools (i.e. deadwood, litter) if one assumes that

1. mortality and decay of necromass (i.e. deadwood, litter) are roughly constant, and
2. Wastes from processing of roundwood are used for bioenergy.

Hence one may be able to separate the contributions of the change in FL-FL to changes in the living gains (i.e. sequestration), and losses due to harvesting activities if MS report living gains and living losses. The EU does report both living gains and losses, but unfortunately many MS report on net living gains (i.e. living gains minus living losses) and the actual living losses must be modelled from additional information on amounts of forest bioenergy, and HWP gains.

The results for the EU are shown in Figure 13.

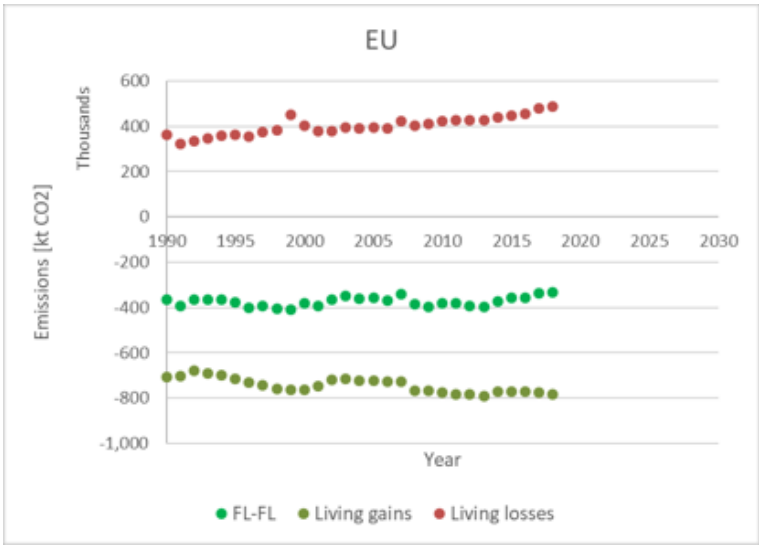


Figure 13: Annual greenhouse gas emissions (1990 – 2018) from living gains and losses for the EU. Source: EU GHGI-data extracted from the 2020 report at UNFCCC.

This graph shows that during the period 1990 – 2018:

1. Living losses (i.e. removals) have increased relatively constantly from 1990 to 2013 at 3 000 kt CO_2 / year. However, since 2013, the rate of increasing removals has been about 12 000 kt CO_2 / year.
2. Living gains on the other hand have become more negative (i.e. more sequestration). From 1990 to 2010, the trend in living gains was about -3 000 kt CO_2 / year. However, since 2010, the amount of living gains has remained roughly stable.

The living losses can be broken into its components:

1. Removals for HWP – which are equivalent to HWP gains
2. Removals for bioenergy and
3. Harvest residuals recorded as losses of deadwood and litter

Breaking the living losses into its components (Figure 14) one sees that the majority of the change in living losses since 2013 is due to increasing removals for bioenergy.

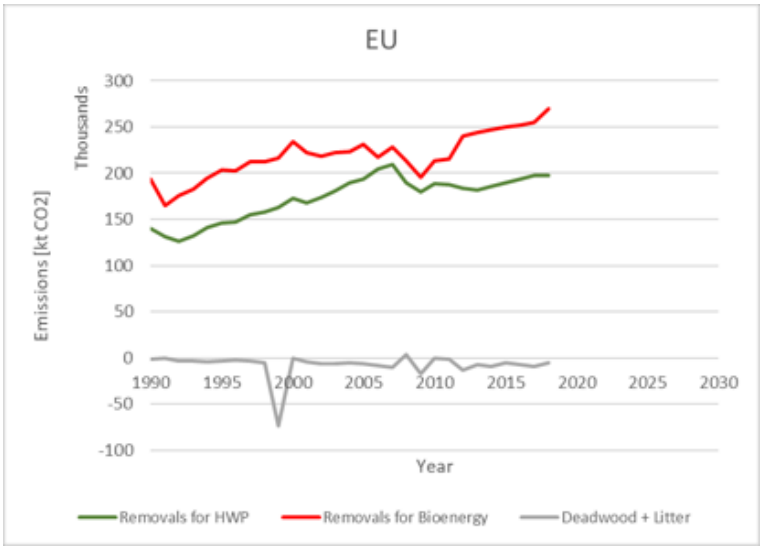


Figure 14: Components of living losses in the EU from 1990 – 2018. Source: Self-calculation based on EU GHGI-data extracted from the 2020 reporting at UNFCCC.

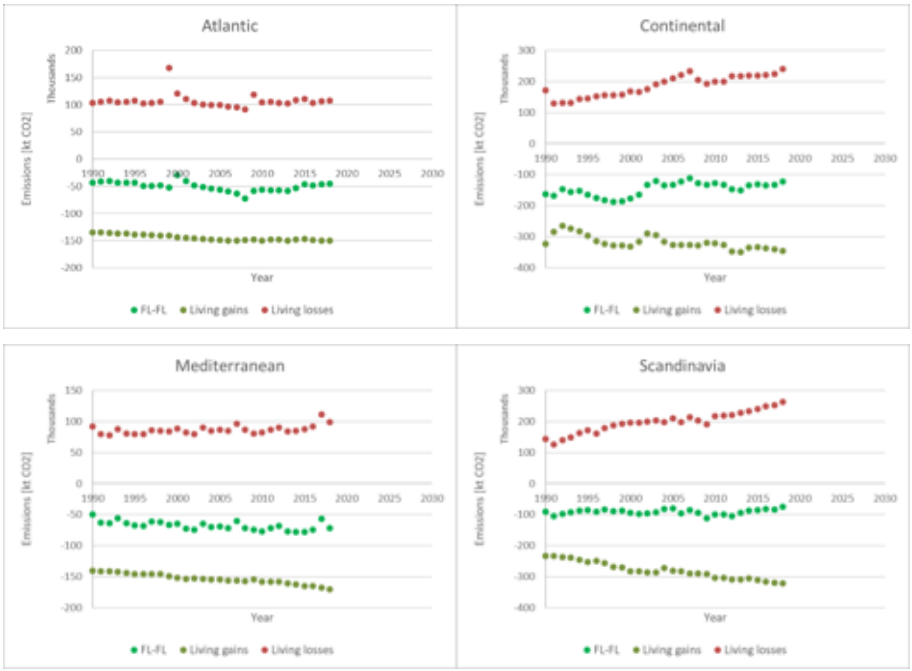


Figure 15: Annual greenhouse gas emissions (1990 – 2018) from living gains and losses by region. It is important to note that a) the model to produce these diagrams is not very robust and b) the sum of the regional results may not equal the EU values. Source: Self-calculation based on MS GHGI-data extracted from the 2020 report at UNFCCC.

A regional breakdown of FL-FL, living gains and losses is provided in Figure 15. This diagram shows that in the Mediterranean and Scandinavian lands the trend in living gains has remained constant, and that the weakening of the forest sink (i.e. living gains) is occurring mostly in Atlantic and Continental regions. Trend in living losses show particularly an increase in the continental region from 2000 – 2005 but this region has been relatively stable since then. The region showing the largest change in trends since 2013 is in Scandinavia.

Figure 16: Components of living losses in the EU from 1990 – 2018 by region. It is important to note that a) the model to produce these diagrams is not very robust and b) the sum of the regional results may not equal the EU values. Source: Self-calculation based on MS GHGI-data extracted from the 2020 report at UNFCCC.

Figure 16 shows that the changes in bioenergy production are mostly responsible for the changes in trends in living losses. In the continental region, there was an increase in removals for HWP from 1990 to 2005. After the economic crisis in (2008 – 2010), there has been little change in HWP production. The trend in removals for HWP in Scandinavia has been relatively constant of the entire 1990 – 2018 period. The trends in living losses due to removals bioenergy show a more complicated pattern:

4. In the Continental region, there was a strong increasing trend from 1990 to 2005, but since 2013 the removals for bioenergy have remained roughly constant (with the exception of 2018)
5. In the Scandinavian region, initially a strong increasing trend (1990 – 2005) was followed by a period of stagnation. However, since 2010, there has been a second strong increasing trend in removals for bioenergy.

The economic crisis in 2008-2010 caused a decrease in living losses for bioenergy in both these regions, presumably due to overall less energy demand.

3.3.1.2. Afforestation and deforestation

As seen in Figure 17, emissions from afforestation and deforestation play less of a role in the total LULUCF sink than FL-FL. Annual emissions from deforestation have remained relatively constant fluctuating between 25 000 and 40 000 kt CO_2/year. Annual sequestration (i.e. negative emissions) from afforestation, on the other hand, increased from 1990 – 2010, due to more land converted from non-forest to forestland. However, this trend has reversed since 2010, and sequestration from afforestation have shown a sharp decrease in recent years.

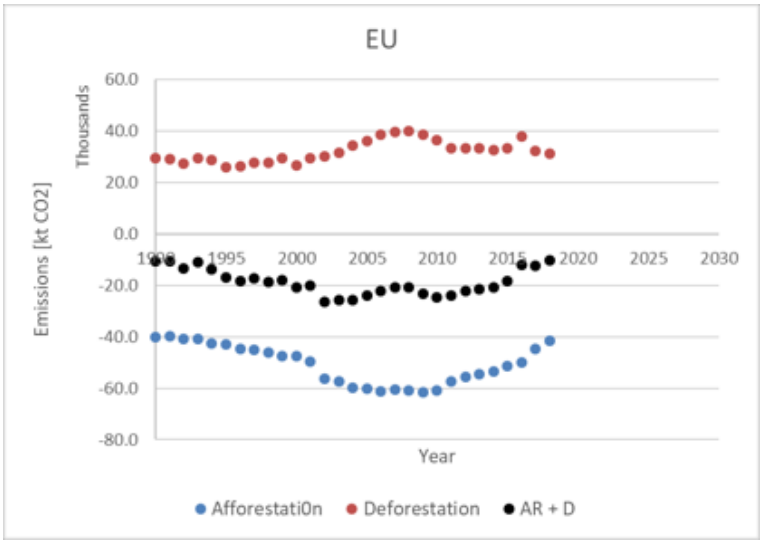
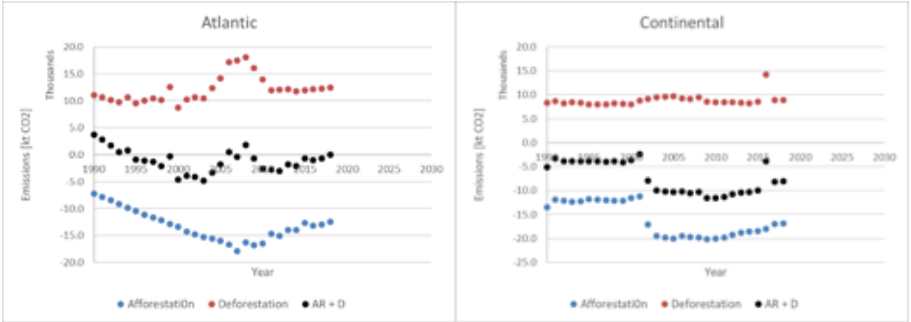


Figure 17: Annual greenhouse gas emissions (1990 – 2018) from lands convert to forest land (afforestation) and forest land converted to cropland, grassland, settlements and other land (deforestation). Source: Self-calculation based on MS GHGI-data extracted from the 2020 reporting at UNFCCC.



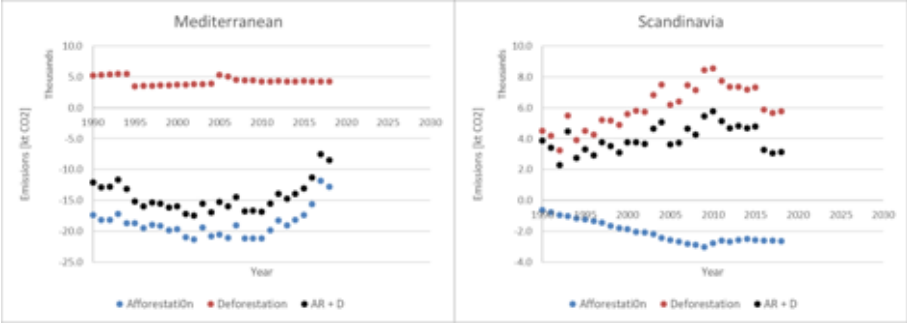


Figure 18: Annual greenhouse gas emissions (1990 – 2018) from lands convert to forest land (afforestation) and forest land converted to cropland, grassland, settlements and other land (deforestation) by region. Source: Self-calculation based on MS GHGI-data extracted from the 2020 reporting at UNFCCC.

On a regional basis, one can see that all regions are showing a strong change in the trend of afforestation starting in 2010. This change is most apparent in the Atlantic and Mediterranean regions. These are the regions with the largest agricultural areas.

3.3.2. Key drivers

Historically, the EU has had a relatively large forest carbon sink. During the reconstruction after the two World Wars, the demand for wood increased significantly, leading to a deforestation which released a significant part of the carbon stored the below ground in deforested areas. Not much of the carbon in these deforested areas has yet been restored. More recently, the search for alternatives to fossil fuels has led to the use of the renewable biomass as a fuel. This is another key driver to slow down the replenishment of the forest sinks in the EU following the 50 years' depletion period. The slowing growth in the EU's forest carbon sink is mainly due to reduced afforestation activities, a decrease in living gains across the forest stock, and – most importantly – an uptake in removal activities for forest-based bioenergy production.

Table 8: A summary of the changes in LULUCF emissions from 2013 to 2018 in the EU. A few notes:

1: In this table, an emission is a positive value and a sequestration (or negative emissions) is a negative value.

2: The change in the total value from 2013 to 2018 is positive (i.e. an emission), and since the total value is negative, this is a negative change in the sink (-16%).

3: CL: cropland, GL: grassland, S: settlements, OL: other lands. These categories are shown excluding deforestation and draining because these items are included in deforestation and wetland respectively.

Source: Self-calculation based on MS GHGI-data extracted from the 2020 reporting at UNFCCC.

	2013	2018	2018-2013
	[kt CO2]	[kt CO2]	[kt CO2]
Afforestation/Reforestation	-54 643	-41 366	13 277
Deforestation	33 202	31 162	-2 040
HWP	-31 159	-44 621	-13 462
FL-FL	-398 158	-333 623	64 535
Living gains	-789 928	-782 630	7 298
Living losses	428 326	488 109	59 783
Removals for HWP	*181 697*	*197 740*	*16 043*
Removals for forest-based bioenergy	*253 668*	*296 007*	*42 339*
Deadwood + Litter	*-7 039*	*-5 637*	*1 402*
Other pools	-36 556	-39 102	-2 546
WL	16 527	15 849	-677
CL (excl. deforestation and draining)	54 857	48 705	-6 152

GL (excl. deforestation and draining)	-11 531	-10 767	764
S (excl. deforestation and draining)	27 816	30 913	3 098
OL (excl. deforestation and draining)	-836	-710	126
LULUCF Total with HWP	**-363 926**	**-304 457**	**59 470**
Forest-based bioenergy (Imported)	*248 384*	*222 857*	
Forest-based bioenergy (Total)	*502 052*	*518 864*	

As shown in Table 8the LULUCF sink including HWP decreased by 59,470 kt CO_2 from -363,926 to -304,457 kt CO_2. This means that the sink, a negative value, decreased by 16%. Three drivers contributed the most to the decrease in the sink. These are:

1. Reduced afforestation: 13,277 kt CO_2 less sequestration
2. Increased removals for forest-based bioenergy: 42,339 kt CO_2 more emissions
3. Decrease in the living gains for forests: 7,298 kt CO_2 less sequestration

Is important to note that even though emissions form living losses have increased from 2013 to 2018, the two major components: removals for HWP and removals for bioenergy partially result in increased sequestration or reduced emissions elsewhere in the inventory. Specifically, increased removals for HWP (16,043 ktCO2) are directly converted to HWP gains and results in net sequestration (HWP gains minus HWP losses) in HWP (-13,462 ktCO2). Similarly, increased removals for bioenergy may partially be compensated by decreased emissions from the use of fossil fuels[9], which are not reported in this table.

These three listed drivers are explained below respectively.

3.3.2.1. Reduced afforestation (13,277 kt CO_2 less sequestration)

The decrease in afforestation is most prevalent in MS with larger amounts of agricultural land. The Atlantic and Mediterranean regions show a large reduction in the annual emissions (removals) from afforestation since around 2010 (Table 8). This could indicate an increase in financial incentives to other land uses than afforestation. Such land uses could stem from a growing bioenergy demand or increased food demand. It could also be because of a drop of financial incentives for afforestation. Valin et al. (2015) forecast the possibility of reduced afforestation. They considered that between 2010 and 2030 up to 145 Mt CO_2e / year, depending on scenario, in what they called “foregone sequestration” could be expected in the EU. By 2018, there was about 99 Mt CO_2 in foregone sequestration due to the reduction in afforestation.

3.3.2.2. Increased harvest for forest-based bioenergy (42,339 kt CO_2 more emissions)

The major contribution from the change in the sink from 2013 to 2018 is due to the increase in living losses for bioenergy. As we have discussed above this is currently mostly coming from the Scandinavian region.

It should be noted that, while harvest for bioenergy actually causes emissions as a decrease in forest stocks, one must remember that these are **not** the full impact on the environment

[9] They are only partially compensated because: 1) the C per energy ratio is higher for wood than for fossil fuels, 2) the energy efficiency of fossil energy systems tends to be higher than for wood-based systems, 3) the wood-based energy may replace natural gas systems (low C / energy, and high efficiency), and 4) the wood-based energy may only expand energy consumption.

because they (may) have caused a decrease in emissions in the energy sector. These emissions are not shown here.

3.3.2.3. Decrease in the living gains by forests (7,298 kt CO2 less sequestration)

As discussed above, the gross annual increment of the forests has increased, and as a result the living gains have become more negative (i.e. forests are absorbing more) since 1980 (Nabuurs et al., 2013) and it stabilized around 1990 (Bellassen et al., 2011). However, as evidenced in the national inventories, since around 2013, the rate of absorption has become less. The change in gross annual increment is a result of the aging EU forests.

As a result of these drivers, the EU is facing problems with an aging, climate sensitive, poorly managed, and un-replenishing forest. Below, this situation is explained.

3.3.3. Problems derived from the drivers

There is a need for forest renewal in the EU for numerous reasons. However, how forest renewal is achieved has an impact on the forest sink. Four main problems have been found to follow as a natural effect of the drivers explained earlier. They all contribute individually to the decreased carbon sink from the European forests. They are:

1. Increasing maturity/average age of forests
2. Sensitivity to droughts, fires, and storms due to climate change
3. Forest management practices
4. Decline in afforestation

Below, these four problems are examined:

3.3.3.1. Aging of forests

As forests age, their increment rates decrease and eventually the forests approach a steady state. Further, the EU forests have been characterized with skewed age structure, with large areas now approaching maturity (Nabuurs et al. 2013). This is apparent as a decline in forest increment. One method of stimulating an increase in forest increment is to harvest the older stands and thus move the forest into a younger, more productive age class. However, harvesting also causes a temporary decrease in carbon stocks and has implications for biodiversity. A holistic forest management strategy, across MS, needs to be developed that includes biodiversity considerations and scenarios for future demand of bioenergy, HWP and a strong LULUCF sink. With both afforestation and forest management practices being challenged, the aging of forests is a persistent problem and one that requires substantial and cross-cutting measures to solve.

3.3.3.2. Sensitivity to droughts, fires, and storms due to climate change

An aging forest is more susceptible to disturbances (fires and storms), and as the mature forests were planted shortly after the World War II, they were planted in a different climate. Modelling suggest that we should expect a 2 – 5 increase in mean annual temperature, a decrease in annual precipitation particular in S. Europe (European Environment Agency, 2017) and an increase extreme winds particularly in around the Baltic Sea (e.g. northern Germany, and Poland). These climatic changes will require a modifying the forest from the current species distribution to more suitable species to maintain or improve the forest sink.

3.3.3.3. Forest management practices

Forests stocks follow the “fast-out, slow-in" paradigm. Harvesting for bioenergy or harvested wood products causes a quick loss of forest carbon stocks (i.e. a fast out emission) followed by a slower forest carbon stock recovery as the forest regrows (i.e. a slow in sink). On the other hand, increasing thinnings may enhance forest growth and especially increase the future yield of larger stems available for longer lasting harvested wood products (e.g. boards and lumber). Numerous, less intrusive interventions allow for quicker recovery, but are more costly. Financial incentives beyond the value of the biomass are needed to help forest owners manage their land to promote the forest sink.

3.3.3.4. Decline in afforestation

To a certain extent, afforestation can help mitigate short term decreases in the managed forest sink due to harvest and cause a delayed increase in the forest sink as the newly planted forests move into their prime growth years (>20 years). Hence, the decline in afforestation that we are currently observing will lead to a decrease in the future forest sink with respect to what would have occurred.

With these drivers and problems, research studies, NECPs, and impact assessments have led to scenario modelling about the coming decades in the EU. Below, the most prominent models will be presented.

3.4. Future scenarios

Not many future scenarios have been made for the EU, but Böttcher (2008) made a relatively comprehensive modelling of the future biomass accounting on the MS level. The result is shown in Figure 19.

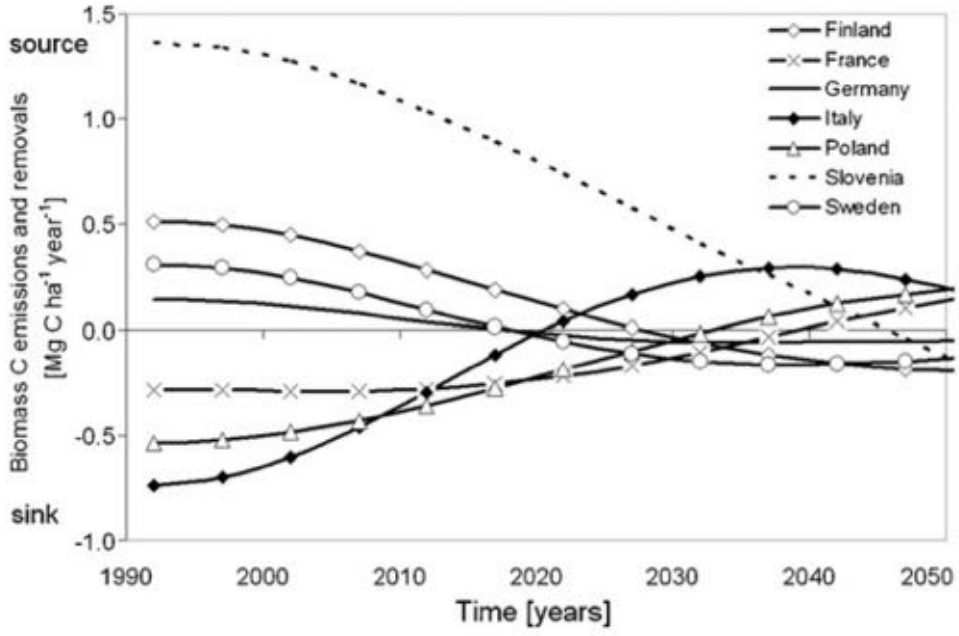


Figure 19: Development of forest biomass C sinks and sources under business-as-usual in selected countries as projected by the model over a 60-year simulation period under sustainable harvest conditions. Emissions have positive sign, removals negative. C stock changes are only due to age–class legacy under assumed constant management and harvest levels. Source: Böttcher et al. 2008.

The figure shows an almost even horizontal average where the included MSs even each other out throughout the years until 2050. Whereas Italy is projected to experience large emissions of carbon to the atmosphere followed by Poland and France, Slovenia offers a counterweight

to Italy, and Finland, Sweden and Germany counterweights to Poland and France. In short, the future scenarios show that the forest carbon sink in the EU will not increase above the current level if policy and practices remain on the current level.

In 2006, the future carbon balance of Austria has been modelled. Figure 20 shows the results of five scenarios, including a reference scenario, three increased logging scenarios, and a reduced logging scenario.

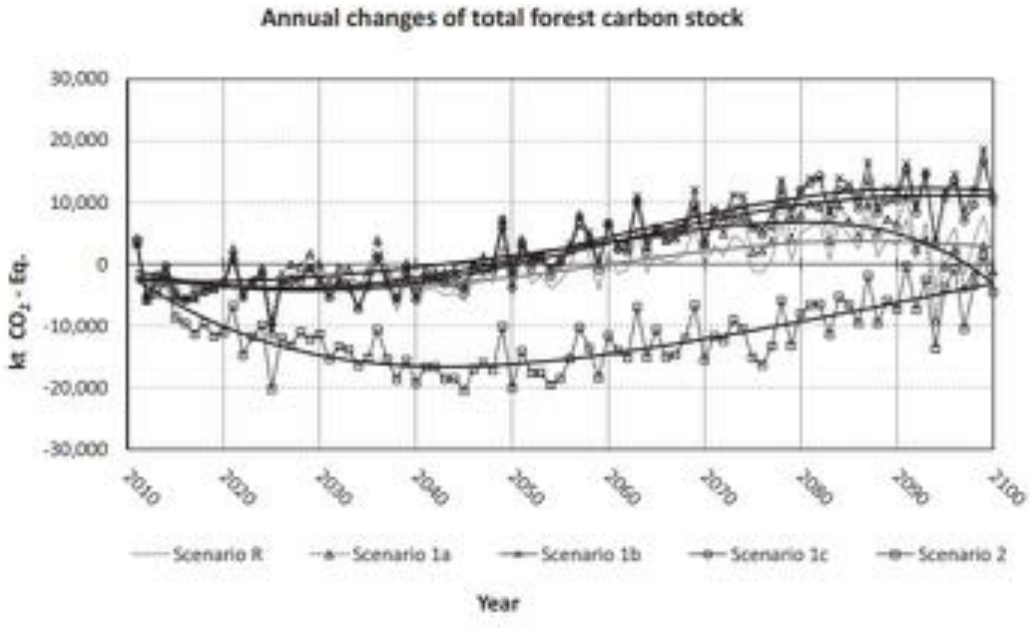


Figure 20: Annual changes of total forest carbon stock. Scenario R: Reference scenario, 1a: Increased logging due to biomass for energy policies, 1b: Increased logging due to policies fostering increased material use, 1c: 1b with optimistic import assumptions, 2: Reduced utilization of timber from managed forests (designation of areas of reduced or restricted utilization due to conservation measures). Source: Braun et al., 2016.

Here, only scenario 2 shows viable substantial forest carbon stock changes the coming 50 years. This scenario is described as follows:

"*Through policies toward increased conservation and growing carbon pools in forestry, a **system for reimbursements** for building up carbon stocks is created **which leads to a decrease in utilized areas of forests available for wood supply**. Additional restrictions concerning logging are implemented (e.g. Natura 2000, EU biodiversity strategy). Furthermore, there is an increase of natural forest reserves, biosphere parks and **subsidies for measures toward an increased carbon stock in forests**. There are reimbursements for losses induced through reduced utilization.*" (Braun et al., 2006, p. 274).

France has been modelled recently. This is shown in Figure 21.

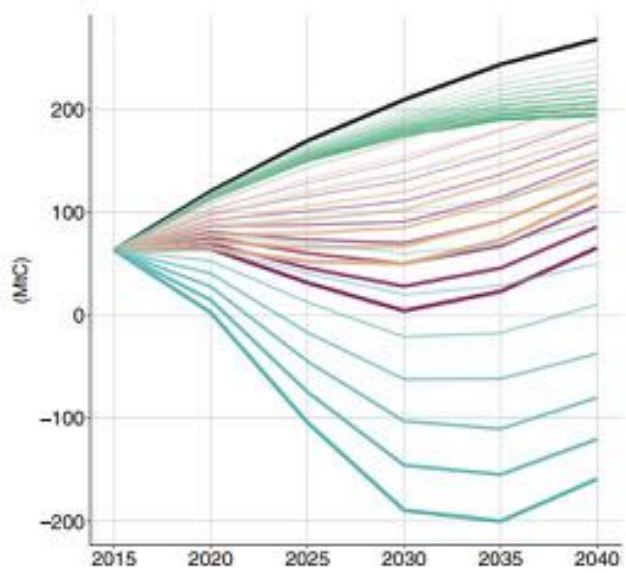


Figure 21: Three intensification scenarios and a business-as-usual scenario. These intensification scenarios targeted either overstocked, harvest-delayed or currently actively managed stands. Blue shows all three scenarios combined (D+Ov+M), brown shows intensification of actively managed sites (M), red shows intensification of harvest-delayed sites (D), green shows intensification of overstocked sites (Ov), and black shows business as usual management of all sites (BaU). Source: Valade, et. al, 2018.

While most of the illustrated scenarios above can seem unrealistic and perhaps overly optimistic, the business as usual scenario is modelled to be removing an increasingly large cumulated amount of carbon from Earth to the atmosphere. This indicates that something drastic will have to be done to prevent this development.

Figure 22 and Figure 23 show the annual greenhouse gas emissions (1990 – 2018) from living gains and losses and the values projected for the forest reference levels, as documented in the countries' National Forestry Accounting Plans (NFAP) for the EU and the four regions.

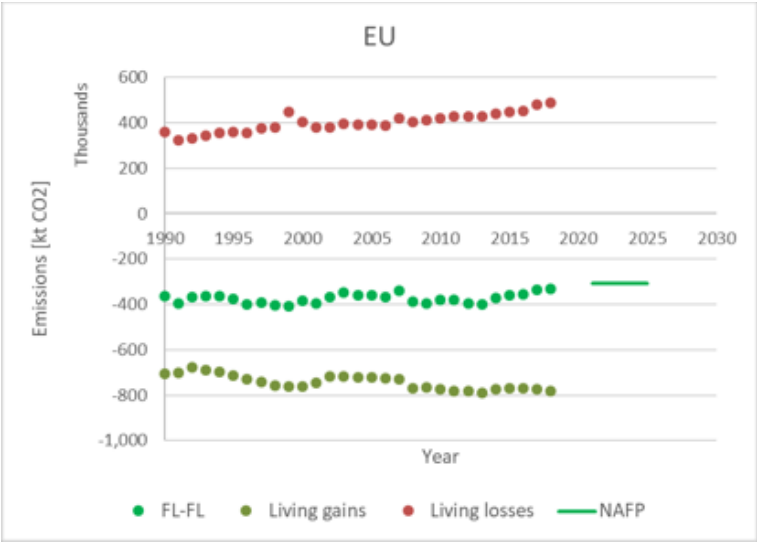


Figure 22: Annual greenhouse gas emissions (1990 – 2018) from living gains and losses for the EU with the NFAP. Source: EU GHGI-data extracted from the 2020 report at UNFCCC. The NFAP value has been provided by the JRC. It has been adjusted to be consistent with the FL-FL value from the EU GHGI

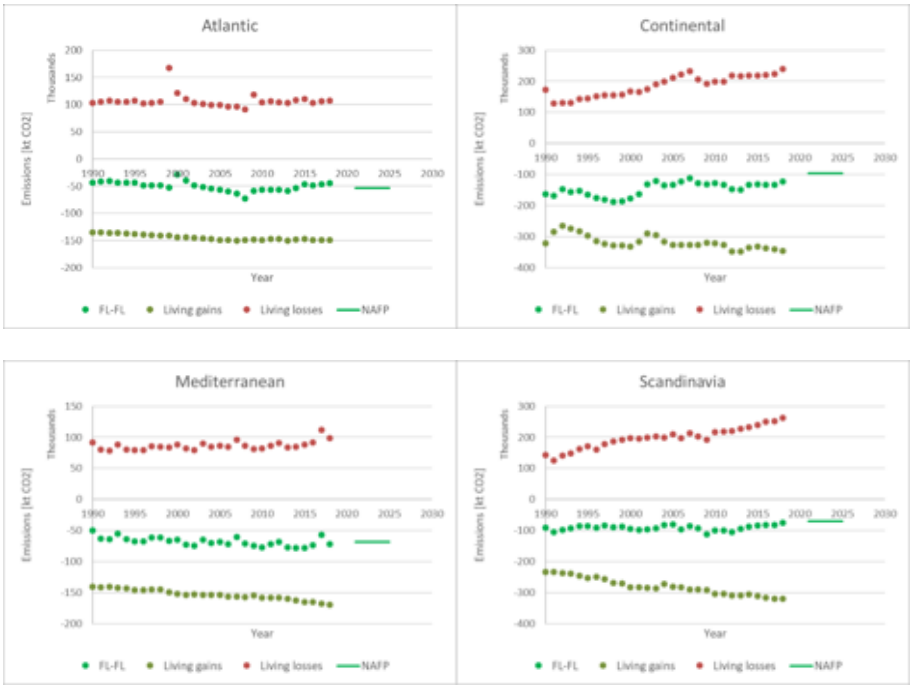


Figure 23: Annual greenhouse gas emissions (1990 – 2018) from living gains and losses by region. It is important to note that a) the model to produce these diagrams is not very robust and b) the sum of the regional results may not equal the EU values. Source: Self-calculation based on MS GHGI-data extracted from the 2020 report at UNFCCC. The NFAP values have been provided JRC. They have been adjusted to be consistent with the FL-FL value from the EU GHGI

The NFAPs forecast that the FL-FL will continue to become more positive by 2021-2025. The Atlantic and Mediterranean regions are forecast to have an FL-FL that will be constant, but both the Continental and Scandinavian regions have predicted a continued trend towards more positive FL-FL emissions.

In the Impact Assessment for *Stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our people* the Commission Staff have assessed future scenarios for size of the LULUCF sink required to meet a goal of EU climate neutrality in 2050, and the impacts on the LULUCF sink from proposed policy options. One point is clear. Minimum compliance by MS with the LULUCF no-debit rules would result in a decrease in the LULUCF sink by 2030 compared to today's sink.

3.5. Conclusion and summary

The aging of the forests is a driver in the decrease in the forest carbon sink. This is due to a lack of reforestation, afforestation, and past forest management practices. Much of the root causes of these trends can be traced back to a lack of financial incentives for the landowners to prioritize such afforestation, reforestation and active forest management. .

A part of the sink reduction can be attributed to the increased amount and intensity of storms, fires, droughts, and CO_2-fertilization-induced growth pattern disturbances.

However, another important driver for the decreasing carbon sink in forest land is decrease in afforestation, forest degradation, and worsened forest management due to an increasing demand for bioenergy. While there is an urgent need for a rapid phasing out of any fossil fuel combustion, more sustainable alternatives to the short-term bioenergy will need to be developed in order to increase the forest carbon sink once again.

The projections are dire. So far not enough measures are targeting the reversal of this trend, and even scenarios with the additional measures planned by the EU MSs in National Energy

and Climate Plans are not enough to reverse this trend. The need for bioenergy can be expected to increase until enough renewable alternatives are offered broadly in the EU.

Moreover, as climate change worsens, more droughts, fires, storms, and floods can exacerbate the already sensitive forests and make them even more sensitive. In this way, we now have a window of opportunity to rejuvenate our forests before the negative feedback loop worsens the forest carbon sink.

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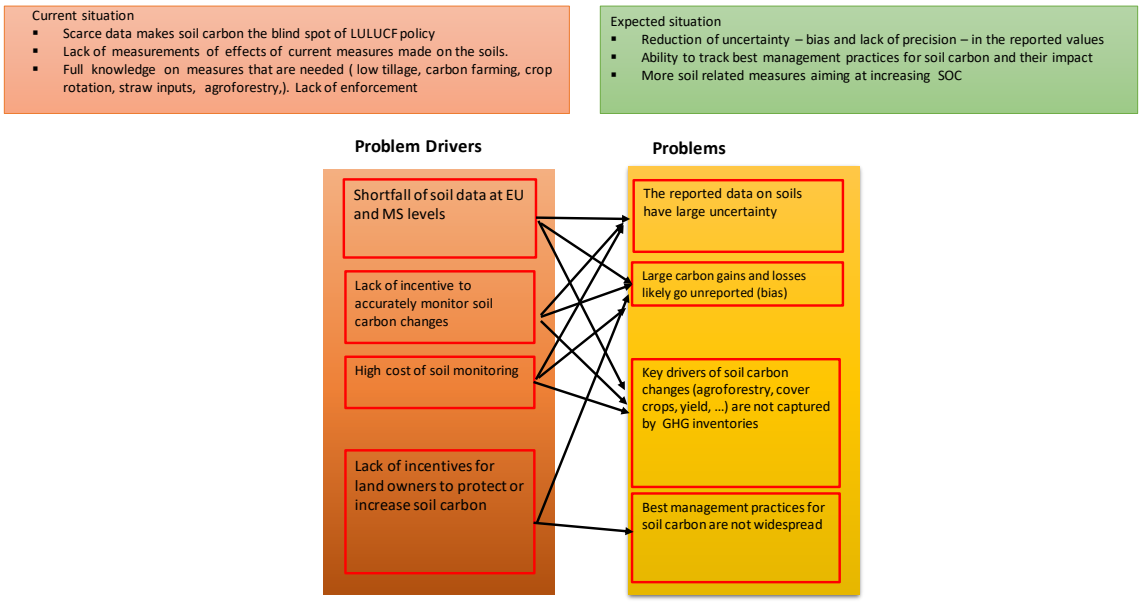
4. Topic Note #2: Soil Carbon: Current Trends and Challenges

Schematic diagram on Soil carbon: Current trends and how to improve them



Abstract

Soil carbon is expensive to monitor. In the absence of strong policy incentives to monitor and increase soil carbon storage, there is an important shortfall of soil carbon data, both at EU and MS level. As a result, soil carbon is the blind spot of LULUCF policy. Large carbon gains and losses go unreported. Unreported losses could be around 70 MtCO2/yr in croplands and unreported gains could be around 15 MtCO2/yr in grasslands and 45 MtCO2/yr in forests, but data shortage makes these estimates very uncertain. The share of EU forest area for which soil carbon is being accurately reported is at most 33%, and more likely close to 24%. The picture is even worse for grasslands and croplands. This is part of the backdrop for the currently very low levels of adoption of key carbon farming practices (peatland restoration, agroforestry, substituting maize with grass) which could remove an additional 200-300 MtCO2/yr if they became widespread. But even if strong policies managed to disseminate them, current GHG inventories would not capture their climate mitigation benefits in most member states.

4.1. Introduction

This topic note presents the current trends in soil carbon changes in Europe, how they are reported in national greenhouse gas inventories (GHGIs) and the potential of best management practices to protect and enhance soil carbon stocks in the EU.

4.2. Current situation

Most soil carbon stock changes in European soils are currently not being monitored, which is the most important blind spot of land-related climate policy. If soil carbon was properly monitored all over the EU, new emissions on the order of 70 MtCO2/yr could appear in croplands, and new removals on the same order of magnitude could appear in grasslands and forests. The drivers behind these large numbers are likely a combination of legacy from past land-use changes (eg. grassland/forest conversions into cropland) and environmental changes (eg. increased organic inputs to forest soils as a result of CO_2 fertilization and nitrogen deposition) (Solberg et al., 2009; Zaehle et al., 2010).

Drained organic soils are also a large source of emissions, reported at 100 MtCO2/yr in GHGIs. They are better monitored than mineral soils, although substantial improvements are also desirable which would likely increase the current estimate. Interestingly, these total emissions are comparable to the carbon stock changes likely occurring in mineral soils, but they are concentrated on 5 % of the land .

A few key management practices – agroforestry, cover crops, substitution of maize by grassland, wetland/peatland restoration and increased organic returns to soil - have the potential to enhance carbon removals by 200-300 MtCO2/yr (see section 4.4.5). Yet, with the possible exception of cover crops, these practices are not widely adopted by farmers and other land managers.

The expected situation following the implementation of the European Green Deal is one where best soil management practices are being widely implemented to protect and enhance soil carbon stocks and where the results of these practices is being accurately monitored and reported in GHG inventories

4.3. Problem drivers

This chapter covers problem drivers related to the monitoring of soil carbon including data production and gathering. While mentioned here, the connection between the weak incentives for soil monitoring of the current LULUCF policy setup and GHG reporting and accounting rules, are covered more exhaustively in the respective Topic Notes (TN5 and TN6) on Reporting and Accounting.

4.3.1. Soil data is scarce

Most MS do not regularly monitor their soils through a soil inventory. Belgium, one of the few MS which had been conducting a regular soil inventory since 1990, stopped doing so in 2006. At the EU level, the LUCAS soil survey has been implemented at regular intervals since 2009 but its quality, representativeness and resolution have been questioned. The LUCAS remeasurement campaign since 2018 should provide estimates at EU level. A recent working paper from JRC[10] is consistent with the general trends in European soils from the scientific

[10] https://esdac.jrc.ec.europa.eu/public_path/shared_folder/dataset/66/JRC120138_lucas_changes_09-15_-_final_1.pdf

literature but falls short of providing figures on stock changes, expressed in tC/ha/yr (only changes in concentration are estimated, expressed in gC/kg soil/yr).

4.3.2. High cost of extensive and repeated soil monitoring

To track and understand changes in soil carbon stocks in different soils, climate conditions and under different management regimes, one must have repeated field trials or campaigns with relevant spatial resolution, including soil sampling and lab testing, and soil and land use mapping on the ground and from alternative sources such as Remote Sensing and CAP administrative systems. Proper monitoring of soil carbon including regular soil measurements at a reasonable spatial resolution is however resource intensive. In France for example, it has recently been estimated to cost between 2 and 6.5 million euros per year (Voltz et al., 2018). A coarse upscaling proportional to land area puts this amount at 15-55 million euros per year for the EU.

4.3.3. Limited climate policy attention to soils until now

Until 2021, cropland and grassland management were voluntary activities under the second period of the Kyoto protocol, and only DK, PT and ES decided to include these activities for their KP target setting and compliance. For the remaining MS, the incentive to improve their reporting of soil carbon was ensured via reporting obligations under the LULUCF Decision (Decision 529/2013), but there was no associated target, as LULUCF was not part of the 2020 EU climate framework.

Current reporting and accounting rules under the LULUCF Regulation (2018/841) and the Governance Regulation (2018/1999) require to improve the monitoring and reporting LULUCF systems, including for soil carbon (see TN5 and TN6 for more details). While the effect of these recent Regulations remains to be seen, it is found that the requirement that soil carbon in key "managed land" categories be monitored using at least a Tier 2 approach is not fully implemented and likely insufficient to ensure proper monitoring (see section 4.4.1).[11] Furthermore, it is considered that:

the MS-level incentive for increasing soil carbon storage in forests is diluted by LULUCF-specific accounting rules designed to factor out natural effects and limit windfall credits, such as caps, FRLs and limited flexibilities (see TN6);

in contrast to the EU ETS which directly provides incentives to firms, the incentives from LULUCF regulation only apply to MS which largely fail to pass them on to land owners and land managers through national legislation (see TN3).

4.3.4. Few and scattered non-Climate policy incentives to protect and enhance soil carbon stocks

Another key problem driver is the shortfall of incentives (see TN3), both at MS and landowner levels, to protect and enhance soil carbon stocks. No policy tool is primarily aimed at storing carbon in soils (Pellerin et al., 2019). This does not mean that landowners are totally deprived of incentives to store carbon in soils and there are still some tools in place:

- Some policy tools with other primary objectives such as the cover crops mandated by the Nitrates directive or CAP subsidies for agroforestry indirectly provide incentives to store carbon in soils;

[11] Tiers refer to emission factors:
1 = UNFCCC default
2 = Country specific 3 = Modelled from primary data

- The ancillary internal benefits of high soil carbon stocks such as higher fertility and water retention are sometimes sufficient to convince farmers to implement soil carbon enhancing practices;
- Several MS have encouraged the development of carbon standards aimed at channelling private corporate social responsibility (CSR) money towards soil carbon sequestration (eg. Finland, Belgium, Sweden, France (Cevallos et al., 2019)).

However, these minor or indirect incentives and/or constraints are not sufficient to drive widespread adoption of best management practices such as cover crops, agroforestry, or wetland protection.

4.4. Problems

This chapter presents four problems resulting from the drivers identified in the above chapter. For the first problem (data gaps and uncertainty), a component is investigated at the land category level.

4.4.1. Reported data has large gaps and large uncertainty

Emissions factors from land conversions are properly reported by all MS as even IPCC Tier 1 methods are reasonably accurate in this respect. Therefore, we focus here on the "land remaining land" categories. Throughout this section, "cropland" refers to the "cropland remaining cropland" category, "grassland" refers to "grassland remaining grassland", etc.

For these categories, the Tier 1 method ignores carbon stock changes in mineral soils. Tier 2 methods generally apply a fixed emission factor to estimate the soil carbon stock changes resulting from conversions between predefined management types (eg. perennial crops vs annual crops, tillage vs no-till farming, low vs large manure inputs, …). Additionally, there are two very different types of Tier 3 methods:

1. Soil inventories: soil carbon content is repeatedly measured over a large number of sample plots across the country;
2. Model: a soil model (eg. Yasso, C-Tool) – often based on half-decay factors and carbon transfers between different organic matter pools – is run to estimate soil carbon changes based on variable inputs such as weather data, soil type, harvest statistics, etc.

In the following section, two proxies are used to determine how many MS and how much European area are properly monitoring soil carbon:

1. The method type: the Tier 1 method is obviously too coarse (they assume that no change is occurring), and only soil inventories are sufficient. Indeed, many Tier 2 methods are restricted to the distinction between annual and perennial crops, a typology which fails to capture key carbon storage practices. On the other hand, Tier 3 approaches based on modelling are usually not properly validated (see 4.4.1.2).
2. The variability of reported carbon stock changes: carbon stock changes in mineral soils are subject to large variations, both in the short term (weather, yield, …) and in the long term (change in practices, …). The reporting of a constant or almost constant value over 1990-2018 is therefore a sign that carbon stock changes are not being monitored with precision. Based on a few countries using accurate methods such as soil inventories or detailed Tier 2 approaches, we determine that a standard deviation higher than 0.01 tC/ha over 1990-2018 in the implied emission factor for carbon stock changes is a likely necessary – but not sufficient – indicator that soil carbon is being properly monitored.

4.4.1.1. Current gaps in reported data

Mineral soils

Current reporting completely ignores carbon stock changes in an estimated 5% of EU cropland area (Tier 1 method, see table below). Based on the proxies for proper monitoring defined above, the share of EU cropland area which is being properly reported is estimated to be at most 37%, and more likely close to 1%: the implied emission factors exhibit a standard deviation higher than 0.01 tC/ha over 1990-2018 – a likely necessary but not sufficient indicator of accurate reporting. In 11 MS this reporting adds up to 37% of EU cropland area, and only Belgium is actually reporting soil carbon changes based on a soil inventory for this land category.

The reporting gaps are even larger for grassland and forest soils: Tier 1 reporting rises to 32% and 53% respectively, and only 8 and 3 MS respectively report a substantial standard deviation in their implied emission factor. However, two large MS, Sweden and Germany, base their reporting on a soil inventory for forest soils, representing a quarter of the EU forest area.

Table 9: Reporting methods for soils in GHG inventories (2020 submissions)[12].

	Total area (kha)	**Reporting type**						**Substantial inter-annual variation in IEF (SD > 0.01 tC/ha)**	
		Tier 1		**Measurement-based (Tier 3, soil inventory**		**Modelling-based (Tier 3, model)**			
		# of MS	Share of total area	# of MS	Share of total area	# of MS	Share of total area	# of MS	Share of total area
Cropland remaining cropland	109,922	5/27	5%	1/27	1%	3/27	7%	11/27	37%
Grassland remaining grassland	64,519	12/27	32%	2/27	1%	1/27	1%	8/27	29%
Forest remaining forest	145,481	19/27	52%	2/27	24%	3/27	14%	3/27	33%

Organic soils

Overall, the current reporting of organic soils is more satisfactory, although the reported figures are incomplete or imprecise in several MS.

Barthelmes (2018) identified substantial gaps in the reported areas of drained peatlands for 5 MS but in the 2020 submissions, Romania was the only MS with a sizeable (> 200 kha) unreported drained peatland area. Note there is still a gap of more than 1 Mha between the information compiled by Barthelmes (2018) and the area reported by the UK in 2020.

Many MS are still using Tier 1 approaches to estimate emissions from drained organic soils. This generates substantial uncertainty. For example, Estonia uses an average emission factor of 1.3 tC/ha/yr for drained forested peatlands, derived from the IPCC default values for the boreal zone. Whether this emission factor or the emission factor for temperate forests is more relevant is a matter of debate, but the temperate zone would increase Estonian emissions by approximately 0.6 MtCO2/yr. Ultimately, the only way to settle the debate is to invest in the development of a country-specific measurement-based emission factor (Tier 2 approach).

[12] Adding Tier 2 reporting type allows the numbers to sum up to 27 MS.

In addition, 50-70% of MS with drained organic soils do not estimate all sources of emissions (CH_4, N_2O and DOC). In the MS where these omissions occur, emissions from drained peatland may be underestimated by up to 20% (Barthelmes et al., 2015).

4.4.1.2. Large uncertainty from Tier 3 soil models

Process-based model (Tier 3) is often put forward as an efficient alternative to soil inventories for accurate reporting. This strategy is implemented by some MS for all land uses (Sweden) or for a subset of land uses (Finland or Austria for forests, Denmark for cropland and grassland).

Unfortunately, most of these models are not able to reproduce recent trends. This is illustrated below with the examples of Sweden and Austria. In Sweden (Figure 24), measured soil carbon changes (black) are 2-3 times lower than inventory and FRL simulations (blue, Q model) in level, and inconsistent trend (simulations are stable whereas sequestration is increasing in measurements). In Austria (Figure 25), simulated regional changes are equally distributed above and below zero, whereas measured changes all point to decreases in soil carbon stocks. Whereas a valid model would be expected to produce approximately aligned points close to the first bisector, Figure 25 shows a large pack with no correlation between simulations and measurements.

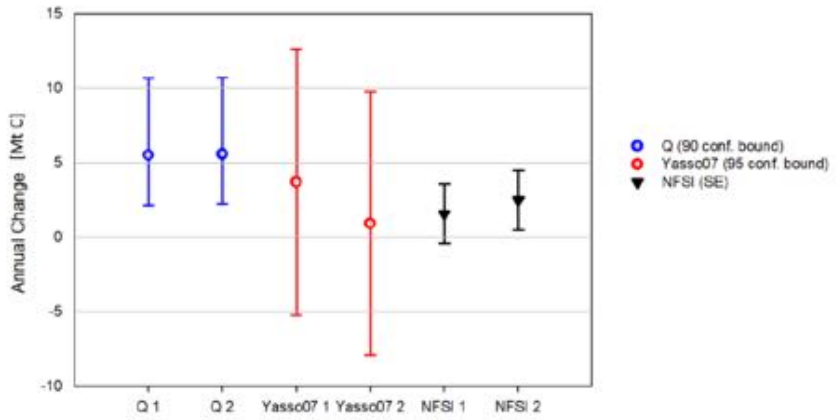


Figure 5. Figure from Ortiz CA et.al. 2009. Change of SOC. Average for two 5-year periods 1994 to 1998 (1) and 1996 to 2000 (2) together with the uncertainty bounds of the modelled change and the standard error of the repeated measurements

Figure 24: Comparison of measured and simulated forest soil carbon changes in Sweden (source: Swedish NFAP)

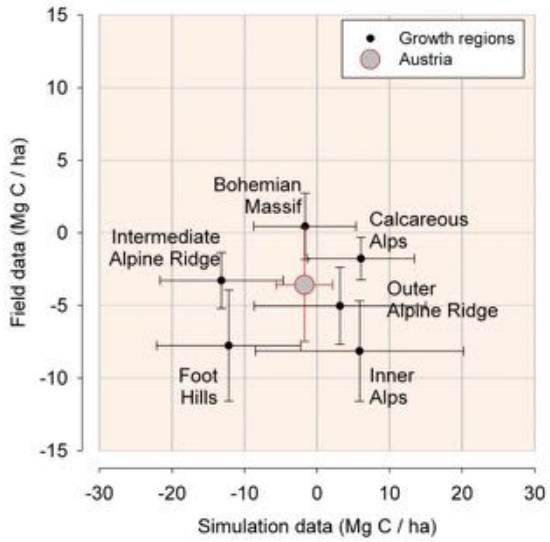


Figure 25: Comparison of measured and simulated forest soil carbon changes in Austria. The soil carbon change of the Austrian Forest Soil Inventory (1989) versus Biosoil (2006) against simulated data with Yasso07 in the same time span. The grey bullet represents the average value for Austria (source: Austrian NFAP, figure 15)

The reason for these serious mismatches may simply be that current knowledge of soil carbon processes is not sufficient to design process-based models suited to simulate soil carbon changes at national level. In all cases, these examples question the relevance of using process-based models for soil carbon reporting and emphasizes the necessity of regular soil inventories to accurately capture decadal changes in soil carbon stocks.

4.4.2. Current trends in what the EU and its Member states are currently reporting

Overall, reported changes in soil carbon – excluding land-use changes – are small: emissions decreased by 29 $MtCO_2$/yr between 1990 and 2018 (Table 10). Actual changes could be much larger as the bulk of emissions and removals in these categories currently goes unreported (see section 4.4.1.1). In particular, reported changes in soil carbon have contributed little to the 18% decrease in the reported total LULUCF sink between 2013 and 2018.

Table 10: Changes in soil carbon, excluding land-use changes[13]

	1990	2013	2018	2018-2013	
	$ktCO_2e$	$ktCO_2e$	$ktCO_2e$	$ktCO_2e$	% of 2013
Forest mineral soils	-38 761	-40 867	-42 573	-1 706	0.5%
Cropland mineral soils	-3 414	-10 924	-9 687	1 237	-0.4%
Grassland mineral soils	665	-2 549	-3 062	-513	0.2%
Organic soils	111 092	98 942	96 441	-2 502	0.8%
Total	69 582	44 601	41 119	-3 483	1.1%
Total LULUCF	-255 038	-324 315	-262 996	61 318	-18.9%

[13] This table is similar to the corresponding overview table in TN1, with a focus on soil carbon in "land remaining land" categories, thereby excluding land-use changes and changes in biomass.

In order to disentangle EU-wide trends for each land category, MS are grouped into four clusters, based on the largest biogeographical zone (Cervellini et al., 2020) in their territory (Table 11): Atlantic, Scandinavian, Mediterranean, Continental.

Table 11: Country groupings according to the biogeographical zones.

Atlantic	**Mediterranean**
Ireland	Spain
France	Portugal
Belgium	Italy
Netherlands	Greece
Luxemburg	Malta
Denmark	Cyprus
Scandinavian	Croatia
Sweden	**Continental**
Finland	Poland
Estonia	Czechia
Latvia	Slovakia
Lithuania	Slovenia
	Hungary
	Romania
	Germany
	Austria
	Bulgaria

4.4.2.1. Forest mineral soils

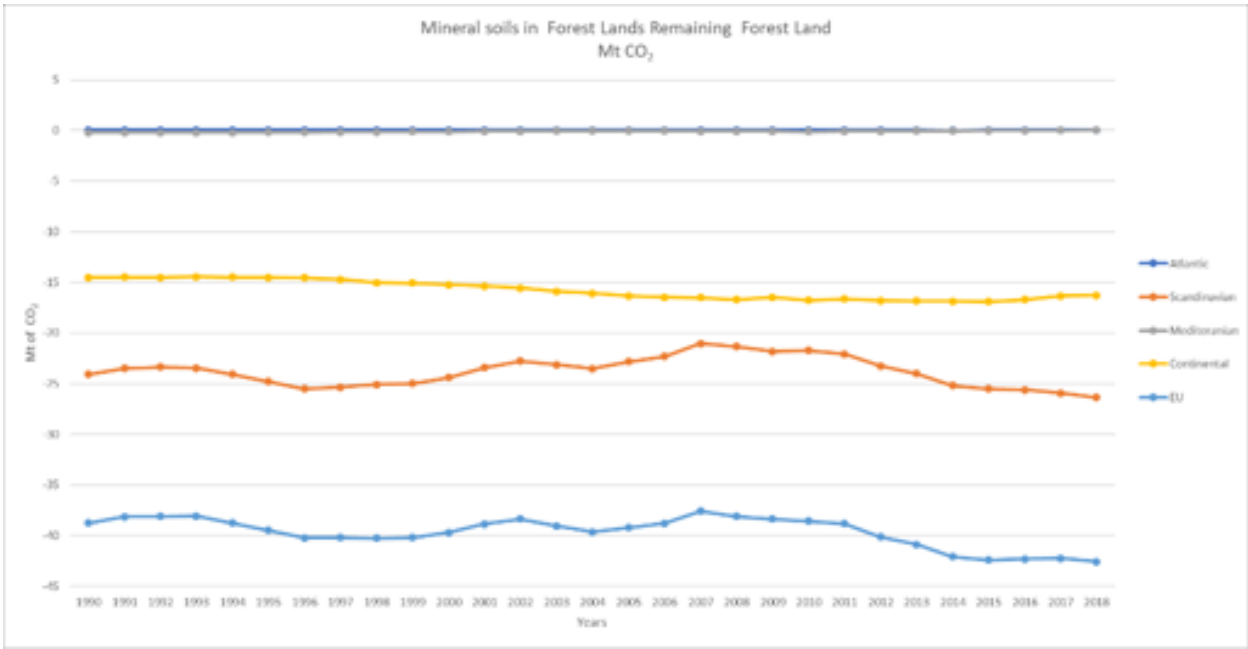


Figure 26. Soil carbon changes in forest mineral soils.

In MS which report soil carbon changes in forest mineral soils, the net sink has remained stable since 1990, around 40 $MtCO_2$. It is dominated by Scandinavian countries, both in level and trend. This dominance is likely an artefact stemming from the overall poor reporting of this category: Finland and Sweden are the only two MS using a Tier 3 approach for forest soils.

The sink has been slightly increased in recent years, from 39 $MtCO_2$ in 2011 to 43 $MtCO_2$ in 2018, largely driven by Sweden. The Swedish National Inventory report does not explain the drivers of this reported increase in removals.

4.4.2.2. Cropland mineral soils

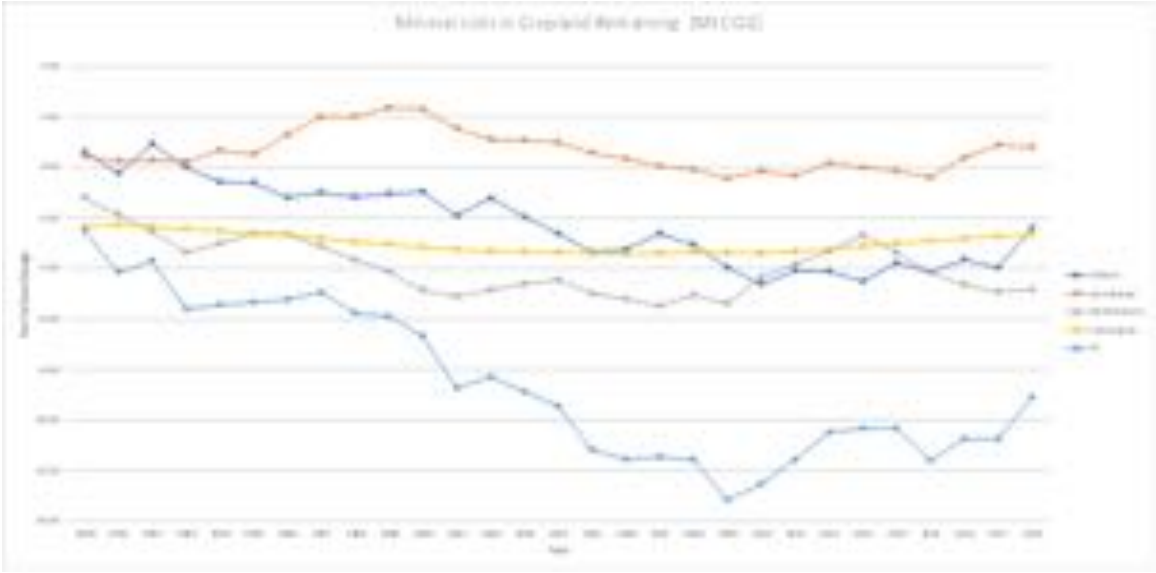


Figure 27. Soil carbon changes in cropland mineral soils.

In MS which report soil carbon changes in cropland mineral soils, the net sink has increased from 3 $MtCO_2$ in 1990 to 9 $MtCO_2$ in 2018, with a peak 13 $MtCO_2$ in 2009. All regions contribute to the level except Scandinavia, but the trend is largely driven by the Atlantic region and more specifically France. According to the French NIR, a switch from classical tillage to simplified or no-till techniques for around 30% of cropland area is driving this reported increased sink over the long term. The short-term variations of the reported sink for the Atlantic region are driven by Denmark which uses a Tier 3 modelling approach for reporting.

In the Mediterranean region, Italy and Spain are driving an increasing sink from 1 $MtCO_2$ in 1990 to 5 $MtCO_2$ in 2018. In Italy, this sink is driven by the increasing share of organic farming in perennial crops, while changes of management in annual crops (organic, conventional, set aside, …) create the short-term variability. In Spain, the reported increase in the sink is driven by an increased area of perennial crops, in which the share of soil conservation practices (limited tillage, set-aside and cover crops) is also increasing. In the Scandinavian region, the reported source of 2 $MtCO_2$ at the end of the 1990s is driven by Sweden. Sweden also uses a Tier 3 modelling approach for reporting. However, the Swedish NIR does not explain the reasons for the reported changes in soil carbon emissions/removals. The carbon stock changes in the Continental region are more or less stable.

4.4.2.3. Grassland mineral soils

Figure 28. Soil carbon changes in grassland mineral soils.

In MS which report soil carbon changes in grassland mineral soils, the balance shifted from net emissions of 1 MtCO2e in 1990 to a net sink of 3 MtCO2 in 2018. Both level and trend are mostly driven by the Atlantic and Mediterranean regions.

In the Atlantic region, the increasing trend is driven by Ireland where grasslands “not in use” have been expanding at the expense of improved grasslands.

In the Mediterranean region, Italy has followed a parabolic trend with a peak in 2006, partly offset by a net sink taking off in Portugal at the same period, ending up at comparable levels, around 0.4 $MtCO_2$ each, in 2018. The Italian curve results from the opposing influences of an increasing share of organic farming in grassland and an overall decrease in grassland area. In Portugal, the increased removals are caused by two projects funded by the Portuguese Carbon Fund. These project focus on boosting grass productivity by sowing grassland with a highly biodiverse seed mix including a substantial share of legumes.

4.4.2.4. Drained organic soils

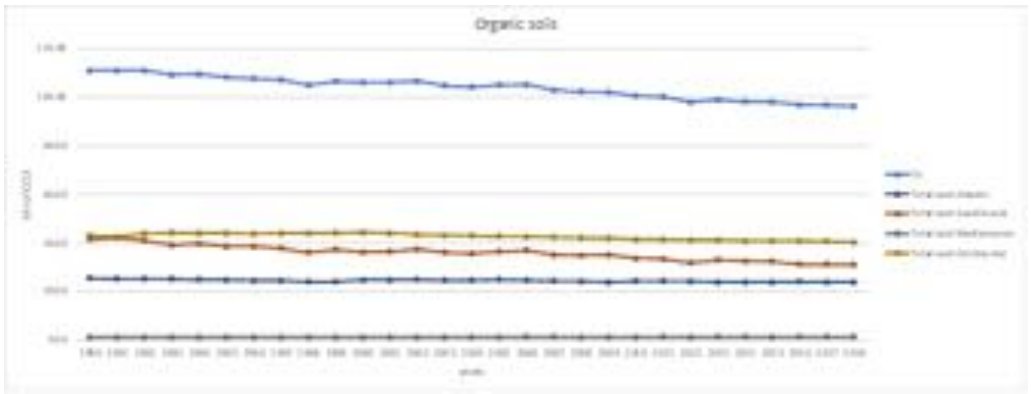


Figure 29. Soil carbon changes in organic soils (mostly wetland/peatland drainage).

CO_2 emissions from drained peatlands and wetlands have been decreasing from 111 $MtCO_2$ in 1990 to 96 $MtCO_2$ in 2018. All regions substantially contribute to the level, but the decreasing trend is driven by Scandinavia. Within Scandinavia, the bulk of the decrease takes place in Finland, where outflow (heterotrophic respiration) is assumed to be constant whereas the inflow from root turnover is increasing in proportion to tree biomass.

4.4.3. Large soil carbon gains and losses likely go unreported

In the absence of reliable reporting of soil carbon changes in GHG inventories, one must rely on scientific publications to assess current trends at EU level. Table 12 compiles recent scientific estimates for different land-uses in European or comparable (temperate) areas. Forests and grasslands are currently storing soil carbon, likely because some of them are still transitioning from former cropland use, but also due to environmental changes which have been boosting vegetation growth and hence organic inputs to soils. On the other hand, croplands are losing carbon, the main driver likely being that many are still transitioning from former grassland use although there could be other explanations such as the stagnation of crop yield since 1990 or rising temperatures. Recent increases in cover crop areas may, however, be turning croplands from net source to net sink.

Table 12: Average soil carbon changes in the EU (tC ha-1 yr-1, adapted from Pellerin et al. (2019)).

From\To	Forest	Cropland	Grassland	Wetland
Forest	0.17 [0 ; 0.41][14]	Over 20 years: -2,31 ± 1,50 Over 100 years: -0,47 ± 0,29	0	0
Cropland	Over 20 years: 0,77 ± 0,36 Over 100 years: 0,80 ± 0,37	-0.17 [-0.5 ; 0.16][15]	Over 20 years: 0,92 ± 0,25 Over 100 years: 0,59 ± 0,11	0
Grassland	0	Over 20 years: -2,08 ± 0,26 Over 100 years: -0,42 ± 0,05	0.11 [-0.03 ; 0.17]	0
Wetland	- 3 ± 2	- 3 ± 2	- 3 ± 2	0.4 ± 0.2

A coarse upscaling of these figures give a sense what current GHG inventories may be missing at EU level: cropland soils could be currently emitting 70 $MtCO_2$ yr-1 whereas inventories report a net sequestration of 3 $MtCO_2$ yr-1, grassland soils could be storing 25 $MtCO_2$ yr-1 whereas inventories report a net sequestration of 10 $MtCO_2$ yr-1 and forest soils could be storing twice the reported 43 $MtCO_2$ yr-1.

These upscaled figures are obtained by multiplying the average implied emission factors from Table 12 by the mineral soils area in each land category. The latter is obtained by subtracting the UK areas from the UK 2020 submission from the areas in the EU 2020 submission which still covers the EU 27 plus the UK. The obvious pitfall of such coarse upscaling is that they rely on one-off soil inventory repetitions in very few and mostly oceanic countries (Belgium, UK, Germany, Denmark) which are likely not representative of current trends in the entire EU. Given the shortage of data however, there is no obvious other way of obtaining more representative and up-to-date estimates.

In addition, one cannot exclude that the emissions and removals currently measured by soil inventories have partly been reported in past GHG inventories as resulting from land-use changes. Indeed, most MS assume that all emissions and removals from land-use changes are compressed during the first 20 years following change, whereas in practice they spread over roughly 50-100 years. There again, the shortage of data makes it difficult to tell apart the

[14] Pellerin et al. (2019) does not provide an uncertainty range for forest soils. 0 is the value reported by Emmett (2010) based on the UK soil inventory and 0.41 is the value reported by Gruneberg et al (2014) based on the German soil inventory.

[15] Pellerin et al. (2019) does not provide an uncertainty range. The range is taken from Ciais et al. (2010) which also averages at –0.17 tC/ha/yr and is quoted by Pellerin et al. (2019).

share of the legacy effects of past land-use changes which are included the average implied emission factors from Table 12 and have been reported, albeit too early, in GHG inventories.

Based on available projections, the EU soil carbon balance is not predicted to deteriorate as a result of climate change (Lugato et al., 2018; Smith et al., 2005; Yigini and Panagos, 2016) although these projections are very uncertain and not unanimous (Wiesmeier et al., 2016). One of the main factors is the balance between rising C inputs and rising decomposition driven by higher temperatures. The amount of soil organic carbon is in constant dynamic equilibrium between the carbon inputs from, mainly crops residues, organic fertilizers and losses of carbon caused by the decomposition of soil organic matter.

4.4.4. Key drivers of soil carbon changes (agroforestry, cover crops, yield, …) are not captured by GHG inventories

In the absence of a regular soil inventory or a valid Tier 3 model, a Tier 2 approach, monitoring the areas of key practices impacting soil carbon, is a suitable way of reporting soil carbon changes. In particular, these approaches are, in principle, able to capture favourable policy moves towards more widespread best management practices.

In their vast majority though, current GHG inventories are not able to capture best practices and drivers. The only practice captured by a majority of MS is perennial cropping, although replacing annual crops with perennial crops is generally not seen as a promising climate mitigation lever, if only because they are not close substitutes. Five and seven MS capture soil carbon changes resulting from changes in external organic inputs (e.g. sludge) and reduced tillage respectively. Only six MS capture, at least partly, the benefits from cover crops. Other key drivers of soil carbon changes are captured by MS representing less than 10% of EU croplands.

Table 13: Current coverage by GHG inventories of key drivers of soil carbon changes. The extent to which temporary grassland are captured is difficult to assess as they may be indirectly and imprecisely captured by artificial land-use changes between cropland and grassland.

			Cropland remaining cropland	Grassland remaining grassland	Forest remaining forest
Total area (kha)			109 922	64 519	145 481
Practices captured	Agroforestry	# of MS	1/26		
		Share of total area	1%		
	Temporary grassland	# of MS	3/25		
		Share of total area	2%		
	Cover crops	# of MS	6/26		
		Share of total area	47%		
	Hedges	# of MS	1/26	2/26	
		Share of total area	1%	1%	
	Organic farming	# of MS	4/26	3/26	
		Share of total area	12%	13%	
	Internal organic inputs (manure, ...)	# of MS	7/26		
		Share of total area	35%		
	Perennial crops	# of MS	16/25	5/25	
		Share of total area	63%	11%	
	Reduced tillage	# of MS	7/27		
		Share of total area	45%		
	External organic inputs (eg. food	# of MS	5/27	4/27	
		Share of total area	16%	17%	
Effects captured	Yield	# of MS	5/27	4/27	5/27
		Share of total area	9%	22%	38%
	Temperature	# of MS	4/27	3/27	5/27
		Share of total area	8%	2%	38%
	Precipitation	# of MS	4/27	3/27	5/27
		Share of total area	8%	2%	38%

4.4.5. Practices to increase soil carbon not adopted

This section covers four key practices for which research indicates significant potential for soil carbon build up: agroforestry, cover crops, substituting fodder crops (e.g. maize) with grass, and wetland/peatland restoration. Their biophysical potential is coarsely assessed at an additional 200-300 $MtCO_2$/yr (sum of the per practice potentials listed in Table 14 below).

Table 14. Sequestration potential of four key practices. Figures from Pellerin et al. (2019) are upscaled from French to EU level in proportion of cropland (for arable agroforestry and cover crops) and in proportion of cattle heads for grass/maize substitution. The original figure from Greifswald Mire Centre (2020) is 25% of EU agricultural emissions, which amounted to 436 MtCO2e in 2018.

	Current area (Mha)	**Carbon sequestration potential in the soil ($MtCO_{2/yr}$)**		
		Pellerin et al. 2019) upscaled	Lugato et al. (2014)	Greifswald Mire Centre (2020)
Arable agroforestry	0.4	60		
Cover crops	7.5	94	46	
Grass/Maize substitution	N/A	25	46	
Wetland restoration	Negligible			109

Reduced tillage is discussed, but there is growing consensus that this practice does not store carbon when the entire soil profile is accounted for (section 4.4.5.5). Increased nitrogen fertilization is not considered either because its soil carbon benefits are offset by fertilizer-induced emissions in grassland (Pellerin et al., 2019). Other practices have been shown to store carbon in the soil - hedges, crop residues, exogenous organic matter input, etc. - but their potential at a large scale is likely limited (Pellerin et al., 2019; Lugato et al., 2014).

Regarding forest soils, existing scientific evidence only provides one clear recommendation: avoiding losses that have been documented to take place when whole-tree harvesting – including remnants and stumps – is practiced (Achat et al., 2015; Mayer et al., 2020). Fortunately, this type of harvesting remains exceptional in the EU. Nitrogen addition or the introduction of nitrogen-fixing species are the only practices which have been consistently

shown to increase soil carbon storage, but the extent to which this increase offsets the associated fertilizer-induced emissions remains to be assessed (Mayer et al., 2020). The impact of other practices such as leaving harvest residues on site, extending rotation length, limiting soil disturbance and replacing clear-cut harvesting by partial harvesting are likely to be beneficial but limited. Further research is needed to obtain robust estimates of the effect of these practices on soil carbon, and derive clear policy recommendations (Mayer et al., 2020).

4.4.5.1. Agroforestry

The sequestration potential of arable agroforestry has been estimated at 0.8 tCO_2/ha/yr in the soil and 3.3 tCO_2/ha/yr in the biomass, leading to a national potential of 34 $MtCO_2$/yr in France at a price of 250 €/tCO_2e (Pellerin et al., 2019). A coarse proportional upscaling puts the European potential at 260 $MtCO_2$/yr. Current agroforested arable areas only amount to 0.4 Mha, or equal to 0.3% of the cropland area in the EU[16].

4.4.5.2. Cover crops

Introducing cover crops, avoiding bare soils between harvest and seeding, is boosting removals by 0.3 tC ha-1 yr-1 (Pellerin et al., 2019) and their area have been rapidly growing from 6% to 8% of EU arable land between 2010 and 2016. With 23-30% of bare soil during the winter, there is still substantial untapped potential estimated at EU level by Lugato et al. (2014) at 45 MtCO2/yr.

4.4.5.3. Substituting maize with grass

Pellerin et al. (2019) estimates the national storage potential of this practice at 5 $MtCO_2$/yr in France at a price of 250 €/tCO_2e. The EU level potential of a similar practice, consisting in increasing areas cultivated with ley/alfalfa, has been estimated at 45 $MtCO_2$/yr (Lugato et al., 2014).

4.4.5.4. Wetland/peatland restoration

While peatland restoration does not allow to restore a positive carbon storage dynamic in the short term, it quickly reduces or stops the considerable CO_2 emissions from peatland drainage that could otherwise go on for decades. Depending on climate, land-use and the extent of degradation, peatland restoration can avoid emissions between 2 and 34 tCO_2e/ha/yr (Table 15; Pellerin et al., 2019; Barthelmes, 2018). The EU potential for reducing emissions through peatland restoration has been estimated at around 109 $MtCO_2$e/yr (Barthelmes, 2018).

Table 15. Indicative emission reductions (in tCO2-e ha-1 yr-1) resulting from rewetting of drained organic soils with various initial land use types based on IPCC default emission factors (source: Barthelmes, 2018).

Land use category	Emission reduction after rewetting (t CO_2eq $ha^{-1}yr^{-1}$)	
	Temperate zone	*Boreal zone*
Forest land	6	2
Cropland	28	34
Grassland	20	25
Wetlands (Peat extraction)	9	11

[16] https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/651982/EPRS_BRI(2020)651982_EN.pdf

4.4.5.5. Reduced tillage

The European potential for soil carbon storage through reduced tillage is estimated by Lugato et al. (2014) at 32 $MtCO_2$/yr. The carbon gains attributed to this practice are however increasingly controversial. While IPCC guidelines and the Cool Farm Tool (a C footprint calculator) still credit low tillage techniques for increasing soil carbon, a French group of scientists (Pellerin et al., 2019) concluded that low/no-tillage only redistributes soil carbon to the superficial (0-30 cm) layer but has no effect on total soil carbon content (0-150 cm), except in Mediterranean conditions. Their conclusion relies on a quality-controlled selection of studies, and most importantly the recent meta-analysis by Haddaway et al. (2017).

4.5. Concluding remarks

Soil carbon is expensive to monitor. In the absence of strong policy incentives to monitor and increase soil carbon storage, there is an important shortfall of soil carbon data, both at EU and MS level. As a result, soil carbon is the blind spot of LULUCF policy. Large carbon gains and losses go unreported. Unreported losses could be around 70 $MtCO_2$/yr in croplands and unreported gains could be around 15 $MtCO_2$/yr in grasslands and 45 $MtCO_2$/yr in forests, but data shortage makes these estimates very uncertain. The share of EU forest area for which soil carbon is being accurately reported is at most 33%, and more likely close to 24%. The picture is even worse for grasslands and croplands. This is part of the backdrop for the currently very low levels of adoption of key carbon farming practices (peatland restoration, agroforestry, substituting maize with grass) which could remove an additional 200-300 $MtCO_2$/yr if they became widespread. But even if strong policies managed to disseminate them, current GHG inventories would not capture their climate mitigation benefits in most member states.

Regarding soil carbon, two priorities are therefore identified: improve monitoring and step up incentives towards practices with a large carbon storage potential. Solutions to reach the first goal are described in TN5 while solutions to step up incentives are addressed in TN6.

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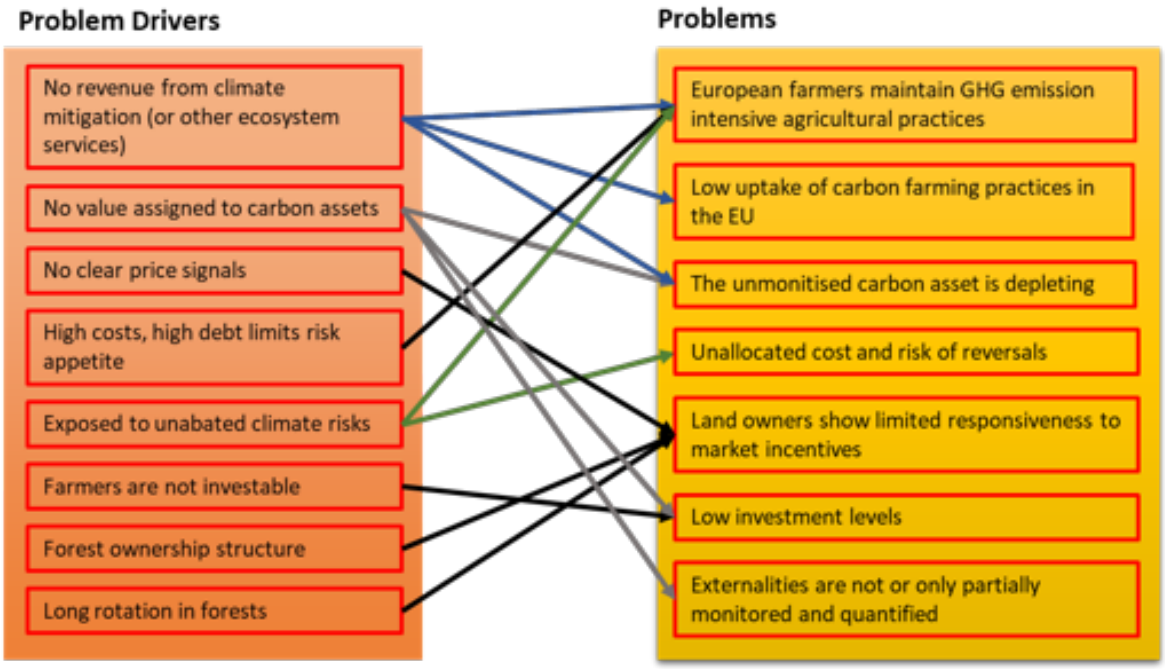
5. Topic Note #3: Externalities and Missing Markets



Abstract

This note presents a set of macro-level drivers related to the ability and willingness of European landowners to respond to climate incentives. These drivers take shape outside of the political sphere and are therefore deemed 'policy-external.' Due to economic, structural and market issues, it is found that significant barriers remain for the transformation of European land use into a provider of carbon removals in a market based, climate neutral EU policy framework. The overarching market failure implicit in several of the drivers is the lack of internalisation of negative climate externalities, which results in the lack of clear, common price signals promoting climate action and transition from the markets, farmers, and forest owners' service. In the context of developing short term, pre-2030 policy proposals and long term 2050 policy visions, the drivers are manifested in a set of specific problems. Past optimisations and technology adoptions have delivered significant GHG emission reductions and halved carbon loss intensity, but also resulted in a lock-in in the farming sector, where high debt levels, absence of carbon revenue streams, increasing costs of climate risks, and limitations in responsiveness to certain incentives renders a future structural change difficult and creates resistance among land owners, which are based in their business and not values. The ramifications need to be understood and addressed by future EU land use policies for the long-term vision to succeed.

5.1. Introduction

True cost of climate impacts not paid

Emissions that result in climate change constitute a well-known 'negative externality' where economic actors impose costs on others without paying a price for their actions (Pigou 1920; Stern 2008). Just as businesses and consumers do not pay anything for – or at least do not pay the 'true' cost of – burning fossil fuels and releasing greenhouse gas (GHG) emissions from deforestation and land degradation, they are also not rewarded for remedial action, i.e. removing GHG emissions from the atmosphere.

Price on GHG emissions, not carbon

An increasing number of countries and economies, nonetheless, have taken to respond to the dilemma by putting a price on the generation of emissions – usually in the form of a tax (possibly labelled as a levy, or surcharge) or a cap-and-trade system based tradable permits.[17] The Kyoto Protocol had installed the first global cap-and-trade system to tackle climate change (based on U.S. practice in combatting acid rain a decade earlier). Yet, the EU became the international trailblazer for translating the Kyoto Protocol's emissions trading approach from a government-to-government affair into the sphere of the market, i.e. where economic operators meet. With 14 billion euros in state revenues from allowances auctions in 2018, the European Emissions Trading System (EU ETS) remains the world's flagship cap-and-trade system imposing the obligation on key energy-intensive industrial sectors to purchase and surrender an EU allowance for each ton of CO2eq. emitted into the atmosphere. More generally, with more than 75% of global carbon revenues being levied by EU Member States, the EU leadership in carbon pricing is undeniable.

As a result, for large scale energy installations, and increasingly other energy using sectors in the EU, a price is placed on emissions to some extent internalising negative externalities. However, for the emissions resulting from anthropogenic impacts on the carbon stocks and fluxes found in biological sources such as plants, trees, and soil, there is no pricing.

5.2. Problem Drivers

LULUCF sector yet to internalise costs

Since 2021, the land use, land-use change and forestry (LULUCF) sector is included in the EU's climate and energy framework 2030, with binding quantitative restrictions on emissions under the so called no-debit-rule (LULUCF Regulation[1][18]) which is essentially a no backsliding provision. This rule applies to EU Member States, not market participants (forest and farmland owners) and therefore imposes limited pressure on pricing. Notwithstanding implementation at Member State implementation level, measures under the Common Agriculture Policy (CAP) benefitting carbon stock enhancement indirectly, and various forms of carbon taxes or tariffs being considered by governments, there is currently no uniform or Union wide internalisation of the externalities in the land use sector. Similarly, there is no price or mechanism in place for the removals of carbon which forests, vegetation and soil processes delivers.

[17] An overview of approaches is provided by I4CE (2019). A similar overview from OECD in 2008, found mostly government-financed subsidies to reduce GHG emissions given the general adherence to the polluter-pays principle. Thus cap-and-trade approaches have gained ground in the past 10-12 years.

[18] Regulation (EU) 2018/841 of the European Parliament and the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU, OJ L 156/1 of 19 June 2018

Support schemes and regulatory incentives, but no price signal

While EU policymakers are clear about the need for the LULUCF sector to contribute to the bloc's long-term net-zero emissions target and while certain sector-specific subsidy frameworks exist to help market operators take climate mitigation action (e.g. under the CAP), there is no regulatory carbon price mechanism in place at market operator level that would pay forest and farm owners or operators to make additional efforts (to what they otherwise do) to increase the sink function of their land.

This is particularly problematic given both the LULUCF sector's high but dormant mitigation potential at relatively low cost (e.g. agroforestry, peatland restoration, see Topic Notes 1 & 2) and the uneven distribution of this potential among EU Member States. An EU mechanism to incentivize land mitigation action could tap into the potential while allowing trade across Member State borders to improve overall market conditions.

8 problem drivers, incl. 2 forest specific

When assessed more closely, eight drivers relating to the lack of internalisation of externalities and pricing of the climate mitigation benefits at the level of the individual land owner stand out.[19] The drivers are organised around trends and developments that are external to the policy sphere; while the current CAP structure and instruments are part of both the problem and the solution for several of them, the CAP is not considered a driver in itself. The eight drivers are:

1. No revenue from climate mitigation (or other ecosystem services).
2. No value assigned to carbon assets, and hence no incentive to protect.
3. No clear price signals from consumers and other end users.
4. High costs and high debt limits farmers risk appetite
5. Farmers and foresters are exposed to climate risks to their business, which are only partially abated.
6. Farmers (less so forest owners) are not investable for private or institutional investors and hence have limited access to e.g. climate, restoration, conservation or biodiversity finance.

In addition, one must bear in mind that carbon pricing can only trigger action from landowners and firms which are responsive to price incentives. In the forestry sector in particular, this cannot always be taken for granted due to two additional problem drivers:

1. A substantial part of forest area consists in small parcels owned by multiple small owners.
2. Forest rotations range from 40 to 150 years, intrinsically conferring a substantial inertia to forest management and its responsiveness to price signals.

The below sections explain in more detail each of the identified drivers.

5.2.1. No revenue from climate mitigation action

Landowners cannot earn revenue from improving their carbon footprint

GHG emissions and carbon loss in the agricultural and land use sectors is an unpriced side-effect or negative externality. When there are no or only limited, distorted or weak signals incentivising actions that increase sinks or reduce GHG emissions, these will be of secondary importance relative to other income generating activities. The CAP, first and foremost, has

[19] Inspired by e.g. https://www.blendedfinance.earth/better-finance-better-food

continued to provide income support for activities that generate substantial GHG emissions such as livestock rearing, and especially ruminants. While the CAP and additional Member State regulation does offer support for improving carbon management in the LULUCF sector, none of these seem to have significant impact on land management priorities (Bonvillain et al. 2020). This drives a host of different behaviours and impose a number of barriers for landowners, which are problematic in the context of the LULUCF sector and 2030 ambitions.

5.2.2. No value assigned to carbon or biodiversity assets

Assets without business value are not managed

Farmers produce commodities and manage ecosystem services, but only the former are currently priced (Ribaudo et al., 2010). Under the current land governance regime in the EU and with current pricing strategies in the agricultural markets, farmers can only earn revenue from the products their natural capital can produce via conventional land management practices, even when this includes depleting the carbon stock (or biodiversity) on their land. With increasing attention on direct emissions of GHG on the farm or from forest management (linked to driver 2.1 above), loss of carbon from the carbon stock to the atmosphere may be regulated in the future, but loss of carbon through overharvesting and use of land may continue.

800 billion euro worth of ecosystems services not in the books

For example, recent work argues that the carbon removal service of global forests, is worth appx EUR 800 billion to society (Llavador et al., 2015), but this value does not translate into any commensurable pricing approaches. Managing a passive asset (in this case soil carbon) is a financial discipline itself, with focus on anticipated long-term profit (Paulson Institute, 2020). With no foreseen pricing of these assets, farmers and forest owners have no reasons to maintain carbon stocks other than the soil improving and productivity enhancing benefits soil carbon delivers, such as nutrient and water retention (Pascual et al., 2014; Brady et al., 2015, Amundson and Biardeau 2018).

Many good initiatives, but yet to price the passive asset

Some of the piloting carbon farming practices in Europe (e.g. Spar Initiative in Austria, 4/1000 in France, and peatland codes in the UK and DE) test pricing of avoiding emissions from soil carbon pools, which is a step towards the valuation of the carbon stock itself. There are however no scheme or mechanism in the voluntary carbon markets (in operation in the EU), that monetise soil carbon as an asset. This situation, if unabated in the long term, may reduce the efficiency of any legal initiative aimed at transferring incentives for carbon sequestration and avoided emissions to farmers and forest owners.

5.2.3. No clear price signals

Markets and consumers do not price carbon management

As a whole, consumers and other end users of products from agriculture and forest sectors send no clear price signals upstream through the value chain favouring GHG emissions reductions or net-zero products and tend to prefer low cost and uniform quality. Admittedly, carbon-related consumer pressure cannot be expected in the absence of labels signalling the carbon content of products, and transparent and clear labelling of climate impacts are intrinsically complex and likely will happen at only some time in the future. But experiments to that end show that even better information is unlikely to drastically change consumer behaviour (e.g. Castellari et al 2019).

Big food companies taking action

On the bright side, the market share of certified value chains such as organic food and geographical indications is rising: organic food consumption has doubled between 2009 and 2018, now exceeding 5% in many Member States. While these labels are providing many sustainability benefits, their contribution to climate mitigation is debated and likely modest (e.g. Meier et al., 2015; Bellassen et al., submitted). Recently, large international food and grocery companies have started certifying their value chains, and calculating scope 1 and 2 emissions from their products and portfolios as part of net-zero claims. This trend promise well for the indirect internalization of externalities and improvement of the overall climate footprint of the food sector, but still leaves farmers with unclear price signals.

Farmers can only wait for pricing to get right

In general, farmers are price takers in oligopolistic markets with little ability to differentiate products for climate impact or footprint beyond such mainstream certification schemes, and are not able to recoup costs of internalising externalities in farm management.[20] This again, serves as a problematic barrier for addressing the market failure through upstream measures, but also for imposing cost-intensive actions or restrictions on farmers through LULUCF policies.

5.2.4. High costs, high debt, and stranded assets means limited risk appetite in the sector

Squeezed business case for farming

High fixed costs (land, equipment) and high labour costs (compared to third countries), combined with high debt levels, restrict farmers' risk appetite and access to finance for new technologies and practices (van Asseldonk et al. 2019). Much of the farming sector outside of various high-value segments (with associated barriers to entry) delivers low or even negative profit margins, obliging some farmers to rely on CAP subsidies for their survival[21], as also reported by the 2019 JRC farmers view report (JRC, 2019).

…and assets may strand when climate changes

Of similar importance, but less prominently discussed for the land use sector and its assets, is the concept of climate transition risks[22]. The currently unpriced risk of structural changes to the land sector and its various types of capital may lead to stranded assets, i.e. land that is no longer available for farming (such as peatlands) or not profitable to maintain. Investments in land that requires significant rehabilitation are much riskier than in land that has been sustainably managed. If no alternative pricing of the services of the land is offered (as covered in 2.3 on natural capital assets), obsolete land uses means the value of the land will decrease. A similar logic may apply for certain equipment, expertise or even animal herds (Caldecott, 2013). In aggregate, loss of income may turn out significant. A recent EEA report (EEA, 2019), estimated that European agriculture could face a potential income loss of up 16% by 2050, with large regional variations. The same EEA report estimates that farmland value in certain

[20] https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/trade/documents/agri-market-brief-04_en.pdf

[21] For instance, the Irish Parliamentary Budget Office (PBO) briefing paper on the CAP in Ireland cites that over half of the average family farm income comes from direct payments from CAP funds. For cattle and sheep rearing, this value is even higher at 114% and 115% of income dependence on CAP, respectively. Source: PBO. (2018) https://data.oireachtas.ie/ie/oireachtas/parliamentaryBudgetOffice/2018/2018-08-17_an-overview-of-the-common-agricultural-policy-cap-in-ireland-and-potential-regional-and-sectoral-implications-of-future-reforms_en.pdf

[22] Climate Transition: An Unpriced Risk? | Beyond Ratings (beyond-ratings.com)

Mediterranean Member States can fall by up to 80% over the same time period due to loss of productivity.

Structural caution towards change

This partially explains the resistance or hesitance of certain farmer groups to increased climate targets and top down regulation that allows no way out or offers no conciliation for or safeguards against stranded assets. Overall, high costs, high debt, squeezed business models and risk of stranded assets, serves as barriers to the adoption of new technologies and may drive resistance in the agriculture and forest sectors to fast, costly or unevenly distributed measures or initiatives as part of more stringent EU LULUCF legislation or targets.

5.2.5. Increasing climate risk

Climate risks are financial risks

Farmers and foresters are inherently exposed to climate risks to their business. Risks related to weather and climate conditions and foreseen changes will materialise in changing conditions and a wide range of changing and erratic events that will increase total risk for farmers for their herds, crops, and costs. It is foreseen that there will be increased need for watering of animals, irrigation and optimised breeds in parts of the livestock sector, positive and negative changes in crop productivity, more and more severe extreme weather events, just as storage, processing and transport of crops and animal products will be impacted and necessitate investments (EEA, 2019). Although risks will play out differently across Member States, as such agriculture faces a climate transition. Also, it is important to note that as many farmers operate diversified and multi-practice farms, impacts on livestock rearing may influence soil management and protection of carbon stocks, as the farmer manages one budget and limited financial resources.

Banks and financial institutions (and re-insurers alike) are realising that climate change risks eventually will materialise as financial risks which will be transferred from landowners to financial institutions one way or the other (see UNEP and Global Canopy, 2020). The main implication of climate risks will be loss of harvest, declining productivity or yield, water stress, or increasing costs of irrigation water. These can be insured however, and several Member States includes insurance schemes to improve climate resilience as part of their Rural Development measures.

5.2.6. Farmers are not investable

Small and medium family farms have limited access to finance

Farmers (less so forest owners) are not easily investable for private or institutional investors and hence have limited access to various forms of potentially relevant finance, such as climate, restoration, conservation or biodiversity finance in particular in the form of equity. The low level of investments into EU farms, may be a result of the ownership structure and business models of the typical EU farmer. Although a group of large industrial farms operated by a company have increased in number over the past 20-30 years, even these farms are often incorporated and operated in ways that offers unattractive risk/return profiles for institutional investors, venture capital and fund managers. For privately-owned small and medium size farms, assets such as land, machines, animal herds and buildings are not included in EU financing programmes. In many Member States, restrictions on ownership and farm size are regulated in land tenure, zoning or agricultural laws, and reflecting traditions or past priorities. In summary, landowners are generally limited to financing through debt markets or market risk insurance, traditional banking credits or government subsidies and loans.

EU Taxonomy part of the way forward

Many recent publications raise the expectation that the assets of agriculture and forests can become investable and that existing financial services available to the sector increasingly will consider climate and biodiversity impacts. This is also reflected in the substantial work undertaken to define an EU taxonomy for sustainable finance for the agricultural and forest sectors, which will surely remove barriers for investment into these sectors. While this will surely mean that certain farms or farming practices such as afforestation or wetland restoration can attract more and other types of finance, it is not expected as such to remove the access barriers for the vast majority of small and medium size farms across the EU[23].

Impediment for change and new technology adoption

The problem driver of low investability leading to resistance to change and slow uptake of new technologies and practices works in concert with and is exacerbated by the lack of revenue for climate mitigation activities and the lack of value for carbon assets mentioned above (in 2.2 and 2.3).

5.2.7. Ownership structures of European forests not conducive to market induced changes

Public forests may respond differently

40% of European forests are public-owned, and this share often exceeds 75% in most Eastern European countries[24]. This substantial portion of European forests cannot be expected to perfectly respond to market incentives as predicted by standard economic theory. This is all the more true for municipal ownership. In France for example, municipalities represent two thirds of public forest ownership and a key priority for them is to supply their constituents with a regular yearly provision of energy wood.

Small forests managed differently

Even among private holdings, responsiveness to market incentives can be questioned. Among others, 30% of private forests consists in land holdings smaller than 10 hectares, and another 13% belongs to land holdings smaller than 20 hectares[25], while 15 hectares is commonly considered as the minimal area allowing for active forest management. This scattered private ownership is the result of inheritance laws and inheritance tax regimes. Many Member States have long been aiming at defragmenting forest land ownership[26] but as illustrated by the above figures, their policies have not lived up to the challenge.

Tricky to devise effective result-based climate schemes for forests

The ownership structure becomes a problem driver as small, private forest owners on the one hand may not adopt professional management practices and respond to market incentives. On the other hand, state or municipal ownership may adhere to certain Sustainable Forest Management practices and can be directed towards carbon forestry practices, but not

[23] UNEP and Global Canopy (2020). Beyond Business as Usual: Biodiversity Targets and finance. UNEP-WCMC, Cambridge, UK.

[24] https://efi.int/sites/default/files/files/publication-bank/2018/tr_88.pdf

[25] https://unece.org/DAM/timber/publications/SP-26.pdf

[26] https://www.sciencedirect.com/science/article/pii/S1389934117301740

necessarily through market incentives or price signals as they operate forests not only for commercial reasons.

5.2.8. Forest rotations range from 40 to 140 years, intrinsically conferring a substantial inertia to forest management and its responsiveness to price signals

Structural inertia to change

In Europe, forest rotation length typically ranges from 40 to 140 years, depending on species and pedo-climatic conditions[27]. Classical Faustmannian forest economics demonstrates that shortening optimal rotation lengths comes at exponentially rising opportunity costs (Samuelson, 1976). These timelines confer substantial inertia to the forestry sector. Of course, forest managers can somewhat delay or move forward thinnings and final cuts to seize market opportunities or respond to the risk of natural disturbances. But they cannot rapidly alter species mixes, forest type (e.g. high stand vs coppices) or other key management choices. Even where they are timely, the monetary and carbon benefits of management interventions, such as converting coppices to high stands or thinnings intended at improving fire resilience, typically take decades to materialize, which mitigates their appeal for profit.

5.3. Problems

Eight problems that future climate policy should address

As a result of the above drivers working in concert, land owners in general maintain land management practices that do not optimize climate mitigation (or other ecosystem services), as pointed out in Topic Notes 1 and 2. The above drivers are structural and frame the agricultural and forest sectors in the EU. At the same time, they lead to a number of concrete problems or barriers which an EU Climate Policy and governance framework that includes the LULUCF must consider and possibly mitigate or address. This section explain and substantiate eight problems that result from one or more of the drivers. Each of these are formulated so they can be targeted and addressed fully or in part by policies and measures within the mandate of the European Commission.

Land management decisions considering regulations, markets, nature

The core problem remains that climate externalities are not internalised and therefore that there is no clear, common and unionwide market signal from financial service providers, food industry, retailers, commodity traders or consumers that incentivise reduction in GHG emissions, sequestration of carbon and protection of the already existing carbon stock (or biodiversity). When making management, pricing and financing decisions, any landowner will seek a balance between incentives on offer, feasibility of the solution, regulatory constraints and own beliefs and willingness (Bijttebier et al., 2018; Barnes et al., 2019). Currently, this balance may favour optimising nutrient use, reducing waste, adopting renewable energy technologies and reduced tillage practices among other. But not very often, farmers find it favourable to restore peatlands, adopt regenerative soil management, agro-forestry and inter-cropping, or actively build carbon stocks in mineral soils.

Weak, occasional price signals is a good start

[27] http://dataservices.efi.int/casfor/downloads/kaipainen_et_al.pdf

Based on recent reviews (COWI et. al, 2021), it is found that there are only few and scattered carbon farming pilots or systems in place that offer a transparent, farm level incentive for climate action in the land use sector. Together with the limited uptake of voluntary carbon markets in the EU, the situation is that there are currently only opportunistic and low frequent pricing signals from the market. Such erratic signals is not the same as internalisation in each and every market transaction and financing decision of a farmer, and hence most farmers will maintain status quo unless subsidised or regulated.

Eight specific problems

This overall problem has been unfolded into a number of specific immediate problems for ambitious, cost effective policy action in the land sector, for the purpose of this note:

1. European farmers maintain GHG emission intensive agricultural practices
2. Very low uptake of results-based carbon farming practices in the EU
3. The unmonetised carbon asset is depleting
4. Unallocated cost and risk of reversals
5. Forest owners are only weakly sensitive to market incentives.
6. Farmers respond to market signals but get no climate mitigation signal
7. Low investment levels and in particular for digital and sustainable land use practices and thus slow adoption.
8. Externalities are not or only partially monitored and quantified

Each of the problems are briefly explained in the below sections.

5.3.1. European farmers maintain GHG emission intensive agricultural practices

Net emissions from the land sector not improving lately

For the period 1990 to 2016, the EU LULUCF net-sink increased slightly, however since appx 2000 the trend has been a slight decrease which is furthermore expected to continue, as covered in Topic Notes 1 and 2. Similarly, for the agricultural sector (UNFCCC, non-CO_2 emissions), only a limited decline is observed since 2000, and emissions have stagnated since 2011[28]. According to the latest inventory data published by the EEA, agriculture accounts for appx 10% of EU's total GHG emissions, making mitigation efforts highly valuable to future emission reductions.[29] By one estimate, the use of mitigation technologies and climate-focussed farming practices could reduce non-CO_2 emissions by up to 50-55 million $MtCO_2eq$ per year (Pérez et al., 2016). Furthermore, at a price of EUR 100/tonne, agriculture has a mitigation potential of 90 million $MtCO_2eq$ by 2050 (EC, 2018). This situation testifies, that the beforementioned balance between various incentives have not at scale tipped in the favour of protecting carbon sinks and stocks in the LULUCF sector, and reducing GHG emissions in both LULUCF and agricultural sectors.

[28] Total emissions from agriculture decreased by 24% 1990-2016, JRC Ecampa 2016.

[29] EEA (2018), Annual European Union greenhouse gas inventory 1990–2016 and inventory report 2018, Submission to the UNFCCC Secretariat. Technical report No 5/2018, European Environment Agency.

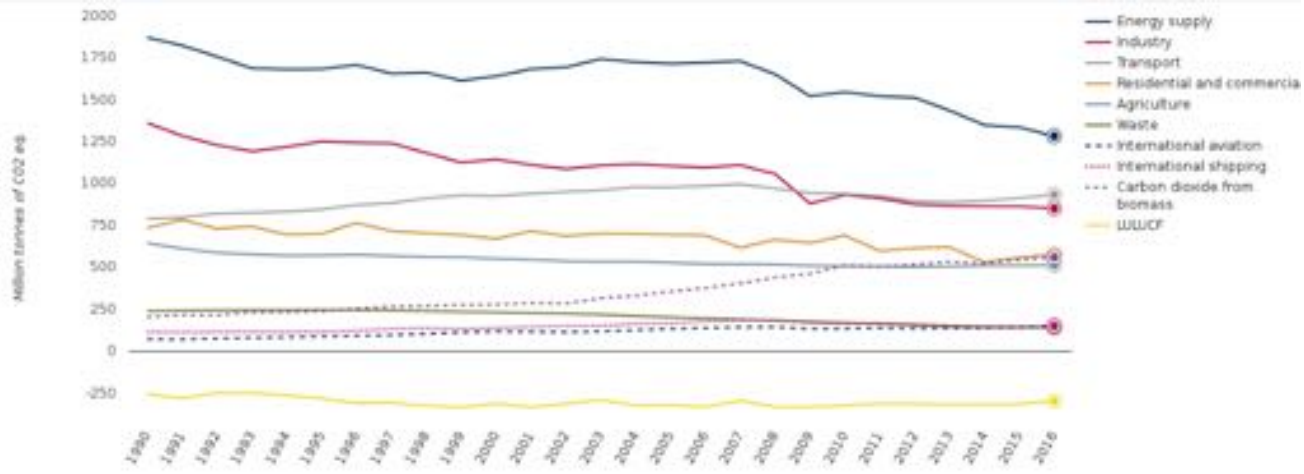


Figure 30: Period 1990 to 2016, EU emissions from different sectors including LULUCF. Source: EEA (2018), Annual European Union greenhouse gas inventory 1990–2016

Considering the limitations in reported data, and the widespread reliance on default factors and statistics for activity data, as covered in Topic Notes 2 (Soils) and 5 (GHG reporting), it is further clear that there is little farm level or forest plot evidence of quantifiable climate mitigation potential.

Past improvements driven by subsidies, regulation and cost reductions

Instead, peatlands remain drained, and intensive single cropping farming and forestry continue to dominate many landscapes, while regenerative or conservation farming practices for some time have seen slow adoption rates in the EU (Lahmar, 2007; Kertesz and Madarasz, 2014). For many years, farmers restoring wetlands, or applying practices to increase biodiversity and carbon services of forests have had to rely on government support schemes or own benevolence to remain competitive in their markets while reducing emissions significantly. It should be noted that new and efficient technologies (Barnes et al., 2019), no tillage farming (Bijttebier et al., 2018) and nutrient efficient land use practices[30], as well as many other positive and worthwhile initiatives have been adopted by European farmers over this period. Mostly, these technologies and initiatives have been adopted without the need for financial incentives, e.g. through pricing or conditionality on sale contracts or supplier agreements (Loevinsohn et al., 2012). For example, no or low tillage has been adopted widely within EU over the past decade because of its combination of cost savings and mainly where farmers where aware of its benefits. However, the practices have mainly been adopted by larger farms and with significant regional differences[31]. At the same time total production has increased, so the main decrease is in GHG intensity (and not total GHG emissions), which is not visible from the above graph.

5.3.2. Very low uptake of result-based carbon farming practices in the EU

How to translate targets to landowner incentives?

A specific problem is that the EU and Member State policies do not transfer financial incentives directly to farm or forest owner level, and thus that there is an efficiency loss in interventions. The obligations and regulatory incentives (e.g. no backsliding) from the LULUCF regulation

[30] Agri-environmental indicator - gross nitrogen balance - Statistics Explained (europa.eu)

[31] Agri-environmental indicator - tillage practices - Statistics Explained (europa.eu)

have not been translated into farm level obligations or incentives. Beyond the mostly voluntary support schemes, Rural Development Programme measures, and considerations of carbon taxes in certain Member States, farmers climate action is governed by Member State implementation of cross-compliance rules and weak, product specific price incentives from the market. Farmers are not subject to any EU level incentives or regulation. Quantitative GHG targets or obligations are defined at Member State level, and so far with no LULUCF sector target beyond the no-debit rule.

Carbon Farming can test that, but difficult to get started

Carbon Farming is a result-based approach that aims to exactly transfer incentives to farm and forest levels by monetising specific and verified GHG mitigation action. Uptake of result-based carbon farming practices in the EU remains scarce, scattered and linked to dedicated individuals, foundations or pioneering companies. Landowners find that the costs of setting up, participating in and managing carbon farming are prohibitively high, and, without a change of mindset, support-schemes and infrastructure, these barriers will remain. For farmers subject to extensive regulation, servicing a high debt and earning low margins, it is safer and less complicated to leave the initiative to high level policies that apply to all farmers at once, thus minimizing competitive disadvantages that might otherwise appear from solo action. As a result, any farmer or forest owner wanting to monetise and earn from best practice implementation of e.g. restoration of peatlands, afforestation or soil carbon enhancement, do not have access to financial rewards for their action.

Voluntary Carbon Markets are an alternative

In the absence of large-scale Carbon Farming in the EU, Voluntary carbon markets (VCM) are currently the only possibility to monetise climate mitigation in the European land sector. The VCMs (for land use) have generated exchanges of around 100 MtCO2e/yr globally since 2008, with end-demand in carbon offsets around one third that amount (Ecosystem Marketplace, 2020). These numbers are far below the 450 MtCO2e/yr of necessary sink by 2050 in the EU alone.

…but not really so in the EU

In addition, VCMs have only very recently become accessible to EU landowners through the development of national offset standards. Indeed, for debatable reasons, international offset standards have historically been reluctant to certify emissions reductions on EU territory (Cevallos et al., 2019). As a result, the current supply of carbon offsets from agriculture and forestry projects in the EU is assessed at only 3 MtCO2e (Cevallos et al., 2019).

5.3.3. The unmonetised carbon asset continues to deplete

We are losing soil carbon

The fact that the carbon stock or biodiversity on a given plot of land does not represent a financial value (Paulson Institute, 2020) and is not safeguarded by regulations, means it risks not being considered in management decisions on e.g. land use intensity, application of regenerative agricultural practices, or no tillage (Pascual et al. 2014). As a result, land-based natural capital (carbon stocks) is being depleted in organic croplands and grasslands, and in forest soils as such (soil organic carbon losses), see chart below. Since 1990, the rate of carbon stock has continued to decline, although this decline has slowed down in recent years, in particular for organic forest and grassland soils. The annual rate of carbon uptake has stabilised for mineral cropland soils, whereas mineral soils overall build up carbon, although with low intensity per hectare, as the increment is small but covers a very large area.

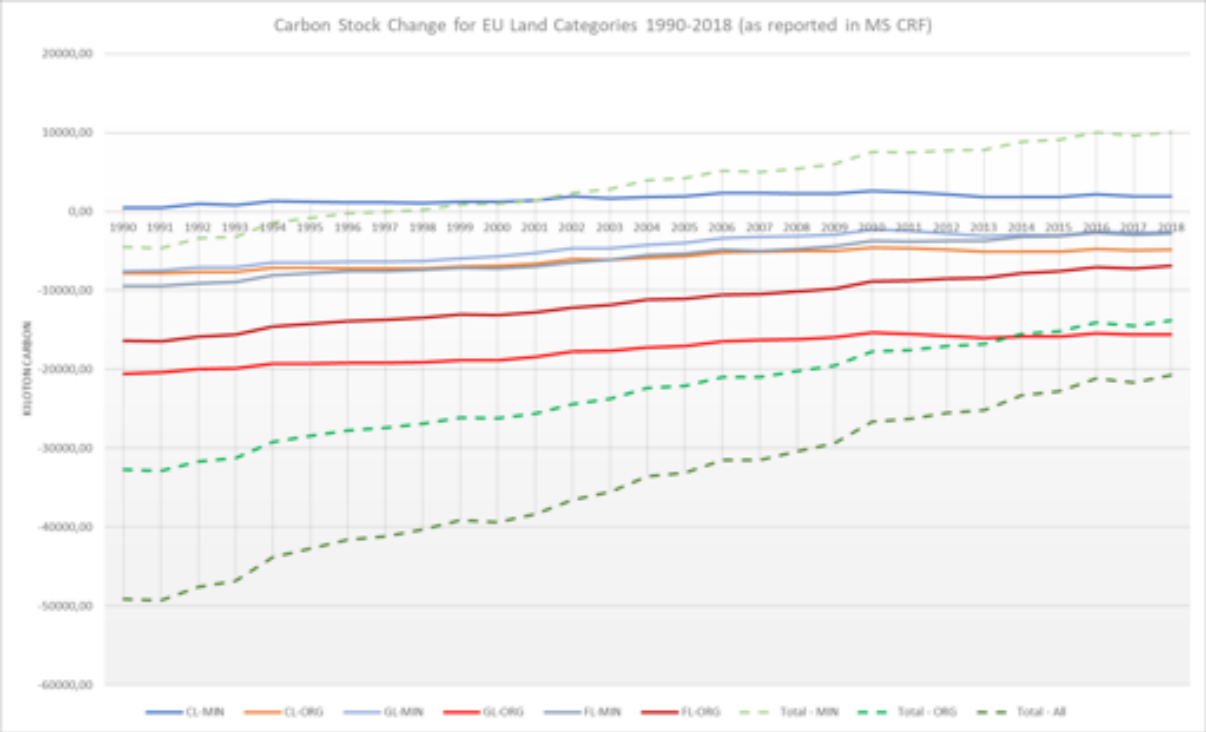


Figure 31: Overview of carbon stock change factors for EU27 for the period 1990-2018 as reported by Member States and aggregated by EEA. Excludes Land Use Changes, and is based on CL-CL, GL-GL, and FL-FL land categories, split into mineral and organic soils. Own production, data downloaded from UNFCCC Data viewer, December 2020.

The observed slowdown in the loss-rate of carbon in forestland mineral soils, cropland organic soils and grassland (organic and mineral soils) is a result of improvements in land management resulting from a combination of improved technology and knowhow, implementation of GAECs and cross-compliance of the Common Agricultural Policy for agricultural soils. Expectedly, it is also as a result of changes to data quality and modelling tools across Member States. Overall changes for both mineral and organic soils show a steady decrease without the same evening-out, possibly due to the continued decrease in organic forestland soils. Data for soil carbon in mineral soils excluding land-use changes from 2013 to 2018 is presented in the table below. The reported changes are small but could potentially be attributed to lack of data from Member States on carbon stock changes.

Table 16. Changes in soil carbon, excluding land-use changes.

	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	% of total decrease	% of 2013
Forest mineral soils	-39	-41	-43	-1.7	-2.8%	0.5%
Cropland mineral soils	-3	-11	-10	1.2	2.0%	-0.4%
Grassland mineral soils	1	-3	-3	-0.5	-0.8%	0.2%
Organic soils	111	99	96	-2.5	-4.1%	0.8%
Total	70	45	41	-3.5	-5.7%	1.1%
Total LULUCF	-255	-324	-263	61.3	100%	-18.9%

Loss rate is slowing down, but still significant

The plateau for the years 2016-2018, indicates a continued loss of carbon from organic soils, partially compensated by an uptake in mineral soils. The above graphs does not show the size of the carbon pools in the soils under the respective land categories, but other sources confirm

that the total carbon stock of organic soils are significantly larger than the mineral soils carbon stock. The loss of carbon from organic soils, is mostly from managed peatlands subject to drainage, tillage and intensive cropping or a combination of these. In a situation with few incentives, and low willingness, capacity or ability to change this, the carbon depletion can be expected to continue for organic soils as the stock is far from empty. Only by valuing soil carbon can economic decisions in the agricultural sector incorporate the many benefits of stable and high soil carbon levels, and consider the opportunity costs related to food security and rural livelihoods (Pascual et al., 2014).

5.3.4. Unallocated cost and risk of reversals

How to mitigate natural risks?

In the context of climate change mitigation and anticipated future emission reduction targets for the LULUCF sector, the climate risks also translate into an additional liability for farmers or forest owners. The risks of reversal of past removals or sudden, significant increases in emissions also pose a risk, which farmer organisations, NGOs and researchers in concert articulate as a barrier for climate action in the land sector. This perception and standpoint is only one of several possible ways to articulate these risks, but nonetheless drives an implementation problem for further LULUCF action.

It is a compliance risk that can be priced

Depending on the choice of incentive instrument and the level of its application (landowner, industry, Member State), the risk will fall on different actors. In a carbon farming and carbon market scenario, landowners (the owner of the credit) will face this risk and have to find means to address it which will inevitably add costs on farmers. Such actions may include change of land management practices, change in land use, or retiring certain lands, or setting up of common buffer accounts and mechanisms for distributing risk. In a regulatory, policy driven scenario with national or sector specific climate targets, the climate risk will materialise as a target compliance risk, which will need to be managed as well.

5.3.5. Forest owners show limited responsiveness to market incentives

Low price elasticity

Forest managers are only weakly sensitive to market incentives when it comes to management of forests and harvest, at least in Southern Europe. For example, in France, the price elasticity of coniferous wood supply has been assessed at 0.06 (Barkaoui, 2007), which means that a 1% increase in wood price raises supply by only 0.06%. This is ten times lower than typical elasticity estimates in the agricultural sector (Arnade et al., 2002; Iqbal & Babcock, 2018; Kim & Moschini, 2018; Miao, 2013).

This indicates that in many countries, institutional or organisational aspects may be more important than price. A substantial share of forest ownership is public (around 40%, FAO 2007). Although public forest managers are increasingly sensitive to price incentives, they likely balance them with other aspects demanded by local or national stakeholders such as the provision of energy wood or recreational services. Furthermore, a substantial share of forest holdings in Southern Europe are smaller than 15 ha and therefore often not actively managed, and management changes therefore inherently difficult to incentivise.

While the production of wood shows limited sensitivity to market signals due to long rotation periods (in particular for hardwoods), ownership structures and lack of active management, the specific end use of harvested wood is highly sensitive to price signals. Current policies in this respect are incomplete and possibly counterproductive as the bulk of the incentives they provide goes to energy use instead of material use (Baron et al., 2013). Unfortunately, there is lack of scientific literature on this topic (Grassi et al., 2019) (Smyth et al., 2014).

Tree planting linked to long term incentives

Due to the long rotation times, tree planting is rarely determined by short term market incentives, such as price of wood. The decision of a private landowner to plant new or more forest (afforestation) hinges on market perspectives and regulatory incentives (Knoot et al., 2015). Based on Australian experiences with afforestation schemes, Evans (2018) finds that in addition to market incentives tree planting is influenced by co-benefits, policy certainty and coherence, and social networks. In the same context, Bryan (2016) reports that land rents for competing land uses quite unsurprisingly plays a key role, and that regulation was needed to maximize the carbon and biodiversity benefits of otherwise unattractive land use change to forest. However, the complexity and user friendliness of requirements of such regulation remains a key determinant of landowner willingness (Knoot et al., 2015). This underpins the impact of a lack of clear carbon pricing at landowner level. A carbon (and biodiversity) price for sequestered carbon would be able to deliver shorter term return on investment (10-30 years) and hence drive afforestation. Favero (2016) finds that at low carbon prices natural forest would dominate afforestation, while at carbon prices above 200 € / t CO_2e, more intensive production of wood would dominate management decisions.

5.3.6. Farmers respond to price signals but there is no carbon signal

Farmers strongly respond to market incentives. Price elasticity of crop supply is high (typically around 0.5) which drives responsiveness to the problem of a missing carbon price signal (Arnade et al., 2002; Iqbal & Babcock, 2018; Kim & Moschini, 2018; Miao, 2013). A recent and specific example is the fast development of rapeseed crops (mostly in France) in response to monetary incentives following the biofuel directive of 2003. However, on the EU and global markets this price signal does not internalise the cost of GHG emissions or depletion of soil carbon stocks.

Limited incentive signal from CAP

Although recent reforms of the CAP tended to improve its contribution to climate mitigation (Baudrier et al., 2015), its overall impactshould be consinusly analayesed The main fiscal incentive in the CAP remains the mandatory green payments which have been designed to have limited transaction costs (Lugato et al., 2014; Bonvillain et al. 2020), but is not tied to the sale and price of commodities, products or goods. The fiscal incentive have been found to have an impact on less than 5% of European agricultural land (European Court of Auditors, 2017). In particular, agroforestry represents only 4 % of the Ecological Focus Areas (EFAs) declared for green payments. The EFA option which was most often selected by the EU Member States is nitrogen-fixing crops (35–46%), which have uncertain impacts on soil carbon sequestration. Catch crops also represent substantial shares (15–35%) but they are likely mandatory in most cases and as such not additional (Mosquera-Losada et al. 2018).

AECMs do not provide a wide and common market incentive

Agri-Environment and Climate Measure under Pillar II of the CAP (AECMs) are voluntary. Some are highly additional (e.g. organic farming support) but some suffer from important windfall effects (Chabe-Ferret & Subervie, 2013). Overall, their complexity and associated high transaction costs has resulted in a limited take-up from farmers (Bonvillain et al. 2020). Beyond AECMs, other pillar 2 measures provide incentives to increase soil carbon storage. For example, Measure 8.2 subsidizes up to 80% of the investment costs of agroforestry. However, this measure has not been widely offered by European regions (Mosquera-Losada et al. 2018).Same line of argumentation, and limited offering of measures applies to afforestation and forest management (Alliance Environnemnet, 2017), and complements and confirms a picture of limited availability of fiscal incentives for actions with climate benefits.

The agricultural soils have some potential to be incentivised by market measures, and in particular price incentives would expectedly be very effective. In France, the potential for

additional removals from agricultural soils has been assessed at around 30 $MtCO_2e/yr$., that is one third of emissions from the agricultural sector at national level (Pellerin et al., 2019).

Wetlands/Peatland

Farmer responsiveness to price signals is high and this inherently includes wetland managers/owners. As peatlands exhibit very different yields, and these are closely to the water table, the below considerations must be used with due consideration. In any case, and different from arable farming on mineral soils, maintaining functional drains is an additional recurring operational cost on the balance sheet which likely fosters regular cost/benefits analysis by relevant land managers.

High opportunity cost for peatland restoration

In an EU context however, the CAP currently provides counter-incentive by raising the opportunity cost of wetland/peatland restoration which effectively makes peatland rewetting and restoration much less attractive even where yields are low. Wetland/peatland restoration entails foregoing 1st pillar CAP subsidies, at least for cropland, as GAEC standards require avoiding the encroachment of unwanted vegetation (wet grassland can be managed for productive uses, although with much lower productivity). Therefore, for drained wetland converted to cropland, the CAP creates an opportunity costs of an average 259 EUR/ha in direct payments, in addition to the net revenues from crop sales. With emission avoidance rates of 30 to 40 t CO_2eq per hectare per year (Tiemeyer et al., 2020) and current Voluntary Carbon Market prices of around 4-6 EUR per tonne for land use credits (Ecosystem Marketplace, 2020), it is not attractive to convert land eligible to support into wetland.

5.3.7. Low investment levels in particular for digital and sustainable land use practices and thus slow adoption

Not able to invest

Given a combination of drivers 3, 4, 5 and 6, many farmers find themselves stressed by decreasing margins and difficult access to financial markets, resulting in limited ability to invest in technologies and take risk on new methods on markets, unless having access to credits, support measures or government projects. While these measures are crucial for innovation in the farming sector, they are often also associated with controls, political pressures and preferences, and rather slow taking months or years from idea to realisation.

Technology lock in

As a consequence of this problem, and closely linked to problem 1, current and conventional technologies and practices are somewhat locked in. Adoption of hi-tech data generating farm equipment such as drones, sensors, mini-robots, and other IoT items are thus slow and add to the problem of inadequate or low quality data on emissions, removals, soils, and land cover/use in many parts of the EU. As data and more efficient new technologies are a core part of digital farm, their slow adoption becomes a problem for developing new business models in farming that can focus on and deliver tangible and quantifiable climate mitigation benefits.

5.3.8. Externalities are insufficiently monitored and quantified

Need for monitoring of trends in ecosystem services in the landscape

Externalities are not or only partially monitored and quantified at farm or forest levels, rendering result-based pricing to correct the market failure a problem. Data on carbon stocks and fluxes are not produced and shared by landowners, their industry organisations or the sector as such, and governments have not prioritised dedicated research programmes due to low perceived

political relevance until recently. Hence, it remains a problem that farm level data from the CAP (IACS, LPIS, self-reporting) and e.g. tractor-collected soil, weather, and productivity data are limited by data protection provisions and not available to researchers, authorities or the market. This means quantifying and understanding the current situation, establishing a baseline for results-based mitigation pricing and introducing fair and realistic pricing mechanisms is difficult as data are incomplete and sometimes lacking.

5.4. Concluding remarks

The concerted impact of the problems is structural resistance and barriers for changes in production systems imposed and incentivised by new or more stringent EU (and Member State) climate legislation, as market forces will counter and data remains scarce (as explored in Topic Notes 1, 2, and 5). This can be addressed through a combination of short- and long-term policy action, and further research and development work to better understand the drivers and problems, i.e. through better and more complete datasets.

5.4.1. Proposed goals for future policy work

Five overarching goals to be met

Based on the content already presented within this topic note, five proposed strategic goals have been chosen to consider for future policy work. These goals have been selected to address the drivers and problems and lead to a situation where farmers and forest owners increasingly adopt practices that increase the carbon stock in products, soils and forests:

- In the short term before 2030, EU and Member State targets and policy architecture address the market failure at governance level by fully incorporating quantitative GHG targets at least at Member State level for the LULUCF sector.
- Private finance can blend into and support public climate mitigation budgets, programmes and projects in the land use sector in the EU through e.g. investments
- There is a union-wide price on biogenic carbon as an asset and ideally ecosystem services in general
- Incentives and responsibilities for climate action are transferred to landowners, at first by developing and testing landowner level quantification and reporting of GHG and sequestration data
- Increase market demand for low-emission agricultural products

5.4.2. Future work to improve understanding and evidence of drivers and problems

Structural drivers beyond scope of climate policy

The identified problem drivers are in many case structural, and beyond the scope of EU Climate Policy (or most other land policies in Member States or EU) to deal with in the short to medium term before 2050. For these, a prudent approach is to consider them carefully when developing new policies and measures. This means that acting on the risks and opportunities inherent in the problems presented above, is an appropriate scope for future policy and measure design. Suggested future work on structural issues and risks and opportunities are presented in turn below.

5.4.2.1. Considering structural barriers

The main structural barriers for increased investment, uptake of new technologies, and long term, risk management capacity in relation to the transition to a climate neutral EU and European agricultural and forest sectors are ownership structures, unvalued carbon assets in soils, and high costs and costs level of European agriculture.

The ownership structures of each Member State are legacy based and tied to cultural heritage and economic macrolevel decisions in the past. It is hardly a matter for the Union to decide on, although the CAP over the years have led to structural changes in many regions towards bigger and more industrialised farms. The ramification of the different ownership structures as concerns average farm size and ownership of land (most for forest land), is that carbon farming and forestry schemes as well as any other mechanism to transfer incentive and obligations to land owner level, must have practices, regulations, administrative and control procedures in place for major categories of different farms and forest holdings.

Research into carbon assets in agriculture and forestry

The lack of valuation of passive carbon assets, means that in some cases the business case for losing soil carbon will be attractive for the landowner, in particular where the carbon is exported from the farm in products. A low-emission, biobased economy incentivising build-up of carbon in products and materials, where only emissions of GHGs to the atmosphere is priced and regulated, can still deplete carbon stocks and will need safeguards to protect carbon stocks. The scientific, GHG reporting and forecasting aspects of soil carbon are explored in Topic Note 2. The note highlights how both data and reporting practices on soil carbon in the EU can and should improve in order to provide policy makers a comprehensive and reliable picture on the state of soil carbon. Unfortunately, it seems that current reporting practices are incomplete, inconsistent and not at a level where transfer of incentives or precise tracking at field level is realistic. Therefore, assigning value to carbon stocks will rely on further conceptual research and development, better data and a regulatory framework. While LULUCF policy can be a major future lever for protection of soil carbon stocks, establishment of market-based price incentives to maintain carbon stocks is most likely a long-term goal.

CAP support and result based incentives in the meantime

Lastly, the high cost and debt levels of European agriculture remains a structural barrier beyond the scope of the LULUCF regulation and future policy development. Rather, as explored further in Topic Note 8 on the synergies between the CAP and LULUCF regulation in the future, creating technical and data infrastructure for future integration of LULUCF targets and CAP incentives, may be a viable way forward in the medium term. Providing more and more targeted climate incentives and support schemes in the CAP, can allow farmers to invest for and plan the climate transition even with limited access to finance and low risk appetite.

5.4.2.2. Acting on risks and opportunities

Several of the problems presented above also materialise as concrete risks and opportunities that can be acted upon in the shorter term before 2030. These relate to data and monitoring, supporting and nurturing carbon farming practices, and getting incentives right.

More and better MRV and data on soil carbon

High quality and resolution data and monitoring of carbon flows and stocks, and ecosystem services at farms and in managed forests in general, will be a crucial enabler for a future policy setup that can introduce clear price signals, farm level incentives and obligations, and hence create revenue streams from ecosystem services and allow valuation of carbon assets. These

aspects are also explored in Topic Notes 1 on Forest sink, 2 on Soil Carbon, and 5 on GHG reporting systems, as well as in Topic Note 4 on a long vision for the AFOLU sector as a major provider of carbon removals for a climate neutral EU by 2050.

Remove barriers for Carbon Farming

Carbon Farming with due consideration and eventually pricing of biodiversity results and co-benefits in general has been highlighted as a possible new business model for European farmers. The Farm to Fork Strategy proposes 27 specific legal action points within sustainable agriculture, one of which is a carbon farming initiative.[32] The carbon farming practices rely on good carbon and ecosystem data, and hold potential to enable the transfer of incentives and obligations to land owner levels. In the short term, peatland restoration and rewetting, agroforestry and possibly afforestation appear to have the highest potential as pilots for testing the approach. When done right, carbon farming can help address all the listed problems, however, to kick start its adoption a range of practical obstacles should be removed. High opportunity costs related to CAP eligibility for direct support, insufficient farm level data in many Member States, and unclear ownership and use of generated mitigation outcomes (e.g. credits) are among the main barriers, which could be resolved by dedicated study work, research programmes, standard setting for MRV, accounting and registry practices at EU level and knowledge sharing.

Test Carbon Removal Certificates early

The current weak incentives are difficult to correct completely before 2030 but will need a longer term vision and plan. In the short term, correcting for the restoration of wetlands is already seriously considered in the CAP negotiations, which is a promising start. Allowing flexibility of trading certain carbon removals certificates between industry and energy sectors and the LULUCF sector under a controlled test-schemes before 2030 will be important in paving the way and gathering lessons learned. It will show farmers that a viable system generating a revenue stream and creating a price incentive can be established. Ways and means for increased flexibility is further explored in Topic Note 7 on LULUCF sector flexibility options in the future.

[32] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0381

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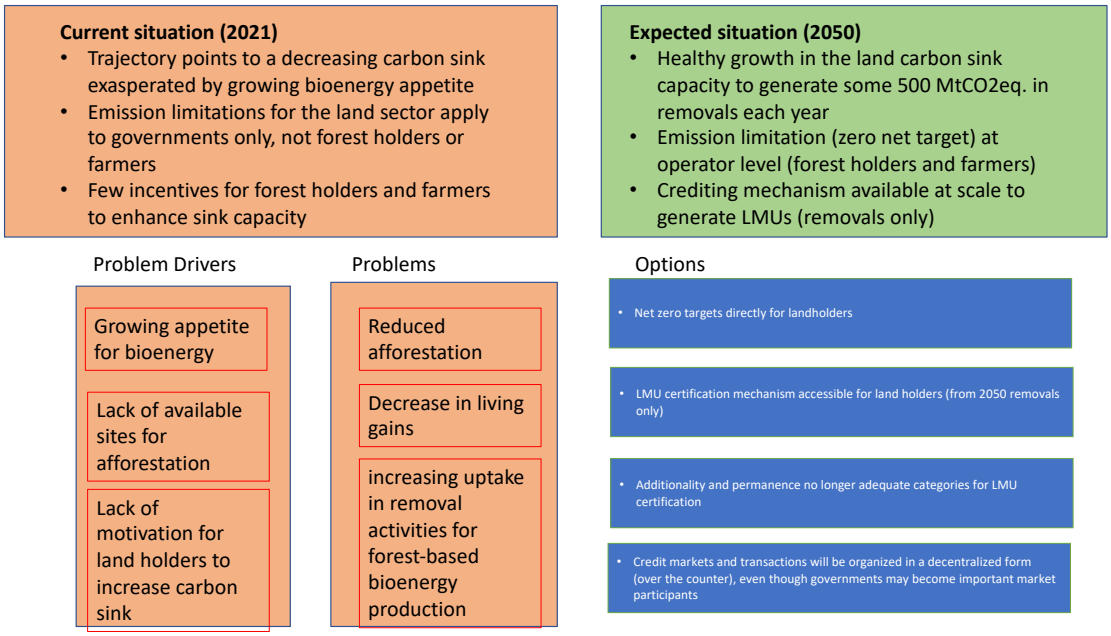
6. Topic Note #4: Vision for 2050



6.1. Introduction: The Land Sector in a Climate Neutral Europe

With the 2050 target set to achieving net-zero greenhouse gas (GHG) emissions and with the 2050 pathway taking shape with the endorsement of the 55% reduction target by the European Council (European Council 2020), the proposal on a European Climate Law (European Commission 2020) and the growing number of initiatives around the EU's new flagship initiative – the European Green Deal – there is still little clarity on how climate economics will look for EU citizens in the year 2050 and beyond.

There is equally little clarity on the specific policy parameters that will drive these climate economics. While this applies in principle to all economic sectors, it is particularly true for the land sector, which will serve an intrinsic triple climate purpose of (1) Reducing GHG emissions to the absolute minimum, (2) Producing biomass as biomaterial substitute and as feedstock to generate bioenergy, and (3) generating sufficient carbon sink capabilities and "land mitigation units" (LMUs).

As the enhanced climate purpose interacts with other functions of the land – producing food, feed and fibre, on the one hand, and providing crucial ecosystem services (such as clean water, healthy soils, pollination, stable waterways, and so forth) on the other – careful policy calibration will be needed. There are two significant issues at play here:

1. In its strategic long-term vision, the European Commission notes that bio-energy consumption may increase by up to 80% from today's levels (European Commission 2018). This puts additional pressure on, e.g. EU forests to deliver significant biomass to support the bioeconomy and run the risk of deteriorating in the long-term.
2. Emissions from agricultural production, for their part, may go down dramatically thanks to smart technologies (precision farming, manure treatment, etc.), diet changes and more. However, residual emissions from the sector will be generated beyond 2050 and require compensation from within the agriculture, forestry and land-use sector (AFOLU).

What these issues imply, is that the forestry sector as well as the farming sector will need to reduce or even bring their emissions to zero, while at the same time boosting carbon sink capacities. This task implies that drained peatlands and other wetlands need to be rewetted at a large-scale; that degraded forest lands are restored and suitable non-forest lands afforested (beyond the need to generate biomass stock); and that farmers and foresters take up agro-forestry and carbon farming practices at scale.

Overall, the AFOLU sector will become increasingly important, while the sectors of historic climate interest – energy sourcing and industrial production – will have faded in significance. In a world that produces 100% of its electricity and heat as well as most of its mobility and industrial production from renewable sources, the climate policy tools will shift their attention to (i) boosting biomass production, and (ii) providing a robust system that delivers negative emissions where and when they are needed.

6.2. Trends and Drivers

If unchecked, current trends of soil degradation, reduced afforestation activities, a decrease in living gains across the forest stock, and an increasing uptake in removal activities for forest-based bioenergy production will exacerbate the diminishing sink capacity of the land sector over the next 30 years.

Policies and measures to stop and revert the trend are highly important, but will need to be supported as well by technological advances across the spectrum of Nature-based solutions (NbS).

6.3. Emissions and removal ranges for the land use sector

The European Commission (2018) *A Clean Planet for all: A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy* assumes that the LULUCF sector will have -236 Mt CO_2 of emissions in 2050 in the Baseline[33]. As one land use example, forest lands, identified as the source of a diminishing EU sink in TN1, were modelled to have -321.8 Mt CO_2 emissions in 2020, -319.7 Mt CO_2 in 2030 and - 292.9 Mt CO_2 in 2050, an increase of 28.9 Mt CO_2. This change is “due to the ageing of the forest and an increasing mobilisation of forest biomass, mainly for material use (industrial roundwood, sawnwood, wood panels, paper, paperboard)”. This emission time series is shown in Figure 32.

Among the various scenarios that would go beyond the Baseline and that would reach between 85% and virtually 100% reduction (climate neutrality) by 2050, the 1.5LIFE scenario assumes the adoption of a more circular economy by EU business and lifestyle changes and consumer choices by EU citizens that demonstrate an increased climate awareness and are more beneficial for the climate. These changes include less carbon intensive diets, the sharing economy in transport, limiting growth in air transport demand and more rational use of energy demand for heating and cooling. The details of emissions as forecasted in the baseline and 1.5LIFE scenarios are shown in Table 17. It is expected that the LULUCF sector will need to deliver an additional 228 Mt CO_2 / yr sequestration by 2050.

[33] From European Commission (2018) page 46: “a baseline scenario (referred to below as “the Baseline”) was developed to reflect the current EU decarbonisation trajectory based largely on agreed EU policies, or policies that have been proposed by the Commission but are still under discussion in the European Parliament and Council.”

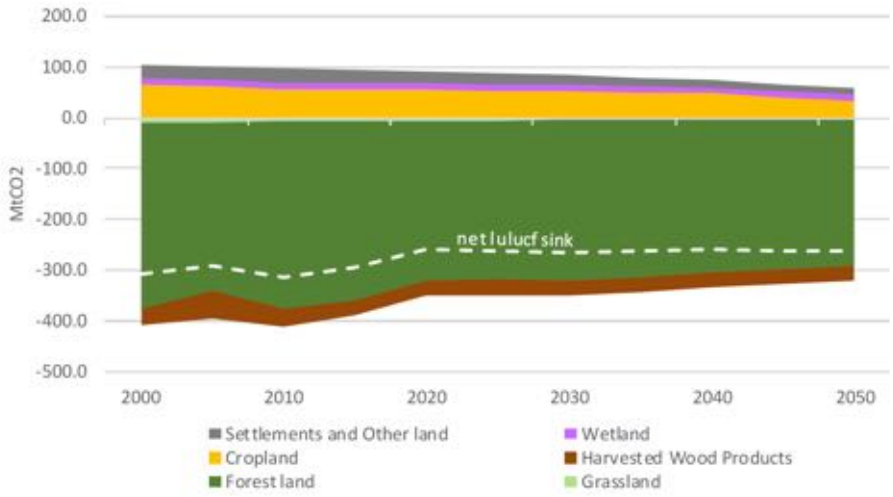


Figure 32: Evolution of emissions and removals from land use, land use change and forestry due to existing policies or policies under discussion (aka the "Baseline") Source: European Commission (2018), figure 13

Table 17:Details of emissions in forecasted baseline and 1.5LIFE scenarios
Source: European Commission (2018), table 9 page 198

	Baseline	1.5LIFE
	[Mt CO_2]	[Mt CO_2]
ETS GHGs emissions	772	123
Non-ETS GHG emissions	1,442	366
Total GHG excl. LULUCF	**2,214**	**489**
LULUCF	-236	-464
Total GHG incl. LULUCF	**1,978**	**25**
Details by sector		
CO_2 Emissions	**1,605**	**202**
Residential	130	11
Transport	667	95
Tertiary	78	19
Industry	484	53
Power	246	24
Non-CO_2 Emissions	**610**	**286**
Agriculture	404	230
Waste	90	29
Industry	116	27
Total GHG excl. LULUCF	**2,215**	**488**

In the European Commission (2018) document, the authors estimated that over 160 Mt CO_2 of enhanced emission reductions could be generated in the LULUCF sector at a range of CO_2 prices (Figure 33). This estimate does not include potential emission reductions from wetlands.

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Figure 33: The estimated potential for enhancing the LULUCF sink at different carbon prices. Source: European Commission (2018), figure 86 page 18

However, the 160 Mt CO_2 / yr is less than the required additional 228 Mt CO_2 / yr required in the 1.5LIFE scenario. An additional 68 Mt CO_2 / yr will be needed and they are assumed to come from the following:

> *"the implementation of agricultural practices aiming at improving the soil carbon sequestration makes possible for EU cropland to turn, in this scenario, from net carbon source to net carbon sink by 2050, with a LULUCF sink in EU increasing to close to 400 MtCO2."*
> Source: European Commission (2018) page. 185.
>
> and
>
> *"changes in consumer choice and circular economy, the combination of reduced energy consumption and increased availability of land allows for a potential larger role for afforestation and land restoration, reducing significantly the need for the deployment of biomass with CCS to achieve net zero GHG emissions."*
> Source: European Commission (2018) page. 197.

In their National Forest Actions Plans (NFAPs), Member States submitted the forecasted level of emissions from forest land remaining forest land during the 2030 – 2035 period. For the EU, the total was -306.6 Mt CO_2 / yr. This value is more positive (i.e. less sequestration) than the value assumed in the European Commission (2018) document (-319.7 Mt CO_2 / yr). This unexpected reduction in the LULUCF sink will mean that even more enhancement of the LULUCF sink will be required to meet the 1.5LIFE scenario and further highlights the need to reverse the trend in the LULUCF sink as soon as possible.

6.3.1. Technological advances and possibilities

Technological advances are under way and will be fully rolled out and refined over the next decades to benefit sink enhancement activities across the board. This applies, first, to novel approaches in climate smart forestry, climate smart agriculture, and carbon farming, including with respect to agroforestry, soil enhancement on mineral soils, sustainable farming on organic (peat) soils, and sustainable farming in coastal wetlands (kelp farming).

This applies, second, to data gathering and management, with improved accessibility of satellite imaging and other remote-sensing technologies, artificial intelligence to inform sink enhancement strategies at the EU, MS and the local level, and ready-to-use monitoring capabilities available to farmers, forest holders and other landowners at no or minimal cost. For a line-up of new technologies tested in 2021 see Klein 2021.

Third, this applies to new financial support, investment and other incentive products for smart, scaled-up interventions, reaching farmers and forest holders in all MS, offering simple terms of participation and substantial benefits.

6.4. Climate governance and policy design for climate neutrality in 2050

6.5. Policy shift

Today's flagship climate policies, the European Emissions Trading System (EU ETS), on the one hand, and the framework defined by the Effort Sharing Regulation (ESR) and the Regulation on the inclusion of GHG emissions and removals from land use, land use change and forestry (LULUCF Regulation), on the other hand, are forcing GHG continuous emission limitations and/or reductions on economic operators (EU ETS) or EU Member States (ESR, LULUCF Regulation).

In 2050, these policies will have lost much of their relevance for most sectors and technologies as these will have achieve zero-emissions production some time before. Instead, the 2050 policy focus will be on securing net-zero compliance, in the first instance, and the subsequent generation of negative emissions. In addition, some protections against backsliding will be necessary to prevent a default on the target.

6.6. Shifting scopes

It is not yet settled whether and for how long today's climate policies and emissions trading tools will remain in place in 2050 and, if so, in what form. The emission levels set for any sectors in any case would be much more stringent than they are today. The decarbonisation of the power sector will have mostly taken place; for example, the Clean Planet Report (Figure 11) recommends that the power sector reduces its emissions from 1000 Mt CO_2e in 2020 to 204 Mt CO_2e in 2050. But those installations and operations that continue to generate GHG emissions, such as steel, and cement will also be required to reduce their industrial emissions (from 863 kt CO_2e in 2020 to 471 kt CO_2e in 2050 – Clean Planet Report).

At the same time, emissions from across sectors – including energy and industry but also agriculture – will not completely disappear. Besides future technological solutions, it will fall primarily on the land sector to neutralize these emissions through stable, if not growing, sink activities.

6.6.1. Sector split

A possible scenario in this respect – to boost the land sector's sink capacities – is the redrawing of boundaries of a policy instrument, that combines most sectors of what today is covered by the EU ETS and the ESR, and the creation of a new AFOLU framework. The ESR framework, then, could largely disappear, though it might be needed in parallel to cover emissions from small-scale operators only. This new AFOLU regime might, on the other hand, incorporate the scope of both today's LULUCF Regulation as well as non-CO_2 agricultural emissions.

6.6.1.1. Shift of responsibilities

Moving beyond the ESR and the LULUCF Regulation would ideally go hand-in-hand with a transfer of responsibility from the MS to the operator-level. There would no longer be targets for MS – except concerning operations that are deemed too small to be covered by the AFOLU framework – but instead there would be strict targets at installation/operation level. It would, thus, work similar to today's EU ETS and establish monitoring and compliance obligations for economic operators.

Addressing the economic operators follows considerations of effectiveness. Defining (as the ESR and the LULUCF Regulation do today) abstract targets at government-level, without implicating the operational level, comes with obvious limitations as to what real change can be catalysed on the ground. Conversely, top-down target setting will have to be followed by domestic interventions at the farm/forest operator-level to become relevant. This is particularly true when considering the need to boost carbon sinks and have economic operators engage in creating negative emissions.

Another motive for addressing economic operators directly relates to climate justice. The more sectors, installations and operators from other sectors are under direct obligations to reduce

their carbon footprint, the less it is defendable to carve out a general exception for the AFOLU sectors as such. Operators in these sectors will have to carry direct obligations as do those from all other sectors.[34]

6.7. Targets and incentives

Several approaches to target-setting and incentive mechanisms are prima facie feasible.

6.7.1. Targets

The AFOLU framework for the year 2050, just as the EU ETS does today, could start from the polluter-pays principle where every operator has to account for their full emissions footprint. This would translate into a net-zero (climate-neutral) target at source, i.e. for each installation or operation covered by the rules. Operators are allowed to offset their emissions to the extent that they have taken all the necessary efforts to reduce their emissions footprint within their operations and that they are generating no more than the residual (necessary) emissions. They would be responsible for sourcing their LMUs on the market.

The alternative would be to involve MS with an active role. Operators would be issued a limited number of allowances to reflect those residual emissions. As long as they do not exceed them, no offsetting needs to arise at their level. By contrast, the net-zero target would be set at MS level in this case, and MS would need to plan for and invest in LMUs to offset the allowances granted to operators in recognition of the residual emissions burden.

While this alternative option has some advantages – control and curatorial power over supply, bargaining power in terms of offset price, and generally economies of scale – it also comes with risks. Governments may not be better than the market to organize offset supply; procurement may be slow and inflexible; operators by contrast might lack incentives to bring emissions to zero. At a general level, it would seem perhaps inefficient and arbitrary to both rely on market forces (emissions trading) and at the same time to have the government control a large segment therein.

The probably stronger case can be made for a decentralized, operator-focused approach whereby each operator (above a certain production threshold) would have to source LMUs directly on the market for any positive emissions they are responsible for. This said, the government may still retain an important, if limited in size, purchasing role to compensate for residual emissions from small-scale operators that fall below the threshold for direct coverage.

Another target-specific question concerns the idea of negative targets. The AFOLU framework, one could argue, should stipulate specific sequestration targets for farmers or forest holders. As the European Commission estimates (though the figures shown above in section 6.3 argue for some caution), the new AFOLU sector could become “rapidly climate-neutral by around 2035 in a cost-effective manner, and subsequently generate more removals than greenhouse gas emissions” (European Commission 2020a). Confining the AFOLU targets, then, to nothing beyond a net-zero benchmark could be seen as lacking in overall ambition. However, setting negative targets at operator-level would be technically difficult, and the very ambition behind any specific targets/benchmarks would almost certainly suffer (as these would likely be conservatively put). What is more, negative targets could be difficult to reconcile with the

[34] Cf. the jurisprudence of the European Court of Justice. In Arcelor (C-127/07) the court opined on the risk of social and financial discrimination. Relying on the precautionary principle and the polluter-pays principle, the Court clarified that the Community legislator “has a broad discretion where its actions involve political, economic and social choices and where it is called on to undertake complex assessments and evaluations” (para. 57). As long as the specific choice is based on “objective criteria appropriate to the aim pursued by the legislation in question” (para. 58), the legislation passes the test of judicial control. While the judgement permits that specific sectors are treated differently from others, it does not allow continuous privileges for one specific sector regardless of changing circumstances.

principles of 'do no harm' and 'polluter pays', which are fundamental underpinnings of climate policymaking (European Court of Justice 2008).

With this in mind, negative emissions should not be imposed through targets (negative targets) but rather incentivized through flexibility instruments. That the overall AFOLU sector generates more removals than emissions says little about the level of ambition at operator-level, namely for those that generate more emissions than removals.

6.7.1.1. Incentives

The AFOLU framework would squarely function as a cap-and-trade system, with each operator obliged to purchase removal allowances to offset all their emissions. Those operators that generate negative emissions can offset their own (positive) emissions or trade them to other operators that face offsetting obligations. They might even be able to trade their negative emissions – LMUs – into the EU ETS (on the difficulties, however, cf. Rickels et al. 2020) or any alternative policy tool still in force by 2050.

The issuance of tradable LMUs will require that operators/landholders have their sink activities certified. Establishing an effective and efficient LMU certification mechanism is a key challenge of the future. There are ample reasons not to wait until 2050 to install such a mechanism. By 2050, it is assumed that such a mechanism has already been established and operates smoothly.

Participation and Scale

While carbon crediting has proved successful across several project types – including afforestation/reforestation, soil carbon enhancement, and peatland rewetting – it is noted that almost all interventions have been modest in scale. The exception is the UK Woodland Code, an initiative to provide results-based finance for afforestation and reforestation measures, which has already given rise to more than 3 million removal units (COWI et al. 2021).

Creating a functional monitoring and certification process will be a key priority on the pathway to 2050. The growing number of (mostly voluntary) initiatives and crediting mechanisms – from Europe (Cevallos et al. 2019), North America (CAR 2020), Australia and elsewhere – offer a useful point of departure to build on and/or learn from. It is important to note, though, that none of the pilots and global precedents comes close to the scale of LMU generation needed by 2050. The European Commission has recently commissioned its own study on the potential and the feasibility of implementation concerning carbon farming activities, namely peatland restoration, agroforestry, enhancement of soil organic carbon in mineral soils and grassland enhancement (COWI et al. 2021). The certification mechanism needs to be built in a way that could absorb the higher end carbon estimates reflected here and in similar assessments on forest carbon potential (cf. Nabuurs et al. 2017; Grassi et al. 2019).

Table 18: Annual potential for additional sink activities per category (figures extracted from Nabuurs et al. 2017 and COWI 2021). Most peatland restoration (in italics) will have to happen or initiated prior to 2050 (emission reductions).

Activity	Annual potential (in MtCO2eq.) (additional to baseline emissions/sinks)
Improved forest management (full-grown coppice, enhanced productivity and management, reduced disturbances and drainage)	129

Forest area expansion	64
Forest reserves	64
Agroforestry	8-235
SOC enhancement (mineral soils)	9-58
Grassland management	4,000-8000
Peatland restoration	*2,000*
Total	6,274 – 10,550

There is a high probability that technological challenges for tracing GHG fluxes at minimal effort and at scale will be overcome over the next decades, if not years. It is less clear whether the societal challenges – ensuring participation of most, if not all, landholders – will be overcome simultaneously. Financial incentives can go a long way to facilitate this, but still require uptake from farmers and forest holders. Outreach and communication policies will be as important as the establishment of support facilities or firms – similar in design and function to energy service companies (ESCOs) – that manage certification and carbon asset generation activities for landholders.

Scope

Between now and 2050, the focus for the LMU certification mechanism will shift. Notably, by (long before, even) 2050, LMUs will no longer be issued for emission *reductions*. All emissions except residual ones (i.e., those for which the abatement cannot be done with reasonable cost and means) will have to be mitigated at operator/operation-level (without offsetting options from emissions trading sources).

Next, the mechanism will define the list of eligible sink enhancement activities and benchmarks for their use. Net carbon gains are not the only criteria. Biodiversity and resilience objectives will dictate which activities are admissible in which ecosystems.

Then, the mechanism could also prioritize specific project types, e.g. *landscape restoration* over *non-restorative afforestation*. Prioritization in this case could be expressed through a specific credit label. Those labels, in turn, may be needed for specific offsetting purposes (e.g., aviation or shipping operators must use landscape / seascape restoration credits).

Additionality

Additionality – one of the core principles shaping emissions trading or, more precisely, carbon offset trading prior to 2050, from Kyoto's clean development mechanism to Article 6.4 of the Paris Agreement – will no longer have a significant role to play. This principle sought to ensure that no fictitious carbon units, i.e. units that do not represent 'real' emission reductions, compromise the carbon markets and result in an overall increase of emissions (Michaelowa et al. 2019). It was used to fend off 'hot air' projections and accounting operations that created credits where there was otherwise no underlying emission reduction.

This function has become redundant in the world of 2050, when all sink projects will occur within an ambitiously capped environment, i.e., net-zero emissions. Instead, any (stable) sequestration gains in the sense of actual stock enhancement from eligible activities will be deemed, as a rule, certifiable and marketable regardless of whether carbon finance was instrumental in implementation. The capacity to enhance carbon sinks will, thus, be treated as a valuable and valorizable asset.

Permanence and Longevity

The stability of the carbon sink and the GHG benefits achieved will be a systematic requirement for the net-zero economy. However, at the operator (project) level, permanence will have lost its significance as a crediting requirement. Any stable GHG benefit generated by an eligible activity and duly verified can be certified without the need to show that the benefits remain in place for 20, 50, 100 years or longer.

This is because any subsequent stock loss (natural or human-made) will be accounted for as a liability for the landholder. While natural disturbances may temporarily exempt landholders from the net-zero obligation at the operator-level, this does not apply for areas that have previously benefited from carbon crediting which – in other words – carry a permanence liability. Human-induced carbon losses will need to be accounted for by all operators whether crediting has happened in the past or not. Small-scale operators may be exempt from monitoring and compliance obligations, though they, too, incur a permanence liability in the case of a carbon crediting legacy on their land.

To cover the liability, operators may pool their risks and invest in a credit buffer or purchase insurance that would pay for future liabilities from carbon losses. The regulator may consider making risk pools or insurance policies mandatory.

When it comes to project longevity, there will be no need for a minimum threshold (beyond a minimal timeframe of somewhere between 2 and 5 years to ensure that verification of stable carbon pools can be reliably made) or, indeed, a crediting ceiling. As long as sequestration continues and is verifiable, certification of GHG benefits and credit issuance will remain available for any project in principle. This said, the regulator should define crediting renewable timeframes (e.g. every ten years) and should retain the option to reject the renewal (perhaps after a project has been renewed already once) on the ground of policy priorities or changes (e.g., to boost certain project activities and/or new entries of operators).

6.7.2. Markets and Transactions

Climate neutrality will be a minimum target, with incentives set and used to frequently overachieve the target. This implies strict compliance and enforcement of operator-level neutrality targets, and the creation of publicly or privately held removal buffers to compensate for any shortfalls.

There is no need to strictly regulate the emissions trading market beyond today's regulation of financial instruments (MiFID). Transactions will be realized via exchanges and over the counter (OTC). Prices will float according to demand and supply.

This said, MS governments will control substantial market shares – a large portion of carbon sink areas are public lands across MS – and may have a bearing on pricing, too. In the event that they issue allowances for market participants in the EU ETS or any alternative tool (see above, section 6.7.1.1), they will need to net those issuances with negative emissions procured elsewhere. Then, if the ESR survives to cover all emissions from small-scale operations, again, there will be the need for MS governments to offset those debits. Finally, they may take on the role of building a removal buffer to compensate for any shortfalls.

To control sufficient supply at cost-efficient prices, MS authorities may hold regular reverse auctions in which farmers and other landowners/-holders bid for a price at which they are willing to sell LMUs. These auctions could define price floors – farmers and forest holders can sell at the auction price but may decide not to – which adds long-term predictability to the market.

6.8. Enablers: The road to 2050

The EU's land sector in 2050 will need to compensate for emissions in the range of 500 Mt CO_2 annually. That sink capacity will not be generated over night. Instead, it takes an ambitious agenda to halt and reverse today's trend of diminishing carbon sinks and to build a large-scale, resilient LMU infrastructure.

Several touchstones on the road toward 2050 need to be defined and met, including:

- A complete or close to complete reduction in emissions, notably of drained organic soils. While the trading with LMUs between 2030 and 2050 will be the main driver of sink activities, complementary regulatory, command-and-control-based may be needed along the road towards 2050. As Tanneberger et al. have shown in their case study for Germany (Tanneberger et al. 2021), achieving net-zero emissions by 2050 implies strict bans of drainage of agricultural and forestry soils and the raising of water tables across drained wetlands, with 2030 and 2040 representing important milestones. There is a risk that these milestones will be missed in the absence of regulatory intervention.
- The projections for the carbon sink show that in many land use types, the sink is diminishing. In particular, the projections for forestry show that there will be a slight decrease in the sink to 2050 at the current state of management and capacity. This is mainly due to the maturing of EU forests and the increased mobilisation of forest biomass, mainly for material use. Without increasing the capacity for forests to act as a sink, the road to net-zero emissions by 2050 will be a dead end.
- The Common Agricultural Policy (CAP) needs to complement the results-based finance mechanism through activity-focused command-and-control as well as incentive measures. Healthy growth targets for landscape restoration – in particular of organic soils – and sustainable, net-zero farming practices (including on wetted soils) must be inscribed in the CAP to help advance the carbon sink goals. The CAP infrastructure will also be important for the roll-out of the LMU certification mechanism (to include emissions reductions and removals before 2050 and removals only from 2050). The capacity for the CAP in farmer support and outreach is also necessary for uptake of financial incentives presented within a certification mechanism.
- Research and development – important drivers for the net zero transformation across sectors – will be instrumental for the success of the land sector to grow and retain its sink capacity while assuming and enhancing all its essential ecosystem services beyond climate mitigation. While many climate-smart technologies are available even today, much innovation will have to be generated in the future ensuring a maximum of stable-ecosystem-based sequestration, highest-performing biodiversity gains and, last but not least, resilience of the EU's land sector to a changing climate.

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7. Topic Note #5: Improve Reporting

no	5
Title	Improving reporting
Area of action (theme)	MRV
Short Background	LULUCF reporting in the EU is part of the Member States' and the Union's reporting under UNFCCC. Even though the current reporting framework is constantly improving and adapting, there are many gaps which have an unquantified impact on overall outcomes. The LULUCF reporting is highly dependent on field data, a lot of which is collected autonomously by Member States with limited EU coordination. The result is data which is heterogeneous and incomplete. This topic note describes the current state of reporting and points out problem drivers such as resources, lack of incentives for better reporting and lack of direct connection between reporting and the policy and economic sectors. The topic note defines a set of goals as a first step in the plan to overcome the defined problems. The goals cover proper monitoring of the contribution of all key activities in the inventories, simplification of the reporting, and increasing the visibility of the sector's contribution. Further, addressing the drivers could eliminate other reporting gaps in the accuracy of soil carbon and improve strategies regarding the necessity to increase the granularity of the reported data.

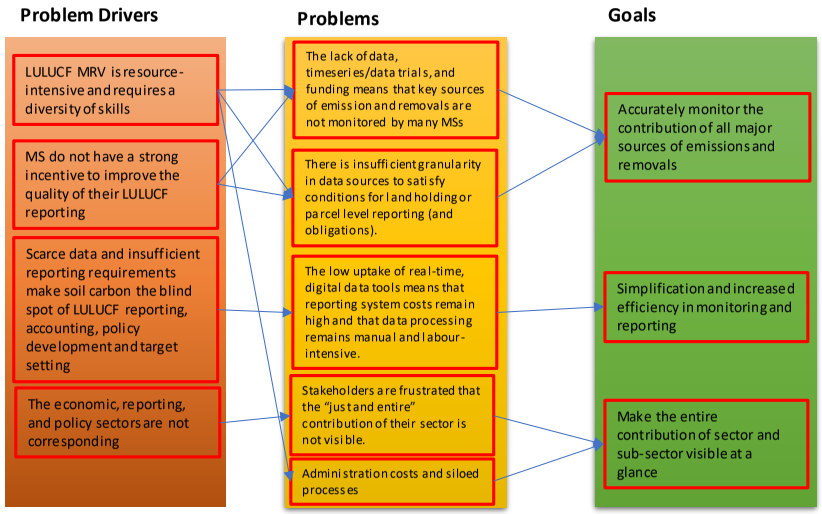
Schematic diagram of the topic note 5 Improve reporting system

Current situation and trajectory

Compilation of UNFCCC-compliant MS reporting
Complex assessment structure

Expected situation

More modern technology involvement
More EU level solutions/GP



Enablers

- Clear legal impulse

Ideas and solutions

Establishing common requirements for soil reporting

R1: Mandatory tier 2 approach monitoring the activity data (area) of these practices
R2: Mandatory, spatially explicit, tier 3 based peatland inventory from 2030
R3: A mandatory measurement-based approach post-2030 (Tier 3)
R4: A verified model which uses the area of these practices as inputs (Tier 3)

Other reporting rule-based solutions

R5: 2% materiality impact rule
R6: Develop a benchmark EU-level soil inventory based on LUCAS
R7: Area based RDP measures altering/managing carbon stocks submit LULUCF compliant mini-inventory
R8: Making available EU-level data on LPIS, and IACS and their use for MS use
R9: Making available pre-treated RS data for land use matrix improvement or verification

Capacity-building solutions (process, skills)

R10: Requiring multiple signatures on NIRs
R11: Building skills and understanding through mandatory UNFCCC review participation
R12: Establish LULUCF reporting help desk
R13: E-learning and seminars to stimulate exchanges of good practices between MS
R14: Explore possibilities to use (new) digital technologies for trends analysis and EFs
R15: EU review backed by CoA

Communication-related solutions

R16: Illustrate CRF tables with sectors and subsectors "at a glance"
R17: Explicit Bioenergy reporting EU CRF table and data viewer
R18: Removals and the rest
R19: A step towards a bio-based products category
R20: Reinforcing the "name and shame" incentive from review reports

7.1. Introduction

An overall aim of monitoring, reporting and verification (MRV) within the LULUCF sector is mapping out the very complex flow of carbon, communicating it in a simple way, and making all steps in the process transparent enough to be able to apply, compare and improve. While significant progress has been made, there are still gaps, often with an unquantified impact, which need to be resolved. An additional constraint is the high dependence on field data, a lot of which is collected by Member states with limited EU coordination and large heterogeneity in completeness. Correctly and fully measuring the natural sink is of paramount importance considering its role in achieving climate neutrality in the EU by 2050.

This topic note sets out to illuminate the most crucial gaps in MS inventories and suggests routes to address them. Underlying drivers such as resource- and skill-intensity of monitoring, lack of incentives to improve reporting, and lack of correspondence between the reporting, policy, and economic sectors incite and invoke a debate on how to best improve upon the systems in an agile and inclusive fashion. These drivers cause a lack of monitoring, most acutely with regard to soil carbon, due to a lack of data, timeseries, trials, and funding. They also halt the necessary increase in granularity that is often pointed out by UNFCCC reviewers; they cause artificially high costs due to a low uptake of technology, and inaccurate and inefficient monitoring due to a lack of best practices within modelling.

These problems call for goals about accurate and understandable MRV. Such goals are formulated in this topic note. Here, concrete options are described that can be implemented by the Commission to address and potentially overcome the challenges needed to place LULUCF MRV in the central role that climate change calls for.

7.2. Current situation and trajectory

The monitoring within the EU varies between Tier 1, Tier 2 and Tier 3[35] level measurements. Within Tier 3, the modelling is similarly diverse, and debate is still ongoing about which models are best. The biomass pool is accurately and precisely monitored in most Member states thanks to regular forest inventories (for forest land) and crop yield statistics (for cropland). This is in particular the case for the 5 largest “forest countries” in Europe (Germany, Sweden, Finland, France and Poland: 62 % of EU wood production and 58 % of EU forest area). The soil carbon pool however is still poorly monitored in most Member states, as well as the areas of drained and rewetted (and restored) wetland. Regarding soil MRV, the Danish case for cropland and having a regular soil inventory while implementing a modelling framework through the use of C-tool is likely the ideal system, yet Denmark is the only MS to have it currently in place (Please see Topic Note 2).

Currently, there are also several emerging technologies that are being adopted and implemented to a varying degree. These technologies include remote sensing, big data, machine learning, interface development (e.g. Land Parcel Information System - LPIS), IoT[36], and quantum computing is not far from joining this list (described further in Chapter 2). Currently, data is still too scarce and scattered for quantum computing or even to some extent big data to be able to contribute significantly to a better MRV. However, as IoT starts to get adopted post-2030, the data abundance and availability will enable models to use big data on available climate, land use, cadastre, Integrated Administration and Control System (IACS), rainfall, soil maps, dipwell measurements, crop production data, tractor traffic, tillage data,

[35] Tier 1: Using default data; Tier 2: Using country-specific data; and Tier 3: Using advanced methods and detailed country-specific data according to IPCC good practice guidelines for LULUCF.

[36] The Internet of things (IoT) describes the network of physical objects—“things”—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

fertilizer use, etc. to compute baselines, benchmarks, variance, and models that would significantly be able to complement classical LULUCF data.

Figure 34 below shows the dimensions reported on forestland to the UNFCCC. The tables for the other reported land types are similar (of course without the columns for litter and wood). The remaining right side of the reporting table refers to carbon stock changes and net carbon emissions / removals.

ACTIVITY DATA			IMPLIED CARBON-STOCK-CHANGE FACTORS						CHANGES IN CARBON STOCK AND NET CO_2 EMISSIONS/REMOVALS FROM SOILS						
Total area (kha)	Area of mineral soil (kha)	Area of organic soil (kha)	Carbon stock change in living biomass per area			Net carbon stock change in dead wood per area	Net carbon stock change in litter per area	Net carbon stock change in soils per area		Carbon stock change in living biomass			Net carbon stock change in dead wood	Net carbon stock change in litter	Net carbon stock change in soils		Net CO_2 emissions/ removals
			Gains	Losses	Net change			Mineral soils	Organic soils	Gains	Losses	Net change			Mineral soils	Organic soils	
			(t C/ha)							(kt C)							(kt)

Figure 34: The parameters reported annually.

In the LULUCF sector, activity data refers to the land area subject to a given land-use or management within a given geographical unit. Carbon stock change factors refer to the intensity of carbon flows per hectare for this land area. At aggregated levels averaging different land managements and geographical units, the weighted averages of emission factors are called “implied carbon stock change factors”. The research and monitoring leading up to this annual reporting is complex. The following Figure 35 illustrates the annual workflow moving from left to right, where the far-right side of the drawing is the reporting itself.

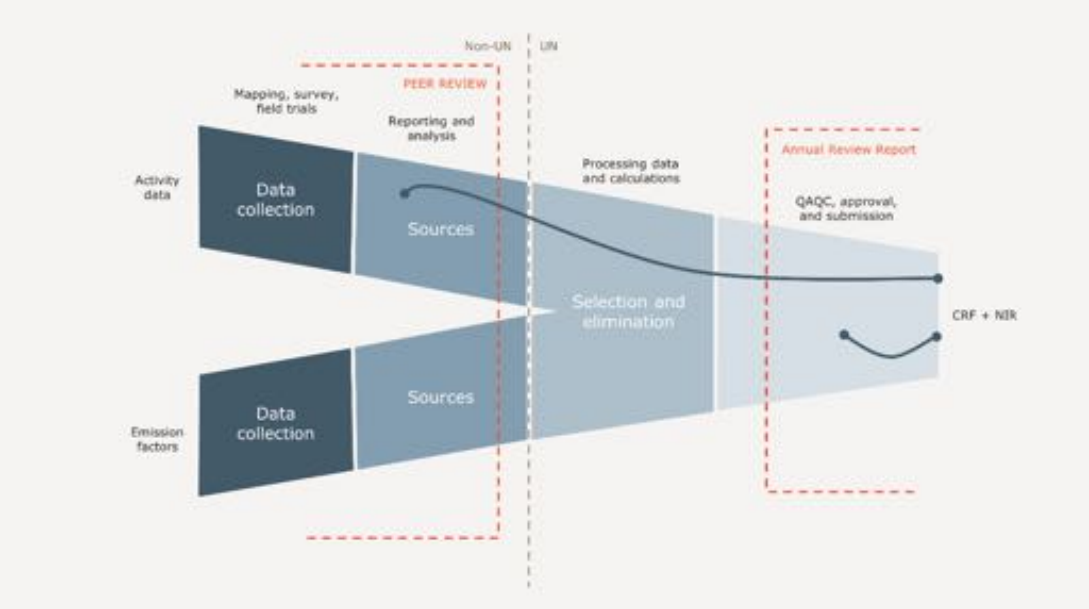


Figure 35: Process diagram illustrating the creation of Common Reporting Format (CRF) data and National Inventory Reports (NIRs) . The red dotted lines show the scope of reviews, and the blue lines show some examples of the back-tracing process in this assessment. In this case, one fluctuation can be traced back to the “sources” section of “Activity data”, and another fluctuation can be traced back to the “QA/QC, approval, and submission” part. Time is in this figure depicted as moving from left to right. The process is repeated yearly.

This process diagram shows how the data collection phase of any given year is synthesized in reports in parallel and independent tracks and not necessarily with any direct connection to each other or any UN goals. During the data preparation phase, a selection - and thus naturally also an elimination - is being conducted by the assessors of the reports with the overall goal to synthesize CRFs and NIRs.

Because of the complexity of this process, evaluating the process of reporting is correspondingly complex. As illustrated with the blue lines, the exercise of back-tracking can lead back to various stages within this figure. The place of origin can be examined for potential selections and eliminations of methods or data that can lead to findings about why any given pattern deviation found in the histograms is as it is.

In practice, reporting happens through annual submissions to the UNFCCC. Verification happens through independent UNFCCC reviewers. Both reporting and verification is currently on a MS level only, although the data is then compiled into an EU-wide GHG inventory. Here, NIRs and CRF tables are submitted annually and reviewed in technical annual review reports written by the UNFCCC reviewers. The UNFCCC has standards for compliance that have been updated and that are currently being implemented nationally.

7.3. Problem drivers

In total, the problems with carrying out cost-effective accurate monitoring are here identified as having three overall drivers. Before diving into the problems, these three drivers are presented:

1. LULUCF monitoring is resource-intensive and requires a diversity of skills.
2. Incentives for MS to prioritise the necessary investments, resources and attention, to bring LULUCF inventories to the necessary level for full and high-quality removal reporting are insufficient.
3. The correspondence between sectors as defined in GHG inventories and economic sectors is not straightforward.
4. Scarce data and insufficient reporting requirements make soil carbon the blind spot of LULUCF reporting, accounting, policy development and target setting

7.3.1. Problem driver 1: LULUCF MRV is resource-intensive and requires a diversity of skills

LULUCF MRV is inherently cross-disciplinary and cross-thematic. Understanding natural science and within this science the differences between forests, cropland, grassland, wetland and urban areas is key to finding solutions for LULUCF. Equally, understanding the differences within and between the legislative and financial playing field of the same dimensions are paramount to identifying and understanding the challenges in MRV. Also, science and technology behind available and new technologies is key to understanding the differences between the strengths and weakness of current and emerging remote sensing technology and being able to compare them with the strengths and weaknesses of current and emerging use of modelling combined with big data, neural networks, and IoT. Even communicating with 3d-modelling and mixed reality interfaces is important to be able to improve MRV. Human science is also critical.

Beyond the ability to understand this diversity of disciplines and themes, the inventory team must gather the capacity to understand and process data sources related to them, which range from field surveys to remote sensing and sector-specific statistics.

Each of these dimensions and perspectives can make the MRV-processes more difficult, distort them, and slow them down, and they all influence the evolution of the carbon sink.

7.3.2. Problem driver 2: MS do not have a strong incentive to improve the quality of their LULUCF reporting

Some of the data used in LULUCF reporting primarily respond to other important economic or policy needs. For example, forest inventories are primarily intended to assess wood supply and LPIS is primarily intended to control CAP payments. However, where such exogenous incentives do not exist (eg. peatland mapping or soil carbon monitoring), there is little incentive for MS to become able to report increased removals in subcategories or pools which are currently not adequately monitored. This is as a result of:

- Accounting rules diluting the benefits of being able to report improvements in the LULUCF balance. Currently, the LULUCF balance of a MS may improve without improving its ability to comply with its climate target (eg. because it has no ESR debit or because its LULUCF balance already allows for the limited possibility to offset an ESR debit, see TN 6 for details). This uncertainty on the benefits of being able to report LULUCF improvements lowers the incentive for accurate and precise monitoring.
- Monitoring rules allowing for not reporting a carbon pool as long as it is not a source of emissions (Regulation (EU) 2018/841, art. 5.4). They also allow to report under Tier 1 – which for litter and soil carbon is equivalent to not reporting – carbon pools in non-key categories or carbon pools which contribute less than 25-30 % of a key category (Regulation (EU) 525/2013, annex 3A). As a result, if the costs of monitoring a pool outweigh the perceived benefits of monitoring it, MS can be tempted to opt out. While such provisions make sense for materiality purposes, it decreases the incentive to adequately monitor all sources.
- Lack of visibility of GHGI review outcomes. Currently, the only incentive to comply with IPCC guidelines for GHGIs is of a “name-and-shame" nature. All points of non-compliance are reported by UNFCCC reviewers in biennial Assessment Review Reports (ARRs). Although the UNFCCC has improved the readability of these reports since 2015, they remain very technical and it is challenging for a non-reviewer to tell apart a good reporting system from a poor one on this sole basis. As a consequence of the limited audience, the “name-and-shame" incentive is also limited.
- Verification is mostly delegated to the UNFCCC and its accredited reviewers. Overall, the stringency of the UNFCCC accreditation and the biennial occurrence of inventory reviews ensures that major flaws in an inventory are unlikely to remain unflagged in the long run. There is nevertheless a heterogeneity in reviewer competence and dedication, partly linked to the lack of sufficient funding (e.g. the UNFCCC Secretariat does not have sufficient resources to pay for the travel costs of EU reviewers, let alone their time). As a result, the EU has little means to focus the reviews on categories or practices that it would deem particularly important (eg. wetlands, agroforestry, …) and to enforce its own interpretation of the IPCC guidelines for GHGIs.
- There is no monetary incentive for MS to maintain good reporting systems or improve them. In particular, the EU spends a lot of money on the land sector, mostly through the CAP, but these subsidies are not conditioned to proper reporting systems and therefore do not provide an incentive to improve reporting.
- There is an ineffective coordination between different national organisations (ministries, agencies…) which hampers the awareness of what synergies are there to exploit.

7.3.3. Problem driver 3: The economic, reporting, and policy sectors are not corresponding

In the UNFCCC guidelines, there are six reporting sectors:

1. Energy
2. Industry
3. Industrial gasses
4. Agriculture
5. LULUCF
6. Waste

There are also three EU policy frameworks for climate change mitigation, policy development, stakeholder interaction, and research:

1. Emission trading
2. Effort sharing
3. LULUCF

Furthermore, there are economic sectors (such as retail, transport, healthcare, etc.).

These sectoral breakdowns are far from aligned. The dissonance between these breakdowns and their stakeholder group distorts the flowcharts that would give policy makers and scientists alike the possibility to create crosscutting solutions for the EU carbon sink. Furthermore, the ability to translate between these three dimensions (the reporting, the policy, and the economic) is challenged by their inherently different metrics, structures, and reports.

Reporting (CRF tables) is structured around 5 sectors. But these "IPCC sectors" do not correspond to economic sectors or actual value chains. For example, the contribution of the forestry sector to climate change and its mitigation is spread across four IPCC sectors: *LULUCF* for the forest and HWP stock changes, *energy* and *industrial processes* for the substitution of other feedstock than wood, and *waste* for the decomposition of wood products. The same problem occurs for the agriculture and food sector.

Furthermore, simple HWP accounting may not capture full removal benefits. Many product uses are not clearly or accurately reflected, e.g. through country and product specific emission factors. Also, the scope of HWPs leaves out many long-lived biomaterials and products not directly produced from wood or harvest and sawmill residues. It has been suggested that the current coarse HWP accounting may underestimate actual removals by as much as 40%.[37]

In the same line of thought, agroforestry may not be captured in accounting under the forest definition. Accounting rules and practices give little attention to this promising practice.

7.3.4. Problem driver 4: Scarce data and insufficient reporting requirements make soil carbon the blind spot of LULUCF reporting, accounting, policy development and target setting

While emission factors in forestlands can be relatively easily generated with a high granularity by using decades old data sets about the tree species growth patterns combined with general climate and soil conditions, similarly high tier emission factors for soil carbon are less accessible. This makes soil carbon the major blind spot of current LULUCF reporting with as much up to 100 MtCO2e/yr of unreported fluxes, either emissions or removals (see TN2 for details).

[37] Steel, E. A., Officer, F., & Ashley, F. A. O. 2021. Carbon Storage and Climate Change Mitigation Potential of Harvested Wood Products.

In order to reach a high granularity of soil carbon emission factors, complex modelling is in theory a substitute to build up tables of emission factors in various conditions for various soil types. Unfortunately, even complex soil models fail to reproduce observed soil carbon changes in the MS where they are implemented (e.g. Austria, Sweden, see TN2 for details and demonstration). Therefore, there is likely no substitute to increasing soil carbon measurements and facilitating their availability at MS level. The recent launch in 2020 of the European Soil Observatory is step in that direction.

This need for improving soil carbon measurements is not sufficiently reflected in reporting requirements, accounting, policy development, and target setting.

7.4. Problems

The four above mentioned drivers lead to six distinct problems, namely:

1. The lack of data, timeseries/data trials, and funding means that potentially large sources of emission and removals are not monitored by many MS.
2. There is insufficient granularity in data sources to satisfy conditions for land holding or parcel level reporting (and obligations).
3. The low uptake of real-time, digital data tools means that reporting system costs remain high and that data processing remains manual and labour-intensive.
4. Stakeholders are frustrated that the “just and entire” contribution of their sector is not visible.
5. Administration costs and red tape.

7.4.1. Problem 1: Lack of data, timeseries/trials, and funding means potentially large sources of removals are not monitored by many MS

Whereas the CAP, economic interests and national legislative frameworks ensure a certain standard of monitoring of the area of croplands, grasslands and forest lands as well as the aboveground biomass in forests, accurate and precise data is lacking in many MS on carbon stock changes in soils (see TN2) as well as in the biomass of out-of-forest trees (agroforestry, hedges, …).

Even for croplands and grasslands, CAP data does not necessarily fulfil all the needs of GHGIs. Agroforestry or hedges for example are not necessarily recorded in LPIS, and both LPIS and IACS are limited to the land and practices which receive subsidies, leaving aside unsubsidized climate-relevant practices. Some MS directly use LPIS for their land-transition matrix (eg. Denmark), some indirectly use it (eg. France) and some do not mention it (eg. Germany).

7.4.2. Problem 2: Insufficient granularity in data sources to satisfy conditions for land holding or parcel level reporting (and obligations)

Even when the GHGI monitors practices associated with removals, it may not do so with sufficient granularity to be translated into a parcel-specific incentive. In France, for example, the presence of cover crops is monitored through the “farm practice” survey which documents a very limited sample of farms every 5-6 years. While it is sufficient to estimate the frequency of a given practice at national scale, it is not suitable as a basis for parcel-level incentives. This coarse granularity is becoming increasingly problematic in line with the increased political

ambitions to increase the carbon sink in the EU. Whether future policy incentives to do so come through the CAP or through a dedicated carbon farming scheme, a fine monitoring granularity is becoming increasingly essential.

7.4.3. Problem 3: Low uptake of real-time, digital data tools means reporting system costs remains high and data processing manual and labour-intensive

The assimilation of technologies into the LULUCF MRV is not fast enough to keep the cost down. This is because of several factors.

1. The technological readiness of key tools such as IoT, neural networks, big data, and quantum computing is not yet at the point where is can be easily accessed, understood, and used. Remote sensing products are more readily accessible for monitoring purposes (eg. Copernicus or the Global Forest Change dataset), yet they are still seldom used in GHGIs.
2. The siloed management of data between ministries, departments, and sectors does not invite sufficiently for the broad collaboration needed to adopt such new technologies at the required cross-disciplinarian spectrum.
3. The complexity of the emerging technologies is still at a stage where they have not yet been made intuitive for non-experts to understand, let alone use. This leads to manual and labour-intensive implementation plans.

7.4.4. Problem 4: Stakeholders are frustrated that the “just and entire” contribution of their sector is not visible (e.g. spread across the LULUCF and energy sectors)

Thus far, the LULUCF sector is not sufficiently incentivized, conditionalized, and financially supported, and because of this, the policy is not giving enough use of the LULUCF-related removals[38]. The inconsistencies across the three economic, reporting, and policy sectors cloaks and blurs contributions made by the individual stakeholders, creating a feeling of red tape and lack of political ambition.

The inconsistencies between economic, reporting, and policy sectors not only frustrates stakeholders, but are also a source of confusion for interested non-LULUCF-experts and policy makers to understand. This information barrier keeps the LULUCF data at a hand's length from financial and legislative incentive inclusion.

7.4.5. Problem 5: Administration costs and siloed processes

LULUCF is a complex and vast sector which touches land uses and economic sectors that have historically been at the core of business of different departments, agencies and ministries in the public administration at national scale (e.g. forest, environment, agriculture, nature, etc.). These departments, agencies, ministries, and Universities are siloed clusters where information often flows imperfectly, and where data can be both marginalized, incompatible, and inaccessible. Researchers producing data and estimates of GHG fluxes may not communicate it to the agencies in charge of GHG reporting, while these agencies often fail to

[38] This is however understandable as the LULUCF's separate target has only recently been introduced. The MSs (people beyond the LULUCF world) should now be made aware of this, and in some MSs the work has already started concretely.

involve academic researchers in their quality assurance process. This drives up administration costs and hinders the full exploitation of all available information for reporting purposes.

7.5. Goals

Each of the six problems described above have solutions that can be achieved by setting goals. In this case, particularly three goals are worth mentioning here. They have a relatively large potential for improving the monitoring.

7.5.1. Goal 1: Accurately monitor the contribution of all major sources of emissions and removals

Through the three following tracks, MS need to improve their monitoring:

1. EU-MS work programme on soil inventories and soil carbon modelling
2. MS research to establish benchmarks and soil maps, in particular for wetlands and peatlands
3. Digitisation and digitalisation of soil inventories
4. Activity data on out-of-forest trees such as agroforestry and hedges.

Data on agroforestry, wetlands, peatlands, lands with cover crops, lands with temporary pasture, and with the use of HWPs in the buildings sector are important to measure early in order to advance towards the 2030-targets. Moving towards a world with higher incentivisation is essential to ensure that all key activities are accurately monitored.

7.5.2. Goal 2: Simplification and increased efficiency in monitoring and reporting

First of all, flows need to be digitised through measurement. IoT is improving this capability and will continue to do so the coming decades. Already, however, there are many datasets that are unused or underused (e.g. LUCAS, LPIS, ...). Data across many platforms need to be merged, and metadata needs to be produced. This is a fundamental step to increase geographical and temporal accuracy substantially. This merging requires improvement in data storage as well as data modelling across platforms.

Simplification of the processes resulting in monitoring and reporting, illustrated in Figure 36, makes both MRV as well as communication easier. Such a simplified data flow requires adoption of advanced technologies, simplified graphics, increased intercommunication between data sets, and larger transparency.

7.5.3. Goal 3: Make the entire contribution of sector and sub-sector visible at a glance

The importance of the LULUCF sector for 2030 targets and 2050 climate neutrality remains largely un-recognized outside sector stakeholders and climate mitigation experts. Partly because of its perceived complexity, partly because of the complicated reporting of the sector, and perhaps partly because of socio-economic circumstances. Therefore, the current communication gap must be bridged by intuitive graphics, tables and texts that are accessible for non-experts both nationally and internationally. These contributions must be understandable enough to also foster closer collaboration between currently siloed sectors and organisations.

7.6. Incentives to improve monitoring

The reporting of complete, wall-to-wall, consistent, updated and accurate data are the basis for high integrity accounting, target setting, compliance checking and eventually land holding level incentive transfer. This section presents and explains ideas and suggested solutions for improving reporting of the LULUCF sector across the EU. Some of the solutions overlap or represent partially different means to achieve the same improvement, which is on purpose. The list of approx. 20 solutions proposed is therefore not a list of 20 unique, mutually exclusive solutions. These proposed solutions solely reflect the views of the authors of this document and do not reflect the views of the European Commission.

7.6.1. Establishing common requirements for soil reporting

As outlined, scarce data and insufficient reporting requirements make soil carbon the blind spot of LULUCF reporting, accounting, policy development and target setting (Please see TN 2 for detailed justification). The problems are tier specific and presented below.

Tier 1: E.g. Only a few MS report soil carbon in the "forestland remaining forest land" categories, and most of those MS have been reporting a constant or almost constant value since 1990.

Tier 2: There is more reporting for other "land remaining land" categories, but there is little measurement. Some countries use Tier 2, which is more accurate, but in these Tier 2 approaches, the key activity data or variables worth monitoring are often not the ones actually being monitored. In many MS, the Tier 2 method boils down to distinguishing annual and perennial crops. In the case of France, activities such as agroforestry and temporary pasture have a large mitigation potential and are left unmonitored. The three activities actually monitored are cover crops, low tillage and crop residues, which, except for cover crops, have little mitigation potential at national scale (Pellerin et al., 2019). This demonstrates that the current implicit requirement from the LULUCF regulation (article 7) that soil carbon in key “managed land” categories be monitored using at least a Tier 2 approach is not sufficient to ensure that the most promising activities to increase removals are properly monitored.

Tier 3: Similarly, most MS that have adopted a Tier 3 level use models that are not valid: the model is not able to reproduce historical data from soil inventories (e.g. Norway, Sweden and Austria – see TN2 for details). As a result, soil carbon changes being reported are likely very far from actual soil carbon changes.

In addition, models have to be reactive to the policies that the MS want to use, but this is rarely the case with a few exceptions such as the model used by Denmark, which is a responsive model sensitive to crop yield and cover crops. These are two important drivers that are often left out. This pitfall can also happen with a Tier 2 approach (see above).

Very few MS actually measure soil carbon changes for all land uses: Belgium recently stopped, France had its first remeasurements in 2020, and Denmark and Sweden do it regularly. Supposedly, 1-2 other MS do measure soil carbon. Some countries have monitored as specific land-use type (e.g. Germany or Austria for forest soils).

In terms of ways to address the shortcomings of current soil modelling, there are three ways for reporting systems to be reactive to major levers of soil carbon sequestration (agroforestry, cover crops, temporary pasture, wetland drainage or rewetting, and to a lesser extent, hedges):

7.6.1.1. Solution R1: Mandatory Tier 2 approach, with a requirement to monitor the activity data (area) of key practices

The practices above are the most influential on soil carbon stocks. Therefore, their emission factors should be refined, but even more important is to obtain accurate and up to date activity data. The solution is therefore to mandate that activity data for these practices be monitored, possibly using innovative data sources (see 2.2.4) which would also improve the comparability between MS.

The Pro of this requirement is that it will provide a key improvement in the ability of GHGIs to respond to best management practices regarding soil carbon. It would likely be the cheapest monitoring approach to guarantees this, and it is already partly in place in several countries (see TN2).

The Con is that if activities are made the centre of attention emission factors would remain a large source of uncertainty. Also, other important drivers of soil carbon changes (crop yield, temperature, moisture, …) could be overlooked.

Regarding forest soils, no practice with a large storage potential has been identified (see TN2). However, full tree harvesting has been identified as a threat for soil carbon (Achat et al., 2015). It could therefore be added to the list of key practices to be monitored.

7.6.1.2. Solution R2: Mandatory, spatially explicit, tier 2 based on wetland inventories

Wetlands are carbon-rich landscapes with significant potential for avoided emissions to be reported and accounted, not to mention longer term potential for significant carbon sequestration. Therefore, in MS where drained wetlands and peatlands are reasonably expected to be a key soil category (i.e. exempting Greece, Cyprus, Malta, etc.), the highest quality requirements should be imposed on MS.

The requirement from Regulation (EU) 2018/841 that managed wetland be included in MS commitments (art. 7.3) may draw MS to dedicate more resources to wetland monitoring, but without explicit minimal requirements on activity data and emission factors, wetland monitoring may remain inaccurate (see TN2). Tier 2 approaches from the 2013 IPCC Wetland supplement with country-specific emission factors, or measurement-based Tier 3 approaches, should be imposed. Either of these solutions will necessitate the implementation of wetland inventories covering all organic soils, that is both current and former, drained, wetlands. The primary objective of these inventories should be to regularly update activity data, that is the area of drained and restored organic soils. However, these inventories should also include soil carbon measurements which can either be focused on a few cases if the objective is to derive emission factors for Tier 2 approaches, or regularly repeated over a large and representative sample to support a measurement-based Tier 3 approach.

7.6.1.3. Solution R3: A mandatory measurement-based approach post-2030 (Tier 3)

While the impact of several key practices on soil carbon is known with a reasonable confidence (see above), there are still enormous gaps in the knowledge of soil carbon dynamics. For example, while several models have been validated for biomass changes in forests or crop yield in agriculture, most soil carbon models remain unable to reproduce soil carbon change

data (e.g. Mao et al. 2018)[39]. As a result, there is currently no alternative to a proper soil inventory to know the overall trend in soil carbon changes in land remaining land categories.

The Pros are that it would shed light on the most important blind spot in current EU LULUCF reporting. The Cons would be that it is costly and demanding in terms of know-how, analysis capacity (both physical analysis of soil samples and statistical analysis of results) and planning to achieve this. Three ways to mitigate this: 1) mandate it only for large countries; 2) mandate it only at meta-country level (e.g. allow a single soil inventory for several similar/neighbouring countries); 3) organize an EU-wide soil inventory.

A coarse estimate of the cost of an EU-wide soil inventory not accounting for the synergy with LUCAS puts the figure at 15-55 million euros per year for the EU (see TN2).

7.6.1.4. Solution R4: A verified model which uses the area of key practices as inputs (Tier 3)

This approach is often promoted as a cost-saving alternative to soil inventories. Its major pitfall however is that few models are actually able to provide valid simulations of soil carbon changes at national level (see above and TN 2). This pitfall leads to two sub-solutions: a) an EU research strategy to develop and regularly validate such a model and b) refining the reporting requirement to curtail the use of invalid models in GHG inventories.

In principle, such invalid models are not allowed by IPCC guidelines. Yet, it may take several UNFCCC reviews to notice that a complex Tier 3 approach is invalid, and when such invalidity is notified in review reports, countries do not necessarily correct the model or change the monitoring approach (e.g. Reverting to Tier 2). The UNFCCC designed an online training on reviewing Tier 3 approaches to address this pitfall, but without success.

Therefore, the EU could impose minimum requirements for any model contributing to reporting of a key category, and a core principle should be that models are verified. Furthermore, any future EU review of GHG inventories should require a response from a reviewer and a MS to the questions: “If a modelled Tier 3 approach is used for soil carbon, has the ability of the model to reproduce soil carbon changes as measured by soil inventories at the national scale of the country reviewed been demonstrated?” To avoid a heterogeneous assessment of this demonstration, as was the case for the ability of FRL models to reproduce historical data, prescriptive guidance and tools could be developed (please see TN6).

From a legal basis point of view, the revised LULUCF regulation could require that one or more of the solutions R2-R5 are applied for key “land remaining land” categories, “cropland remaining cropland” likely being the most important one.

7.6.1.5. Solution R5: 2% materiality impact rule

Materiality means allocating resources in proportion to the size of emissions sources and the level of uncertainty. For example, wetlands in Greece are much less significant and offer much lower mitigation potential than in Sweden. This would suggest allowing the use of a lower tier or exemption for Greece.

A solution could be to introduce a "2% impact rule" into the LULUCF regulation (note that this is conflicting with the higher stringency of the UNFCCC guidelines which set the cumulative threshold 0.1% of national emissions), which would relax the reporting requirements for sources smaller than 500 $ktCO_2e$/yr and 0.05% of national emissions, up to a cumulated 2%.

[39] Mao, Z., Derrien, D., Didion, M., Liski, J., Eglin, T., Nicolas, M., Jonard, M., Saint-André, L., 2018. Modeling soil organic carbon dynamics in temperate forests using Yasso07. Biogeosciences Discussions 1–39. https://doi.org/10.5194/bg-2018-219

Whenever a country would use such a materiality rule to avoid a higher Tier reporting requirement, the country should estimate the order of magnitude of the corresponding source based on reasonably recent – e.g. at most 20-year old – data. Harking back to the example of wetlands in Greece, an option could be to estimate their area and demonstrate that even if they were all drained, the associated emissions would remain below the materiality threshold.

A few precisions or guidelines could be added to make this materiality provision more operational:

- Specify how the demonstration that a given category meets the "insignificance" criterion can be provided. Examples could be the use of activity data and/or emission factors from a comparable country or an existing publication allowing an estimate for a given year.
- Specify how often the demonstration that a given category meets the "insignificance" criterion needs to be provided. 10 years could be a reasonable period: a minor source is unlikely to become major in less than 10 years.
- Increase the cumulative total to 1% or 2%. Such low percentages are already much below the uncertainty of national totals. Requiring that resources be put to improve completeness beyond 98% is arguably of lower priority than investing these resources to reduce uncertainty on the already estimated sources.

A key challenge with these solutions is that they would make the EU reporting requirements diverge from the UNFCCC ones. Being more "lenient", they will have little effect as long as EU countries continue reporting to the UNFCCC. An option would be that the EU negotiate the inclusion of such changes in the next set of UNFCCC reporting guidelines.

Materiality provisions could also be introduced in the verification/review process. For example, the urgency to take action on an identified error in reporting or the severity of the review report (see solution R20) could be inversely proportional to the amount of emissions at stake. Note that the UNFCCC review process however does not include any materiality provision.

A large majority of the participants to the workshop held on "LULUCF Reporting and Accounting approaches"[40] supported Tier 2 reporting only above a minimal threshold.

7.6.1.6. Solution R6: Develop a benchmark EU-level soil inventory based on LUCAS

The "Land Use/Cover Area frame statistical Survey Soil" or simply LUCAS is an EU-wide soil inventory, which is repeated every 3-7 years depending on budget allocation and practical feasibility. After its third campaign in 2018, up to 45,000 samples have been taken and analysed, most of them recurring. In the 2009-2012 campaign, a limited range of parameters were measured, and hence absolute soil carbon (in weight) could not be derived, but this has later changed. As of now the resulting inventory of spatially explicit soil data on key parameters including organic soils holds valuable information that could complement MS data, serve as basis for improved MS or regional soil maps, or provide benchmarks. As more measurement cycles are completed before 2030 (and possibly more sample sites and parameters covered), the soil database could also support regional emission factor development, separate organic soil or peatland reference data sets, or even EU level soil carbon modelling valuable for future reviews, baselines or natural disturbance issues.

The lack of soil maps in some MS and incomplete or weak data for emission factors warrants a recommendation to make wider use of LUCAS. It is therefore proposed to study and refine

[40] The workshop "LULUCF Reporting and Accounting approaches" was held on 18th November 2020. The presentations and discussions were used to design or refine several proposed solutions in this topic note as well as in TN 6.

how future campaigns could best serve LULUCF soil reporting and allocate EU funding to JRC for this purpose. In parallel, existing data should be used to produce benchmarks, national maps and support services for MS. A third component could be to prepare for the development of a database of Emission Factors and eventually an EU soil carbon and GHG model with sufficient spatial granularity to offer MS specific modelling.

Sample size is a key element to assess whether LUCAS could, in time, replace existing national soil inventories for national-level estimates such as GHG inventories. The current sample size of LUCAS is comparable to existing soil inventories, with variability between MS (Table 19). This comparison shows that the use of LUCAS for national-level estimates is realistic, especially considering the possibility to use points from neighbouring countries with similar characteristics.

Table 19: Sample size (number of sites, with often 4-5 measurements per site) of a few existing soil inventories.

Member State	LUCAS sample size in 2015[41]	Sample size of the National inventory[42]
France	3050	2158[43]
Belgium	146	629[44]
Denmark	222	336-590[45]

7.6.2. Solution R7: Area based RDP measures altering/managing carbon stocks submit LULUCF compliant mini-inventory

In some MS, the Rural Development Plan (RDP) measures have already been used to pilot or test actions to protect or enhance the carbon stock in peatlands, organic soils, or trees. However, the mandatory result or impact indicators are usually coarse and standard methodologies for estimating the direct impact of the measure at field, farm or measure/national level are lacking. Expectedly, several MS will use RDP measures in the coming CAP period to prepare and test results-based interventions and some may even prepare for Carbon Farming schemes with associated mini/restricted (domestic) carbon markets.[46]

In view of this situation, it is recommended to develop a suitable RDP specific standard for reporting of GHG impacts from e.g. peatland restoration, agroforestry or afforestation, and require in both CAP and LULUCF regulation that the MS level methods are internally consistent and any impacts are directly and explicitly listed and used in the LULUCF inventory. In practical terms, the requirement could focus on regional or measure specific mini-inventories to be set up. The inventories should minimize the administrative burden on farmers or forest owners, and push MS to invest more resources and capacity in LULUCF inventories. Such a

[41] https://esdac.jrc.ec.europa.eu/public_path/shared_folder/dataset/66/JRC121325_lucas_2015_topsoil_survey_final_1.pdf

[42] When the sample size varies between measurement campaigns, a range is provided.

[43] Meersmans, J., Martin, M.P., Lacarce, E., De Baets, S., Jolivet, C., Boulonne, L., Lehmann, S., Saby, N.P.A., Bispo, A., Arrouays, D., 2012. A high-resolution map of French soil organic carbon. Agron. Sustain. Dev. 32, 841–851.

[44] Meersmans, J., Van Wesemael, B., De Ridder, F., Dotti, M. F., De Baets, S., and Van Molle, M.: Changes in organic carbon distribution with depth in agricultural soils in northern Belgium, 1960–2006, Glob. Change Biol., 15, 2739–2750, 2011.

[45] Taghizadeh-Toosi, A., Olesen, J.E., Kristensen, K., Elsgaard, L., Østergaard, H.S., Laegdsmand, M., Greve, M.H., Christensen, B.T., 2014. Changes in carbon stocks of Danish agricultural mineral soils between 1986 and 2009: Soil carbon storage and management. Eur J Soil Sci 65, 730–740.

[46] Matthews, A. 2020. Promoting climate action in the future Common Agricultural Policy. Italian Review of Agricultural Economics, 75(3), 19-24.

requirement could be a precursor for a later system to prevent double-counting and inconsistencies between CAP payments and carbon prices for LMUs.

7.6.2.1. Solution R8: Making available EU-level data on LPIS, IACS, and their use for MS use

The LPIS maintained for CAP reporting and compliance purposes can also be used for the land transition matrix, at least for changes related to cropland and grassland. The destination or origin of the transition may not always be known (e.g. Forest or settlement) but at least it provides total losses and total gains. It should be noted that the LPIS does not necessarily accurately cover unsubsidized areas. Depending on national circumstances, LPIS may be used for activity data on subcategories (e.g. Agroforestry, hedges, …) or as data for verification, control or as supplementary data source. Where a given practice can reasonably occur only if subsidized (e.g. afforestation in Denmark), IACS can be used for activity data on this practice.

LPIS and IACS data are generated and owned by MS so in principle, MS could already be using them for GHG reporting. However, few of them do it, likely because this data is in practice not readily available in a user-friendly format to inventory compilers in most MS.

A combination of specific actions could serve to enhance the use of LPIS and IACS data for LULUCF reporting, among others:

- A data viewer or common interface hosted by EEA and/or JRC where inventory makers and the public can access prepared land transition matrix based on LPIS data and download datasets. The data viewer should also present EU level aggregate data, land transition matrix and other relevant information.
- To ensure a regulatory push, a revised LULUCF regulation could impose a requirement for MS to ensure consistency for activity data reported for CLrCL, GLrGL, and various other key categories, and national LPIS data on area and land use changes.
- A reverse consistency requirement could be introduced requiring future compliance reports of MS and national control guidelines to ensure that (by e.g. 2026), farm level area or land use changes are reported to the GHG inventory team and any inconsistencies between IACS data and LULUCF land transition matrix are explained in a non-technical narrative and made public.
- An EC led study to map and understand data ownership, restriction and sharing issues for LPIS and IACS in view of a later review or amendment of the EU legislation to remove legal/regulatory barriers at EU level and help MS do the same. This should include workshops and a guideline for use of LPIS and IACS data for LULUCF reporting and the land use matrix.

7.6.2.2. Solution R9: Making available enhanced/value-added RS data and products for land use matrix improvement or verification

Various Remote Sensing data and products can be used for the land transition matrix, possibly in combination with LPIS. Depending on RS products, it may be possible to obtain activity data on subcategories (e.g. cover crops, hedges, …). Wall-to-wall land use maps are deemed to be a key component to improve reporting. However, only a few MS have tapped into this data source. The barriers for this are not clear. To understand and respond to this situation, three successive actions are recommended:

1. An EC study and/or JRC work process targeted at use of Remote Sensing products for populating CRF tables, identifying technical, capacity and budgetary barriers and proposing solutions to these.
2. A JRC or EEA hosted platform gathering, pre-treating and offering RS products for GHG inventory making.
3. A help desk for GHG inventory staff on RS products.

7.6.3. Capacity-building solutions (process, skills)

The below proposed solutions all relate to the process, staff, or political capital to be invested in GHG inventories for the LULUCF sector and not the population of the CRF tables themselves. Two particular priorities have been guiding the development of solutions:

1. In many MS, different datasets in different institutions co-exist but are not combined or used for various reporting purposes. Some of these could be useful for the GHGI compilers, but due to institutional barriers they may not be aware of the data let alone have access to it. In order to accommodate for these inconsistencies, increasing awareness of the LULUCF inventories would be direly needed in most MS. Therefore, many of the solutions contain an element directly or indirectly promoting **breaking down of institutional barriers and silos**.
2. Reporting to EU and UNFCCC (and other conventions) is already complex and requires many manhours across MS. The resource efficiency of the reporting must increase so that costs and staffing does not continue to increase with the importance of improved LULUCF reporting. Therefore, several of the solutions seek to directly or indirectly decouple improvements from (too many) additional budget increases. A priority has been to promote **simplification**. By aligning reporting and accounting categories which were different under the Kyoto Protocol (e.g. former difference between Afforestation and Land converted to Forest Land), the LULUCF regulation has already simplified the task of inventory teams.

7.6.3.1. Solution R11: Building skills and understanding through mandatory UNFCCC review participation

A great learning opportunity is to study the LULUCF inventories of other MS or annex 1 parties. That way, different approaches, detailed data processing, or modelling decisions may inspire GHG inventory teams for their own country.

It is therefore proposed to apply a requirement that MS nominate and make available to UNFCCC at least one LULUCF reviewer per UNFCCC sector with more than 5 million tonnes of net emissions or removals, or another relevant quantitative benchmark/threshold. This should encourage training and career planning in the respective MS. A threshold of 5 million tonnes this would require 15 MS to provide a LULUCF reviewer and a threshold of 10 million tonnes would concern 8 MS.

Furthermore, the solution could be expanded to ensure the participation of independent reviewers in all reviews. The participation of independent reviewers – non-members of an inventory team such as scientists, NGOs, etc. – to the review process achieves the double objective of bringing new ideas into the process and of limiting conflicts of interest. This external participation would require the Commission to be in charge of recruiting them, to avoid interference by MS. Commission staff could be part of this pool of independent reviewers.

7.6.3.2. Solution R12: Establish LULUCF reporting help desk

Given the complexity of the collaboration as well as potential conflicting interests, establishing best practices and lessons learned is an important step towards improving monitoring and reporting. This is true both on the organizational level, the MS-level, and on EU-level. In order to both collect and distribute best practices and lessons learned, the EU could establish a LULUCF help-desk that could offer just-in-time support to all MS and all involved organisations and thus speed up the adoption of an efficient monitoring mechanism. Such a help-desk could gather best practices and offer training, a data and study repository, and share all of it with the implementing staff in each MS. This is primarily a top down approach that can be supplemented with input from JRC and MS.

7.6.3.3. Solution R13: E-learning and seminars to stimulate exchanges of good practices between MS

There is an uneven distribution of institutional capacity, LULUCF file history, capacity to follow negotiation and Subsidiary Body for Scientific and Technological Advice (SBSTA) networks, relevant national university level training and domestic knowledge bases among MS. While not a revolutionary recommendation, a LULUCF reporting master class could be envisioned. It should be web-based, produce and host webinars and organise hackathons on specific problems and issues. The online community could be hosted by the abovementioned LULUCF help-desk and could be linked to the LULUCF Review process and SBSTA negotiations.

One need to cover would be basic introduction to LULUCF MRV and accounting for newer staff (to shorten time needed to build capacity and skills) both in political systems, the wider expert groups and junior inventory staff. Another would be the front-end, exploratory investigations of detailed issues for experienced inventory compilers.

7.6.3.4. Solution R14: Explore possibilities to use (new) digital technologies for trends analysis and EFs

To gather data for LULUCF inventory making, MS should seek data sets and historic and ongoing sampling and trials, relying on a fairly limited set of domestic data sources, potentially complemented by case-by-case data or models from neighbouring MS or international journals. However, if capacity allows, many more supportive and complementary data could be used both as primary data or for benchmarks mostly on emission factors. Data from tractors, forest machinery and farm IT systems, weather data, trade and economic activity data, tax data, dipwell and drinking water monitoring data, to name a few, might hold trends or aspects that could support inventories. Many of these are not economically feasible to incorporate at this stage, but new digital tools might allow to expand the scope of data.

With the emerging of quantum computing and machine learning, the large dataset generated by the coming IoT-sector, along with the historical cloud of data, can become activated to specify emission factors, benchmarks, baselines, validation, verification data sets, etc. in certain environments as well as predict the carbon flow over time more accurately.

In practical terms, the solution could be promoted, and kick started by a mapping and identification exercise either in the form of a study or a JRC work package to pinpoint technologies and their possible application. This solution is rather generic, as it tries to cover a range of technologies, countries, uses and barriers in one.

7.6.4. Communication-related ideas and solutions

Given the above described problem drivers and problems related to the cross-disciplinary, cross-sectoral, and cross-technological nature of LULUCF, given the potential conflicting interests of land management, and given the siloed and even entrenched stances between organisations, communication is the best tool for mutual understanding and trust building. During any transition – such as the current green transition – working as one becomes more important.

7.6.4.1. Solution R16: Illustrate CRF tables with sectors and subsectors “at a glance”

The confusion of different reporting sectors across the NECP, UNFCCC CRFs, EU Climate Policy Sectors and common economic sectors could warrant a translation matrix to be produced to help journalists, policy makers, and inventory stakeholders navigate and translate between sectors. Ideally, the matrix would contain a macroed excel that could translate numbers and show allocations.

On top of this, the JRC could produce an annual note or homepage data viewer showing in simple graphics state of play for each MS across the requirements for the various sectors.

7.6.4.2. Solution R17: Explicit Bioenergy reporting EU CRF table and data viewer

The current reporting practice in MS, which is in accordance with IPCC GPGs, requires that biomass used for energy purposes is reported as a memo item, with hardly any narrative around it. In view of Energy Union Governance requirements and the ongoing debate on bioenergy and its sustainability, it is problematic that it is difficult for non-inventory experts to access and compare reported data for bioenergy (see problem 4) between e.g. the NECPs and CRFs. Since both reportings would include bioenergy, inconsistencies between them could be an indicator of incomplete communication. Difficulties accessing comparable and consistent data becomes a barrier for an open and informed dialogue.

Therefore, a solution could be to add an EU specific table in the MS reporting to the EC (submitted prior to the annual UNFCCC reporting) which would show numbers reported for renewable energy use under the Energy Union/National Energy and Climate Plans, LULUCF Forest Reference Levels and Harvested Wood Products, MS based Emissions Trading Scheme installations using biomass, and the memo item. Any inconsistencies relating to the choice of data should be explained in the accompanying NIR.

7.6.4.3. Solution R18: Removals and the rest

In 2050, nature-based removals (equal to LULUCF net sinks) and technological removals (CCU+) will have to deliver the total amount of credits to cover residual emissions (and substitute allowance for all emitters). From an accounting perspective (but not necessarily reporting perspective), it would make sense to aggregate all LULUCF sinks in one category and apply consistent if not similar accounting approaches across the board (provided data and reporting quality allows so). This would further allow for total sink targets, policy incentives and dedicated flexibilities.

Such an aggregation would be a radical shift away from the current land category-based accounting as applied in the other solutions presented. It would entail gathering all sinks (‘gains’) from all CRF tables, irrespective of the emissions (‘losses’) taking place in the same forest, field or farm. This approach would have the benefit of combining all the “slow, future”

removals and have MS and land-owners optimise across land management practices, holdings and regions dedicated to 'sink planning'. For example, deforestation, wetland drainage, grassland conversion and increased harvest on forest land would be aggregated and should be at least balanced by afforestation, wetland restoration, cropland retirement (or extensification) and reduced harvest intensity. A downside of this approach would be the un-intuitive separation of fluxes as a result of the same land management action on the same plot of land. Depending on the monitoring approach, separating gains from losses may not be feasible: for forest biomass for example, it would preclude the "stock difference method" currently implemented in many MS.

7.6.4.4. Solution R19: A step towards a bio-based products category

The current, simple HWPs categories are specified in the IPCC guidelines and stem from WTO trade nomenclature (Harmonised System) and are often populated with data from FAOStat. However, these HWP categories are quite coarse, and may underestimate HWP removals significantly as the half live values in many cases are very average and overall (due to, e.g. lack of country specific Emission Factors).

Many of the long-lived wood, wood fibre, or biomaterial uses of not only wood but also hemp and other biobased fibres are not recognised individually in the system. In a 2050 climate neutrality scenario, the contribution of the circular bioeconomy (AFOLU sector and its products) is crucial not only in terms of delivering sinks to balance sources, but also to offer biobased climate neutral products that can both substitute energy intensive products and serve as a carbon store through successive product lifetimes. Approaches to incentivise such uses are covered in a parallel EU study, not accessible to the authors of this note.

In order to maintain a high level of compatibility or even compliance with WTO nomenclature and rules (Harmonised System, Level 6 or 8), a first step would be to apply more disaggregated/detailed product categories (sub-categories) and/or to recognise non-wood products, in what would become Biobased Products instead of HWPs. This would align well with the overarching policy ambition to advance to a sustainable, low carbon bioeconomy by 2050. The JRCs bioeconomy observatory[47] shows the complexity and current categorisation of pools and carbon flows in the Bioeconomy, see below Figure 36.

[47] https://ec.europa.eu/knowledge4policy/bioeconomy/topic/biomass_en#biomassflows

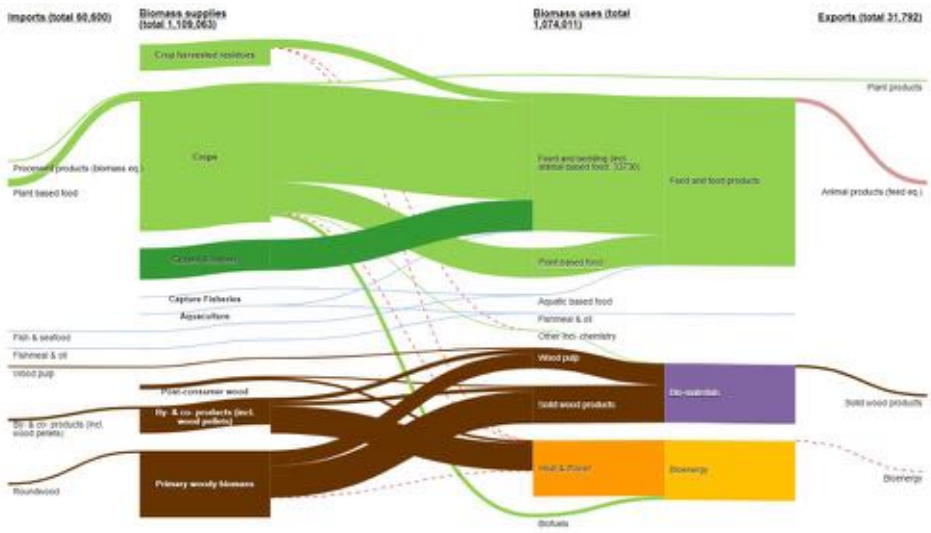


Figure 36: The JRC's current categorisation of pools and carbon flows in the Bioeconomy. Source: https://ec.europa.eu/knowledge4policy/bioeconomy/topic/biomass_en#biomassflows

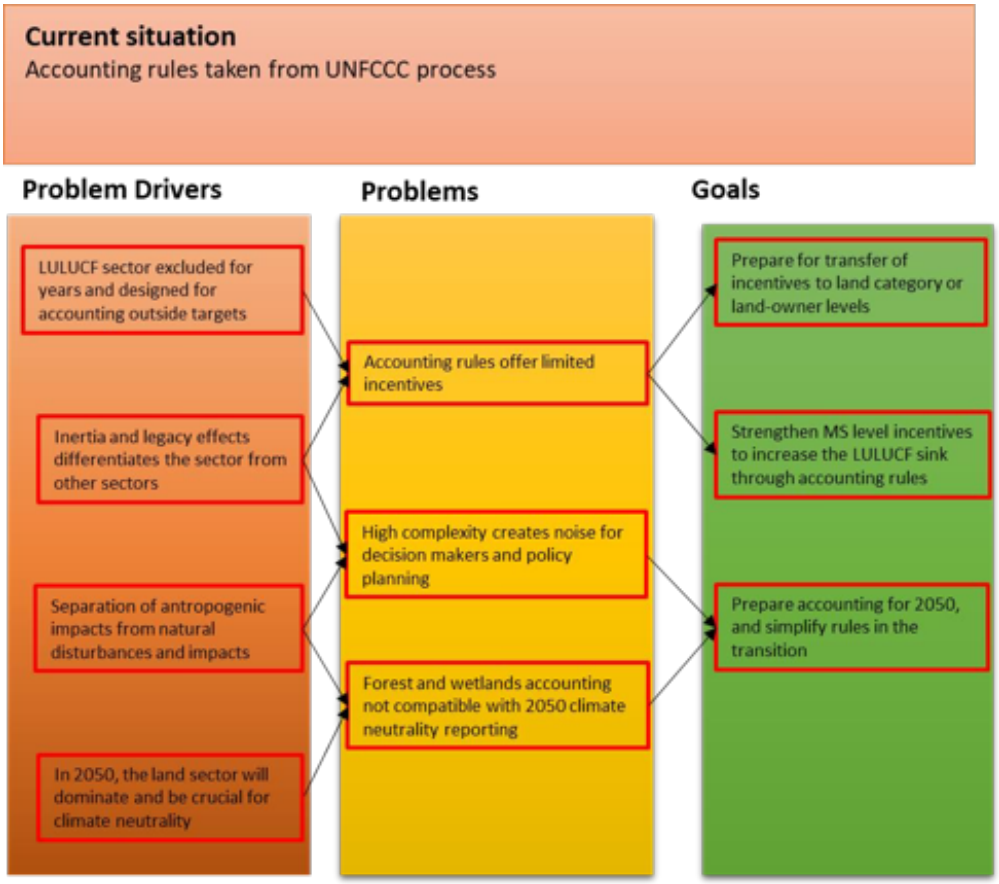
Developing a new Harvested Wood Products or Bio-based Products categorisation, and subsequent data population, is a complex and time-consuming exercise. It is suggested to prioritise and initiate this process soon and aim for a categorisation that can be translated into Harmonized System (HS) codes[48], covers a broader scope, offers more product level detail and initially aims at primary products and goods. From a LULUCF regulation accounting point of view, a first step would be to introduce more MS discretion in (reporting and) accounting categories, but at the same time fix quality, data and categorisation requirements by 2030, allowing MS and the EU to prepare.

7.6.5. Solution R20: Reinforcing the “name and shame” incentive from review reports

Since the demise of flexibility mechanisms of the Kyoto Protocol, there has been little incentives for countries to address the recommendations of UNFCCC reviewers and thereby improve their reporting system. The core principle so far is built around the so-called "naming and shaming", where non-compliant MS will have their errors flagged in the annual review reports. These reports are highly technical and very difficult reading for non-experts, and this difficulty takes away the key principle of the current mechanism – the naming and shaming part. If, however, a traffic light colour painting system were to be implemented, then it would be easier for non-experts to understand the outcome of reviews which would increase the incentive to improve the monitoring and reporting. A key aspect here could be to visually include a chronological dashboard of consecutive non-compliance so that there is a larger shaming in not fixing errors pointed out in the previous review. Going beyond naming and shaming, access to some EU mechanisms such as CAP payments or an EU-level carbon removals crediting scheme could be conditioned to the colours of this traffic light colour painting system to increase the incentives for reporting improvements (see TN7 for details).

[48] For industry classification, Harmonized System (HS) Codes are the most common for the export/import process for goods. The Harmonized System is a standardized numerical method of classifying traded products.

8. Topic Note #6: Amend the LULUCF Accounting Rules to Make the No-Debit Rule More Stringent



Abstract

The current accounting approach for the LULUCF sector is influenced by years of negotiation under the UNFCCC, albeit with slight differences from the UNFCCC approach. The approach serves the basic purpose of regulating how a sector excluded from targets can contribute to target compliance under certain conditions (since 2012). The system is complicated, and represents several political compromises on integrity and completeness. Due to the LULUCF sector's inherent purpose and history, the sector offers very few incentives for increasing sinks, and only at the level of parties or in the case of the EU at MS level. In addition, at policy and decision maker levels, the particularities and complexities of the sector has been difficult to communicate. Risk aversion and the absence of other targets than no-backsliding and no-debit rules in EU regulation, means few MS have planned policies and defined targets that will reverse the declining trend of the EU level net-sink.

The current system with its shortcomings, was furthermore designed for incremental, 5-10 year emission reduction targets. Climate neutrality in the EU by 2050 and across all sectors will require a different accounting practice, where target compliance, understood as annual balance between emissions and removals, is based on reported numbers for all land categories in the sector. The current system is not suited for this, and therefore correcting or improving the current system in view of increased ambition for 2030 may not be future proof or worthwhile. This note therefore considers a suite of proposed solutions, some of which will constitute a radical shift in accounting practices whereas others are merely improvements within the current system which could be implemented short term.

8.1. Introduction

GHG accounting in an EU and UNFCCC context, is understood as the exercise of governing which reported GHG numbers from National Inventories are allowed to count towards target compliance under a legally binding multinational agreement such as the Kyoto Protocol or the Paris Agreement. For all sectors but the LULUCF sector, accounting requires all reported numbers to be used for establishing basis for compliance with targets, whereas for the LULUCF sector only a subset of reported values have historically been allowed to be used. In reality, LULUCF accounting rules have hitherto served the purpose of excluding emissions and removals that were found to be too uncertain, not verifiable, or not understood.

The current situation for LULUCF accounting in the EU, is a result of 20-30 years of incremental rules and policy development in the EU and UNFCCC settings, which gradually have offered new rules for inclusion of more GHG emission and removals for target compliance. For the same reasons as described above, under current rules, the LULUCF sector is not subject to any country or EU level target, other than the MS level no-debit rule imposed since 1 January 2021. In the UN setting, under the Kyoto Protocol (both compliance periods 1 and 2), only afforestation, reforestation, and deforestation were allowed to count towards compliance targets directly, and only a subset of emissions or removals from so-called (Kyoto Protocol) Article 3.4 activities resulting from Forest Management is allowed to count towards KP targets, subject to a Forest Management Reference Level (FMRL). The FMRL was adopted as practice at the Durban COP in 2011, and accepted as the common approach by EU member states with the LULUCF decision (529/2013). For other land management activities, such as Grassland or Cropland Management (GM and CM), parties to the UN Climate Convention could voluntarily include emission and removals from these in their accounts, while rules and practices for accounting of wetland management fluxes and pools were only adopted internationally within the past five years and still to be included by parties.

At the same time, the LULUCF net-sink in the EU is projected to decline in the future (see Topic Note 1 and 2), while reporting of GHG emissions and removals in the non-Forest land categories remains incomplete and inconsistent. For the LULUCF sector to be fully integrated into any future policy and target architecture in the EU, it is therefore necessary to not only improve reporting systems (see Topic Note 5), but also develop rules and systems for how to count emissions and removals from the land sector towards a 2030 target. This will create a MS level incentive for strategic management of the land sink. Notwithstanding any current or future shortcomings in data completeness or quality, it is the long term ambition that the sector should count in full towards EU GHG mitigation targets and eventually Climate Neutrality at least by 2050.

8.1.1. Problem drivers

There are four identified problem drivers outside of the scope of the LULUCF Regulation revision, which frame the analysis herein.

8.1.1.1. Sector designed for exclusion

The current system as described above is a heritage of the Kyoto Protocol and a system where the LULUCF sector for various reasons was treated as a separate system, with separate rules and limited inclusion towards targets. This approach, as confirmed by 20 years of COPs and EU climate policy architecture, was essentially adopted to safeguard targets for other sectors such as the EU-ETS and the sectors governed by the Effort Sharing Decision against dilution, high variability, unmanageable uncertainty, and cheating. The first driver of the current situation is political, historical exclusion of the LULUCF sector.

8.1.1.2. Anthropogenic vs nature

The second driver of the current situation is related to the fact that the LULUCF sector's building blocks are natural processes such as photosynthesis, decomposition and geochemical transformations of matter. These processes influence levels and timing of emissions and removals even where systems are managed by humans. The processes are therefore also susceptible to sudden and significant changes in environmental conditions such as droughts, wild fires, icebreaks and flooding which is not directly a result of anthropogenic land management decisions. Therefore, the beforementioned accounting rules have included progressively complex natural disturbance rules on top of accounting rules that aimed to isolate and count only the human induced changes of the living systems. This driver enforces the fact that GHG accounting rules differentiates between human-induced emission and removals, and those beyond human control.

8.1.1.3. Inertia and legacy effects

Thirdly, the current and any future situations, will be under the influence of the inertia and time-lag that characterises the sector and differentiates it from the industrial, energy or transport emission sectors. In particular the age-related dynamics of forests, but also for some soil processes such as peat formation, response time is decadal, and effects of decision by land managers today may only show in reporting and accounting in 10-20-50 years later. The inertia of these natural systems is a third driver. Legacy effects go in the opposite direction and are classified by past disturbances or management activities and influence the productivity of the forests in terms of future emissions and removals. Legacy effects are complicated because a sink may increase in young forests due to a recovery from a past disturbance, as opposed to concrete management changes (Grassi et al. 2018).

8.1.1.4. Land sector key to 2050 climate neutrality

The last driver presents how the perceived future trend of LULUCF emissions relate to other sectors. Over the next 30 years, ongoing transformation of energy, transport and industrial sectors will lead to a situation where the land sectors emissions from both agricultural activities and land management will be the single largest share of emissions in most MS and in the EU as such. By 2050 it is very likely, that aggregated emissions from the current Agriculture and LULUCF categories will constitute the bulk of economy wide emissions, and that the sink of forests and soils, alongside technological removals from CCU+ will be pivotal for climate neutrality. The fourth drivers is therefore that the Land Sector – and hence its accounting rules – will be the most important sector for ensuring and governing climate neutrality at latest in 2050. Ensuring that the sector does not deterioriate due to current land management practices is a central part of the LULUCF Regulation and in projections for the sector, the sector is expected to make up higher offsets than those from carbon capture technology (European Commission, 2020a).

In aggregate, the challenge is to gradually include a distinct but increasingly important sector into an existing accounting and target architecture system, designed and refined in past decades, while having limited and incomplete data on the actual emissions and removals of that system. This can be translated into a set of specific problems as presented below.

8.1.2. Problems

The list of identified problems with the accounting approaches are presented below. They are grouped into three overarching problem types: insufficient incentives, high complexity, and inertia.

8.1.2.1. Accounting rules offer only limited incentives

There are three specific problems related to lack of clear incentives in current rules:

1. The first problem is that the overall "no-debit" rule is not ambitious, and does not send a strong mitigation action signal to MS. In fact, as discussed in Topic Note 7, most MS tend to prioritise certainty and low-risk of debits from the sector. This problem of lack of ambitious sectoral targets is due to the FRL approach. In theory, this is not a problem as MS can use or sell LULUCF credits if they overachieve. In practice however, the absence of a mandatory ambitious target limits the political momentum to set ambitious "overachievement targets" at national level.
2. Thirdly, the target and accounting system offers no direct incentives to economic agents on the ground – land managers – to mitigate GHGs emissions and increase the carbon sink. Current targets are set at MS level, as in ESR, and not at firm-level, as in the ETS, or in this context at land parcel or farm levels. In theory this is not a problem as long as MS transmit their incentive to economic agents through appropriate national legislation. But in practice, this is seldom the case. The accounting rules and the practices applied by MS reporting agencies, calls for MS level excel-sheets aggregating and estimating emissions and removals from national or regional assumptions, with very little role for bottom up data (see Topic Note 5 on reporting for more on this).

8.1.2.2. High complexity creates noise

High complexity has ramifications for both transparency, verification and review processes, and obscures comparability across MS. Also, in MS governments and non-experts have difficulties devising long term policies based on these systems. The specific problems identified relate to FRLs, and concerns the counterfactual nature of the FRLs, and the incompatibility of FRLs with climate neutrality:

1. FRL is a technical counterfactual benchmark: as such, its calculation is based on many assumptions and creates many challenges, which causes a large amount of uncertainty. For instance, the modelling, updating and review is costly, time-consuming, and offers limited and skewed incentives to enhance sinks while restricting MS and forest owners. Furthermore, due to the MS context dependency of FRLs and the legacy effect of historic pre-FRL decisions on data, Forest Inventories and sectoral or regional specificities result in a stark information asymmetry. In turn, this complicates and restricts any third-party review or contribution. For all these reasons, stakeholders do not wish the FRL approach to be continued[49].
2. Natural disturbance provisions create a potentially large gap between what is accounted and what is emitted. In addition, they require to track land subject to disturbance for a very long time, which is challenging.
3. The temporal asymmetry between immediate emissions from disturbance, harvest or conversion and the slow sequestration in growing biomass, is currently an accounting liability for MS and ultimately the EU. The slow and future benefits of removals are difficult to capture in ten-year compliance cycles and in the business case for ex-ante-based project level crediting schemes.

[49] This information was extracted from the survey conducted on the first workshop. For more information, please refer to the workshop report.

8.1.2.3. Forest and wetland accounting not compatible with climate neutrality reporting

Lastly, the third problem cluster relates to established accounting practices which might conflict with the accounting principles expected to be necessary for climate neutrality reporting. In 2050, to determine climate neutrality across all sectors annually, accounting will need to be similar to reported numbers. This will pertain to all land categories, but in particular for forest land and wetland categories, current rules will result in exclusion of significant emissions and removals, which is not compatible with true climate neutrality.

1. The counterfactual FRL approach is not compatible with the 2050 carbon neutrality objective which requires an absolute target for gross removals, at least for the whole LULUCF sector at pan-European level if not at MS level and for specific sub-sectors. The counterfactual approach excludes from accounting towards any target, emissions and removals that result from legacy effects and is perceived a baseline projection.
2. Unmanaged land is considered outside of scope. However, both CO_2 fertilization effects that can be considered indirectly human (through rising CO_2 levels in the atmosphere), and the ecosystem services provided by unmanaged land, would impact climate neutrality if calculated for the full territory of a country.

8.2. Goals

The proposed goals of any amendment or revision of accounting provisions in the LULUCF regulation would be to:

- Strengthen MS level incentives to increase the LULUCF sink through accounting rules
- Prepare for accounting based on an absolute EU emissions/removals target, similar to all other sectors, in 2050: simplify current accounting practices, tools and principles for this transition, incl. on FRLs.
- Prepare for transfer of incentives to land category or land-owner levels for increasing removals and avoiding emissions by stimulating investments in afforestation/reforestation, agroforestry, peatland restoration and rewetting, and no-tillage soil practices.

While useful for the debate on many aspects of revised 2030 LULUCF regulation, a more precise understanding and definition of the 2050 vision for the sectors and EUs climate neutral climate policy framework is not part of the scope of the review. Ideally, the 2050 vision was clear and concise so as to serve as guiding star for the revision of the regulation. This would allow for already now preparing for the system changes that will be needed. This note will not propose solutions for the accounting system for the LULUCF sinks and sources in 2050, as the vision will remain open for debate in the years to come, including in Topic Note 4. However, as a background for some of the later solutions, the following short section does outline some aspects of possible accounting principles for the 2050 vision as outlined in COM strategies and presentations in the past years.

8.2.1. Accounting system goal for 2050

With the 2050 goal of climate neutrality, the EU should strive for target-based accounting for all LULUCF categories. This is the simplest accounting system and it's similar to what is applied to other sectors. It is fully transparent and allows for the clear establishment of EU-wide targets for LULUCF and the evaluation of MS' (and eventually land owner) progress towards specified targets.

Changing all managed lands from net-net[50] to target-based simplifies the accounting one step further because there is no discussion of which year (or period) is the base year or the special circumstances that an MS may claim occurred during that period.

Here, it is necessary to underline that the only difference between target-based and net-net accounting in terms of climate neutrality is the specification of targets. As shown in the following example, if in a given year a MS emits E Mt CO_2 from the non-LULUCF sectors, then it requires absolute L Mt CO_2 removals from the LULUCF sector where E + L = 0. If one accounts for the removals in the LULUCF sector as $\acute{L} = L - L_{base}$ then the MS need to produce $\acute{L} + L_{base}$ removals, i.e. more than what is due under the target, to achive climate neutrality.

If many absolute removals are needed, it would just complicate the accounting and make it less transparent if net-net accounting is used.

On top of accounting principles, an interpretation of and target-setting for climate neutrality including the role of the land sector should be defined for 2050. The below sections offer two possible principle ways for target setting. The public debate in the years to come will offer more alternatives, and the below should therefore only be seen as ideas for inspiration. A key variable for the discussion of 2050 target setting is whether MS level targets would still be relevant in a hypothetical situation where all emissions are covered by a revised EU ETS, and where carbon removals from both technical and nature based solutions can be issued to individual land or technology owners, and freely traded and exchanged within the EU. Therefore, a third option for EU targets is offered as well.

8.2.1.1. Target setting based on ESR

The general principle of this first target-setting option is that LULUCF is merged with all other non-ETS sectors – ESR sectors – and that discussions on effort sharing between MS start on the basis of the effort sharing already agreed for 2030 on ESR sectors.

Let us assume that the overall EU target for the LULUCF sector is to remove 450 MtCO2e/yr from 2050 onwards. This target is linearly backcast to 390 MtCO2e/yr in 2040 and 330 MtCO2e/yr in 2030. At each interim point (2030, 2040, 2050), the target is then allocated proportionally to the effort required from each MS in the ESR regulation (2018/842)[51], that is the amount of emissions reductions required from a given MS (2030 MS target minus 2005 MS emissions) divided by the total amount of emissions reduction at EU level (2030 EU target minus 2005 EU emissions).

Pros:

- Simple approach
- Effort sharing allocation identical to one already agreed upon for other sectors, taking into consideration the wealth discrepancies between MS.

Cons:

- Large windfall credits for some MS and very ambitious targets for others
- The rationale for the consideration of wealth discrepancies decreases over time

[50] Net-net accounting accounts for the difference between a given base year and each year in the commitment period (e.g. 1990 and 2012).

[51] This idea was presented by one of the participants of the first workshop. For more information, please refer to the workshop report.

8.2.1.2. Target setting based on potential

The general principle of this second target-setting option is that discussions on effort sharing between MS start on the basis of a simplified proxy for the potential of each MS to store carbon in biomass and soil, namely its land area.

Let us assume that the overall EU target for the LULUCF sector is to remove 450 MtCO2e/yr from 2050 onwards. This target is linearly backcast to 390 MtCO2e/yr in 2040 and 330 MtCO2e/yr in 2030. At each interim point (2030, 2040, 2050), the target is then allocated proportionally to the land area of each MS.

Pros:

- Simple
- No obvious windfall credits
- Consistent with long-term persistent removals targets (the long-term removals potential, that is beyond age-related effects, are logically strongly correlated with land area)
- Reasonable ambition for all MS (MS for which the percentage increase in removals is large are MS for which the absolute value in 2018 is small despite a medium land area)

Cons:

- Not based on a historically agreed rationale for effort sharing
- No adjustment for other determinants of the potential (eg. climate and soil conditions, current land-uses and land managements, ...)

8.2.1.3. EU level climate neutrality without targets?

If the transfer of incentives and obligations to entity levels are possible and implemented, the climate neutrality target is in principle applied at the level of actors, and MS would not have a specific climate neutrality target. This situation is however very simplistic for a number of reasons. Firstly, there will be land categories with low intensity on fluxes or stable carbon stocks, where removals would not be issued cost efficiently, even with significant technological advances. Also, for some forests in certain regions at high risk of recurring forest fires, pests or frost-related dieback, the necessary price premium or price reduction to internalise this risk, would effectively price removals from these lands out of the market. In reality, while the majority of EU land would be available for a future carbon removal market, residual land would still need to be reported as over large areas the removals and emission would be measurable. Such lands could still be required to be included in MS level GHG accounts, even if these would be of subordinate importance. One possible approach would be to impose no-debit targets for the residual lands, to make sure the climate neutrality target set for the two components at EU level would not be jeopardised. The management of these residual lands could then be financed from a mandatory share of proceeds from all issued removals units.

Likewise, of principle importance for 2050 target setting is the success of the emission reduction trajectory for the time until 2050. If the sink is increased to the necessary 400-500 Mt CO_2eq annual sink capacity, a significant proportion of the now available potential for afforestation/reforestation, forest management improvements and peatland restoration, will have been used up. One scenario is therefore, that currently unaccounted natural sink in managed forests is recognized as an eligible carbon removal, and likewise that the carbon accrual in peat in managed peatlands is both feasible to measure and verify and made eligible. In such a scenario, a carbon removal target would translate into a target for maintenance of areas and stocks of managed forests and peatlands. This would then need to balance out residual emissions from agriculture, deforestation, and all other economic sectors, and

complemented by technical removals, ensure at first annual climate neutrality at union level, and later an increasing EU net sink to draw down carbon from the atmosphere.

8.3. Options to change the LULUCF accounting rules

The below text briefly presents and explains background, rationale, logic, and benefits of a number of different clusters or aggregations of land categories with shared accounting approaches. A cross-cutting rationale for the proposed clusters is a simplification.

8.3.1.1. Solution A1: Continuation of the current approaches with marginal improvements

One possible solution could be that lands that do not change land use category would remain accounted for using net-net, while impacts of lands use change would be captured using gross-net accounting.

Forest land remaining forest land would remain an exception for which a forecast of future emissions (the FRL) is the basis for accounting. In order to easily implement this quantitative assessment, MS would receive support from the Commission in the form of a tool automatically performing the assessment and potential adjustments once MS have entered historical and simulated time-series.

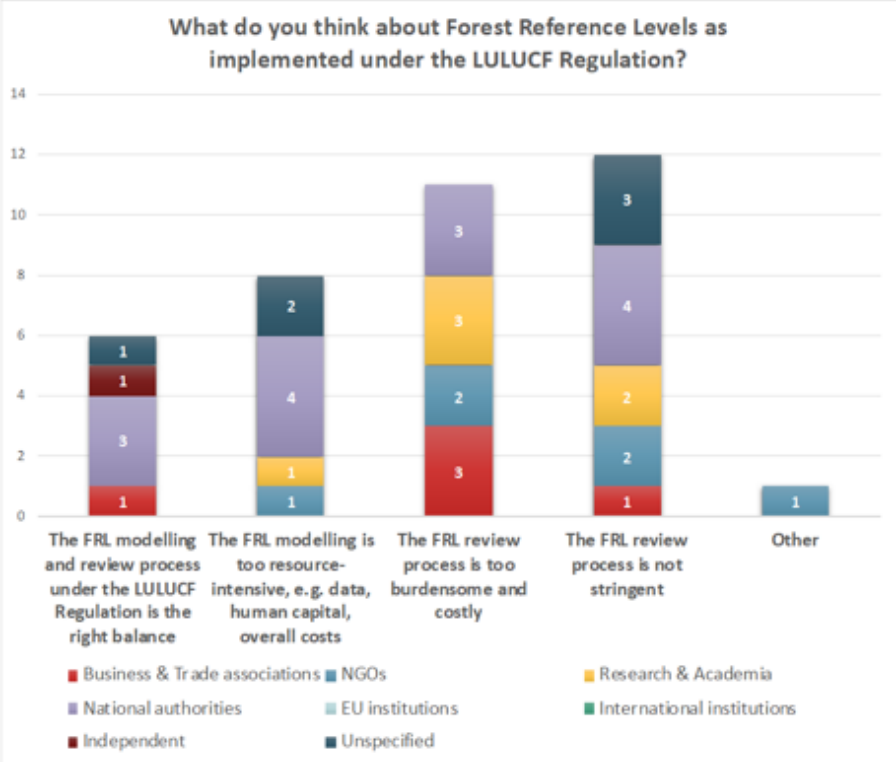


Figure 37: The division of responses by stakeholders on improvement of the reliability of FRLs

8.3.1.2. Solution A2: Combination of Net-net & Gross-net

The continuation of current approaches, and in particular of the FRL system, would be costly, complex, and uncertain. As such, continuation gathers little support from relevant stakeholders. From the Open Public Consultation (OPC) on the EU rules on LULUCF (Figure 38), discontinuation of FRLs is the second highest response after 'Other.'**Error! Reference source not found.**

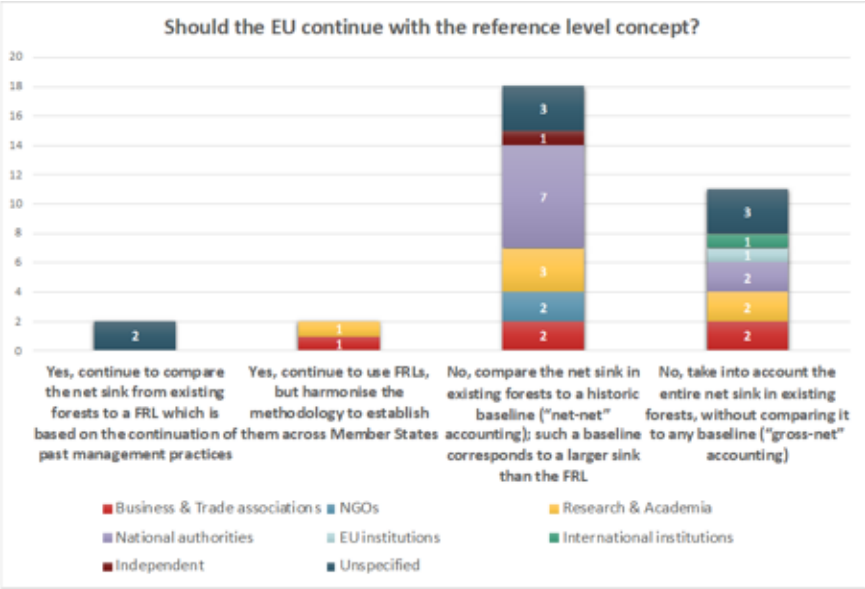


Figure 38: The division of responses by stakeholders during the first carbon farming workshop on the future of the current accounting approaches using the Forest Reference Levels.

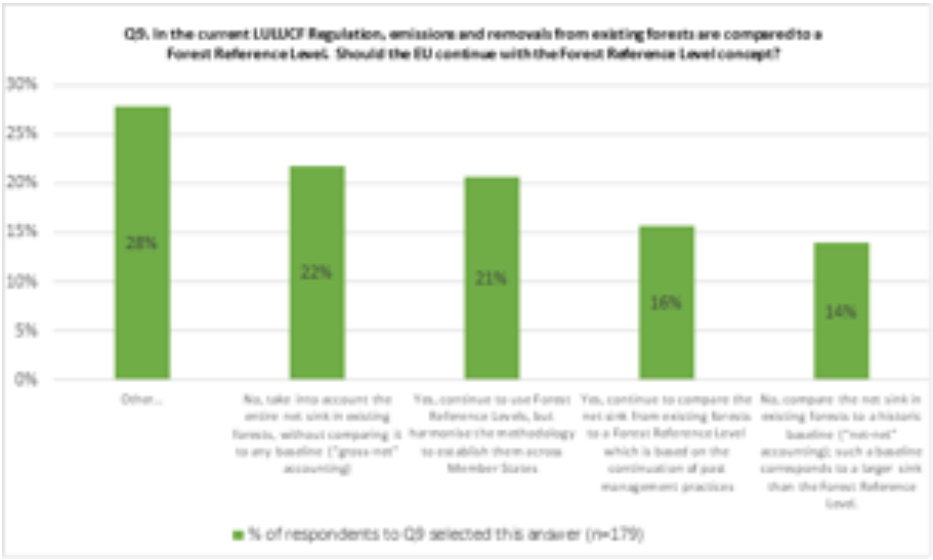


Figure 39: Responses from stakeholders from the OPC for LULUCF in the EU.

An alternative to the FRL approach is to use net-net accounting for all managed lands. This is the position proposed by European NGOs (Climate Action Network (CAN) Europe, 2016).

This solution removes the drawbacks discussed above. In addition, a drawback of this solution is the potential for "windfall" removals for an MS in FL-FL without any action and the "burdening" of an MS with emissions due to existing forest structure. Overcoming this drawback will require the use of an EU-wide pooled target for FL-FL and an intra-MS negotiated contribution LULUCF Effort Sharing Regulation (ESR_{LU}) or a mechanism to allow intra-MS trading of FL-FL credits and debits. The concept of winners and losers is illustrated in Figure 39.

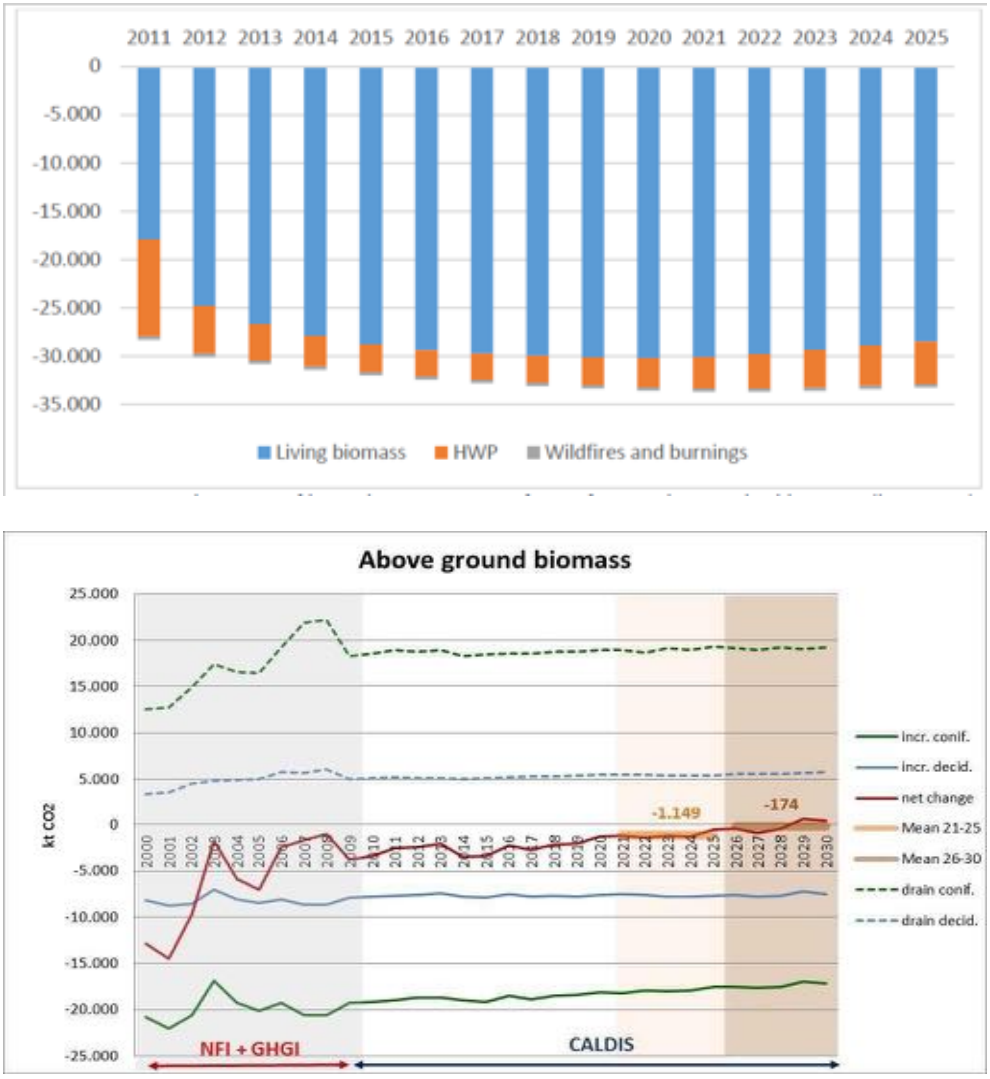


Figure 40: Two types of forest show "winners" and "losers" from a switch from FRL to net-net (or gross-net) accounting. Spain (above) has an increasing forest and will have a credit in 2021-2025 in a net-net or gross-net accounting system. Austria (below) has projected a slight removal from managed forests in 2021-2025 (gross-net). However, if net-net accounting was used with 2000-2005 as the base period, Austria would have emissions of around 8.500 kt CO_2. Using FRL, both MS will have no emissions if the forests behave as predicted. Source: FRL submissions for Spain and Austria

The benefit of this solution is improved simplicity and transparency and allowing clear establishment of EU-wide targets for this category and evaluation of an MS' progress towards targets.

8.3.1.3. Solution A3: no backsliding subrule for categories with large potential for "fast out" emissions

Aggregating the accounting of and aligning the accounting principles for the carbon intensive land categories is another solution. This adapted carbon pool centric, risk-based accounting system would gather the land use categories for which land conversion will lead to significant and immediate emissions in one group. For this group, specific targets or restrictions could be applied. As these would also be the categories for which project and results based carbon farming and carbon forestry mechanisms would be most feasible, this set up could be a neat precursor for a later EU wide mechanism with associated common CRC rules, registry (see later) and eventually extended review. The Carbon Rich Land Categories (CRLC) group should by 2050 have its own and detailed set of gross-net based accounting rules. The remaining sectors could have more flexible and lenient rules, thus allowing for a simplification and focusing of administrative and inventory work on the most important sectors.

8.4. Increasing stringency of benchmarks for 2030

The benchmarks for 2030 should be tightened to counteract the decline in the LULUCF sink. The recent GHG inventories show that currently, the combined LULUCF sink in the EU is - 263 Mt CO_2/year. To reach the - 55% EU-wide 2030 target a minimum sink of - 225 Mt CO_2/year is required. However, a a range between – 340 and – 260 Mt CO_2/year is feasible at a relatively low cost. Finally, to be on track for the 2050 net zero emissions goal, an interpolated sink of - 300 Mt CO_2/year would be needed around 2030.

8.4.1.1. Solution A4: More stringent national LULUCF targets

As discussed above, the absolute removals in 2030 need to be at least 300 Mt CO_2/year, 14% more than they are currently. How these are distributed to each MS is varied. They may be allocated using one of the following indicators (not limited):

a) Share of total land area [with an adjustment for MS climate and net primary productivity]. This assumes all MS can contribute equally.

b) An indicator based on amount of removals per hectare below the EU-wide target [with an adjustment for MS climate and net primary productivity]. This is an indicator of fairness – all MS contribute equally to the EU sink.

c) Share of current removals (or removals in the last five years). This is an indicator of efficiency (e.g. cost-effective mitigation potential).

d) Share of removals in a chosen historic time period.

8.4.1.2. Solution A5: More stringent EU-wide target for managed forests (FL-FL)

As indicated in Solution A2 (section 8.3.1.2) it may be necessary to treat managed forests as an EU-wide pool with a shared target for all MS. This could be an option to be considered as forest policy is not an EU mandate, and building on experiences from the 2030 Energy Efficiency EU level target and its implementation. If tied closely to the continuation of the no-debit rule principle, the EU level target could be legally linked to a no-backsliding principle, where no MS share of the total EU forest sink was allowed to decrease while the total EU sink target would be strengthened over time. Any underdelivery in percentage by 2030 would be sanctioned by fines in the form of either accounting debits or economic fines that would be redistributed to the MS meeting their share.

A different approach would create an EU carbon forestry investment fund, which would offer a floor price for forest credits, and fund improved management practices (and possible afforestation), in exchange of full transparency, third party reviews, and requirements for highest level tier reporting for any land supported. The generated credits would count to the host MS only after a certain share delivered to the EU fund and counted towards the EU level sink target.

Both of the outlined approaches would ensure that all MS promote improved forest management, but with target compliance risk limited to the sector and proportional to the importance of the forest sink. As much as an additional - 172 Mt CO_2/year could be achieved by 2050 through improved forest management (Nabuurs et al., 2017).

8.4.1.3. Solution A6: National removal targets

An MS specific removals target could be defined for 2030 and set as the difference between a total emission reduction target for the ESR + LULUCF sectors, and a calculated/projected potential for peatland restoration, afforestation, and halt of all tillage on organic rich cropland

soils. National Targets for removals should be set using activity data and emission factors as used in reporting by the MS, and achieved via the implementation of the actions described in CAP Strategic Plans or other land-related national policies. The national strategy to achieve the target would be based on considerations on future land use dynamics, the risk assessment produced and a qualitative assessment of potentials for increasing land area of peatlands, forests, and low- or no-tillage cropland. The targets could be set as milestones every fifth year between 2030 and 2050, with the end point being defined from a 2050 projection and plan as outlined in A17 later.

The national level removal target would be more flexible than the activity or land specific approach proposed below in A7.

8.4.1.4. Solution A7: National, land category specific targets

In line with the CAP discussion in GAEC 2 (on protection of peatlands), and the overall ambition to increase the sink by 2050, it could be considered to have a net-net, no-debit target for the emissions and removals from all reported WLrWL, conversions to WL and conversions from WL to other land use. The target could also be more specific and relate to conversions from WL to other, thus effectively punishing draining of new wetlands.

8.4.1.5. Solution A8: National targets for HWP use

In line with later assessment and text on HWPs (see chapter 6 herein), it could be relevant to propose quantitative targets for the net-storage of carbon in the HWP pool by 2030, and possibly a trajectory towards this target. Any such HWP target should be computed from a combination of domestic wood production, availability of wood processing industries, past and project import and export shares/amounts, size and age class distribution of forests, mean residence time and current storage rate.

HWP targets would translate into a wood and other biogenic material use target and should be seen in a long term Biobased economy perspective. In line with national priorities, the target could be expanded to cover also use of wood derived materials, such as bioplastic and lignin based materials. While the substitution effects and its accounting could be an issue in itself (see chapter 6), the LULUCF accounting rules would link HWP use to national GHG targets and in 2050 help expand the net-sink.

8.5. Forest Reference Level accounting improvements before 2030

The below sections present detailed and specific ideas for how to improve stringency of accounting for forest land. Several of the ideas are directly or indirectly developed from findings of the EU LULUCF Expert group, during their work in 2019-2020 on assessment of draft FRLs as submitted by MS under the LULUCF Regulation (841/2018). As such the ideas should be seen as detailed and specific adjustments to the proposed solution A1 of chapter 3, as they are improvements of the current approach which could then be continued.

8.5.1. Management intensity

The following solution (Solution A9) is related to how to define management intensity. The LULUCF Regulation (2018/841) requests that "The forest reference level shall be based on the continuation of sustainable forest management practice, as documented in the period from 2000 to 2009." In their NFAPs, many MS assume a constant “management intensity” (at national level, per stratum, per age class or other aggregates) to demonstrate that their FRL

meet the “continuation” requirement. However, the definitions of management intensity are diverse[52]:

1. Harvest probabilities based on age-related characteristics (age, standing volume, mean diameter, …)
2. Harvest volume per growing stock / biomass available for wood supply
3. Harvest area per area available for harvest
4. Harvest per increment
5. Harvest volume per hectare

Some of these definitions are more meaningful than others when it is necessary to “take account of the future impact of dynamic age-related characteristics” (Article 8.5), which is the main justification for an accounting system based on FRLs. Take the example of a country with a typical rotation age of 80 years, 5 Mha of forests aged around 50 years and of forests 1 Mha aged around 70 years. One would expect a constant management intensity assumption to project more harvest in 30 years than now, as a larger part of the national forest area reaches harvesting age. This example rules out definitions 3-5.

A necessary condition for management intensity indicators is to project an increase in harvested volume when a populated cohort reaches harvesting age. Harvest probabilities based on age-related characteristics (age, standing volume, mean diameter, …) best meet this criterion and are commonly used in the scientific literature (e.g. Luyssaert et al., 2018).

Coarser indicators such as harvest volume per growing stock for a given stratum – defined as a region, species or combination of both – also meet the criterion, albeit with a lower likelihood to result in valid projection. Being coarser is however a benefit to be considered: the implementation of a coarse indicator is less demanding in terms of know-how, resources and input data. In a nutshell, the relative merit of definitions 1 and 2 can be debated, but definitions 3-5 – which are not less resource-demanding that definition 2 – are clearly less suited than definition 2.

8.5.1.1. Solution A9: Limit range of definitions

Accordingly, restricting the possible definitions of management intensity in the LULUCF regulation to the first two indicators (harvest probabilities based on age-related characteristics and harvest volume per growing stock) would improve the reliability of FRLs without increasing the burden of the regulation.

8.5.2. Demonstrating consistency of the FRL with the GHGI

For obvious consistency reasons, the FRL should include all pool and gases which are reported in the GHGI. When accounting is based on a reference level, this necessity of consistency is actually a good argument for excluding some pools and gases from accounting. Nevertheless, the reasoning behind the exclusion of certain pools and gases is thoroughly checked for inconsistencies. Most MS in their NFAPs reported individual estimates for each carbon pool (European Commission, 2020b). Still, knowledge, resources and data are sometimes largely insufficient to meaningfully model certain carbon pools (e.g. soil carbon). This problem can be addressed through the following two provisions:

[52] Input from first workshop.

8.5.2.1. Solution A10: Materiality based exclusions

Materiality: minor pools or gases can be excluded from the accounting – and therefore from the FRL – up to a cumulated share of national emissions (e.g. 0.05%, see materiality section for details).

8.5.2.2. Solution A11: Pool specific accounting

Use of a non-FRL approach for accounting: some pools (e.g. soil carbon) can reasonably be assumed to be largely independent from age-related characteristics. This would justify a "gross-net" accounting for these pools, thus avoiding random projections when knowledge, resources or data are insufficient.

8.5.3. Numerical consistency for a given pool (level)

Criterion A.h in annex IV of the Regulation requires consistency between the FRL and GHGI, and that the model used to construct the FRL be able to reproduce historical data. However, expert knowledge in statistics is heterogeneous, and as a result, so is their judgement on the extent to which consistency is achieved.

To address this pitfall, the JRC guidance document (section 8.1.1) provides detailed guidance on how this numerical consistency can be assessed and achieved. This guidance was successfully applied by some MS while others either chose not to use it or misused it (Forsell et al., 2018).

A typical example is the application of a standard t-test. When applied to time-series where points are obviously paired (the projected point for year 20XX is paired with the observed point for the same year), a paired t-test is better suited than the standard test. Among others, the paired t-test will detect systematic bias when the standard test will not.

This example demonstrates the technicality of standardizing judgement on numerical consistency. A solution to make this technical approach accessible to all member states would be:

8.5.3.1. Solution A12: Refine JRC Guidance

Refine the JRC guidance (Forsell et al., 2018) and make it more prescriptive. For example, a paired t-test could be mandated to detect systematic bias. Similarly, a minimal number of years could be prescribed.

8.5.3.2. Solution A13: Develop and share automated calculation sheet

Provide MS with a calculation-sheet that would automatically compute the results of statistical tests and adjustments when the projected and observed time-series have been entered.

8.5.4. Numerical consistency for a given pool (trend)

Of course, the solutions proposed for numerical consistency of project levels are only constructive for Member States where modelled trends are reasonably close to observed ones. Indeed, while modelled levels can be adjusted, there is no simple adjustment for modelled trends. Depending on national resources, obtaining such a model and understanding its behaviour may be quite challenging. This is a limit of the FRL accounting approach for which there is no satisfactory solution.

8.5.4.1. Solution A14: Issue encouragement or preference for peer-reviewed models

A possibility would be to encourage MS for which validated models and projections have been published, preferentially in peer-reviewed journals, to use them rather than construct a new model or make new projections from an existing one. This will most of the time require more substantial adjustments for the level (differences in forest area, biomass expansion factors or other such parameters, start date of the projection, …). The associated increase in uncertainty will often be balanced by the decrease in uncertainty obtained from a meaningful, peer-reviewed, trend. Several MS already benefit from published models and projections (France, Austria, Germany, Finland, Sweden, Italy, Poland, Slovenia, …) but this solution will not be applicable to all MS however, as many are lacking such models and projections.

8.5.4.2. Solution A15: Provide centralised modelled trends

Another possibility would be to require the JRC to provide modelled trends for each MS as was the case for the FMRLs of the second period of the Kyoto Protocol (2013-2020). The JRC simulations should then be of mandatory use. Otherwise, MS which possess their own model and projections can pick the model/projection which yields the most favourable FRL. This ability to pick across a menu of projections may have been one of the key explanations for the bias of the 2013-2020 FMRLs (currently around 100 MtCO2e/yr below actual GHGI data, despite changes in policies – towards increased harvest – which should have driven GHGI data below FMRLs if anything).

8.5.4.3. Solution A16: Mandatory explanations of trends in simulations

Mandating that a narrative for the key features/trends in the simulations over the reference and projection periods be provided would help. One can consider that a set of simulations where key drivers are not identified is not properly validated.

8.5.4.4. Solution A17: Project and explain post-2050 climate neutrality

After 2050, it is expected that the EU will become a net sink on an annual basis. This entails that economy wide removals from soils, forests and technical solutions (e.g. CCU+) balance out and eventually exceed any residual emissions. This principle is reflected in the following text included in the annex of the LULUCF Regulation: *"The reference level shall be consistent with the goal of achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, including enhancing the potential removals by ageing forest stocks that may otherwise show progressively declining sinks."*

Starting from 2030, MS will likely be required to produce and update every five years, modelled projections for economy wide emissions. To provide a consistent and complete inventory, emissions and removals from soils, and forests should be included. This will require explaining trends including any legacy effects on forest land and foreseen gaps (or overshoot), and identification of PaMs to address these. A similar requirement could be installed for soils. The reporting could be linked to future NECPs or their successors, and updates timed to 1-2 years before global stocktakes under the Paris Agreement. The purpose would be to promote planning and transparency around long time use and prioritisation of forest and soil sinks.

The mandatory projection could further impose full transparency of and consistency with projected assumed future harvest levels, as already foreseen in the LULUCF decision in 2013

(in Annex B (d)): information on how harvesting rates are expected to develop under different policy scenarios.

8.5.5. Stratification

Stratification is not an explicit requirement in the LULUCF Regulation. As mentioned by the JRC guidance, “The basis and level of detail for the stratification are likely to depend strongly on the national circumstances and the forest management practices applied in the country.” Therefore, there is limited rationale for constraining stratification in the Regulation. The JRC guidance (section 8.5.3) and the IPCC guidelines should be sufficient to help Member States make meaningful choices. A necessary condition is that data be sufficient to model “constant forest management practices” at the stratum level (see section 8.1.1). In most cases, the area of a given stratum is expected to be constant, which facilitates modelling and the understanding of model behaviour (a possible exception being where forest management practices during the reference period consist in systematically replacing one species mix with another after clear-cut). It follows from this expectation that age is not a recommended criterion for stratification. Ultimately, however, any inaccuracy in projections stemming from poor stratification choices can, in principle, be addressed by experts during the review process. Based on this, there is no recommended action or solution for stratification.

8.5.5.1. Solution A18: Explicit threshold of estimated bias

Introducing an explicit threshold of estimated bias above which the Commission is required to propose a correction of the FRL would help focus the review process on major issues and ensure equal treatments of all Member states regarding corrections.

8.5.6. Missed opportunity to use FRLs in national climate strategies

The short term versus long term trade-off of forest management strategies such as incentivizing harvest are paramount and have been extensively highlighted in the literature. Although several criteria (e.g. IV.A.g, IV.B.d) were possibly intended to spur discussion on this trade-off in the NFAPs – e.g. by what time will the carbon debt of a “more harvest” strategy be repaid? – this aspect was generally overlooked in NFAPs. More specific criteria and requirements could be designed to ensure that MS have thought this through and that the strategy they propose will mitigate climate change within a reasonable timeframe (e.g. before 2050).

8.5.6.1. Solution A19: No backsliding for Forest Strategies

A possible solution could be the requirement that MS demonstrate that their national forest strategy is cumulatively better than “business-as-usual” (i.e. FRL) by 2050, at least once substitution effects have been accounted for.

8.5.7. Review process

No matter how hard EU legislators work on refining reporting and accounting provisions, the application of these provisions to specific cases will always be partly up to interpretation. This is why ensuring an expert and independent review process is paramount.

The review of NFAPs has been satisfactory on this aspect. Key elements of success were:

- A mix of experts between independent (type A), member states (type D) and civil society (type C). This prevents conflicts of interest between type D experts – being lenient in the hope that other type D experts will be lenient as well – and allows civil society to signal its concerns to type A experts and the Commission;

- The ability of the Commission to allocate experts to the review of specific countries, matching their expertise with the national circumstances of the reviewed FRLs;
- The possibility for the Commission to conduct its own assessment of FRLs and to alert reviewers about its concerns.

The major pitfall of this process is that it is lengthy and costly, and that despite all this investment in review, the likelihood that final FRLs remain biased is still not negligible. There is no obvious solution to alleviate this intrinsic pitfall of FRL accounting: national experts will always benefit from insider information on their national circumstances and modelling framework which can be used to dissimulate modelling biases to independent experts and the Commission.

8.5.7.1. Solution A20: Expose FRLs to complimentary open public consultations

It is difficult to revise the current Expert Group review process given the narrow mandate Council would supposedly allow. Also, if all or most of the above presented requirements (solutions A10-A20) were implemented, the actual LULUCF EG review process would have firmer ground and a common basis for the assessment of FRLs. Nonetheless, an option for further scrutiny and also for allowing in-country experts (researchers, NGOs, forest owners, etc.) to contribute and challenge assumptions, data and processes, the draft FRLs could be subject to an EU wide open consultation. Experts could be required to register in individual capacity, and MS could be required to respond to consultation questions in a public note. Based on these inputs, the LULUCF EG could start its review. This would not be a simplification of the process in terms of steps but might reduce the uncertainty and hence time spend in the EG review process itself.

8.6. Harvested Wood Products

Currently HWPs are in the accounting system using a simplified methodology for estimating the carbon stock of HWP. They are accounted for using gross-net method.

There is evidence that the simplified HWP flow and lifetimes underestimates the size and flow (removals) to these pools (Aleinikovas et al., 2018; Jasinevičius et al., 2018). Putting that aside, in which sector (LULUCF or other) the flows to and from these pools are accounted remains to be discussed. During the 2000s three approaches for accounting for HWP were in discussion (Skog, 2008):

1. Stock-change approach accounts for the annual carbon stock change in HWP and forests in a country regardless of wood origin.
2. Atmospheric approach accounts for the annual carbon fluxes between the atmosphere and forests/HWPs within a country. Emissions from HWP and removals by forests are accounted for in the country where they occur.
3. Production approach accounts for the annual carbon stock change in HWP and forests where the carbon is from trees harvested in the reporting country.

In 2011, Decision 2/CMP.7 the Parties to the Kyoto Protocol under the UNFCCC process agreed to use the production approach to account for HWPs. This is the current approach used in the EU LULUCF regulation.

In the enhanced transparency framework of the Paris Agreement, Parties have the possibility of using other IPCC reporting approaches than the production approach, but in that case, they shall also provide supplementary information on emissions and removals from harvested wood products estimated using the production approach. Hence, one could account for the storage in sectors where they are used (e.g. construction). This would be equivalent to a stock-change

approach for HWP between the LULUCF and construction sectors. If the construction sector is charged with the emissions from cement and steel use, then adding the stock-change due to HWP may increase the use of wood in this sector. If this stimulation does not occur, then there is no difference in LULUCF accounting. Options for renumeration schemes for climate benefits of wood use in various industrial sectors is currently being explored in a DG CLIMA contracted study (Ricardo et al., 2021).

The proposed solution A8 in chapter 4 concerns target setting for HWP at MS level, and is the only proposed solution for HWP in this note.

8.7. Avoiding double counting and additionality issues of voluntary schemes or initiatives

Double-counting can be a reputational and integrity risk to any GHG accounting system. Counting the same emission reduction or carbon sequestration benefit twice towards the same or two separate targets undermines the purpose of the target, as ultimately the claimed and expected contributions are not delivered in reality. There is a risk of double-counting whenever two accounting systems are applied to the same sink or source, or where a unit representing a unique mitigation outcome can be used twice.

In short, there are three dimensions of relevance for assessing and eventually addressing double-counting, namely jurisdiction, sector, and the formal nature of the outcome. All existing MRV, Inventory and registry protocols and principles, cover the issue of double counting within emissions or activity sectors of the schemes and mechanisms that rely on these. Any action or solution to double counting should therefore consider where there is risk of confusion, non-consistency, lack of information sharing or non-recognition between two systems. The risk pertains to all mitigation outcomes such as government inventories, credits, or certificates.

The risk is usually higher where one or more of the below situations exists:

- Two schemes operate at different scale: A sub-national vs a nationwide or international scheme;
- Two schemes are owned and operated by different types of actors: governments, industry organisations, businesses, NGOs, certification schemes or private citizens;
- Two schemes apply different MRV and unit types or standards: Ex-ante crediting vs. ex-post crediting, or different baselines are applied;
- And lastly where two schemes are not aware of each other: A company claiming emissions reductions in its supply chain (insetting), while some of the same supply chain actors are part of e.g. a NAMA project funded by international donors.

Addressing double-counting in various ways is a precondition for the robustness and integrity of parallel governmental and non-governmental ('voluntary') carbon markets. Below three ideas for solutions to the above issues are presented. The solutions are not mutually exclusive, but rather mutually reinforcing.

8.7.1.1. Solution A21: MS Accounting Based Target approach accredited in EU for all non-governmental schemes

Make it mandatory to follow an accredited approach to setting of company targets and mitigation action. All accredited approaches in the EU should hold specific provisions on how to link to and share mitigation outcomes with the GHG inventory organisation in the relevant MS. An approach like science-based targets encourages linking to and ensuring consistency with national standards, data and approaches, which is already a good starting point.

Using an accredited approach could make companies eligible for applying an “EU approved climate action” stamp or trademark on their products, strategies or homepages.

8.7.1.2. Solution A22: Settle double counting terminology

The term and concept of double counting is used widely and in different contexts, referring to various situations as outlined previously. The relevance, risk and appropriate response from EU, governments, inventory administrators, scheme owners and project owners will depend on the nature of the double-counting. Addressing the different types of double counting situations will require one or more of three actions:

1. Clear and common understanding and definition of various types of double counting
2. Practices and tools to prevent double counting
3. Regulatory responses where necessary and appropriate.

As concerns the EU land sector and the 2050 vision for a carbon removal certification mechanism and market-based trading systems for removals, a first step would be to clarify a common understanding of double counting and identify likely situations where there is risk of double counting. In the medium term (2025-2035), where more local and other sub-national scale private or private-public carbon farming schemes may emerge but where a EU backed trading system for removals is not in place, a *Good Practice Guideline for Avoidance of double counting of mitigation outcomes in the LULUCF sector* could be developed and made available to the public and project developers. It could:

1. Discuss and compare different definitions of varying stringency and scope
2. Map and explain relevant stakeholders and their responsibilities and possible risk mitigation actions.
3. Provide overview of common risk situations
4. Propose practices and guides to avoid double-counting

It is important that any such GPG would aim at a range of stakeholders, such as scheme operators, project owners, credit users, policymakers/regulators, investors, registries, and the general public (serving as buyers off offsets for flights, travel, other emissions).

8.7.1.3. Solution A23: Set up mandatory EU wide registry for all mitigation outcomes

A key to prevent double counting is to be able to assign any approved and unique mitigation outcome and unique ID and register it in a database that can track trading and use in these via a transaction log.

An EU wide registry, linked to an EU approved stamp (see solution A21 above), available with a small registration fee could be set up based on the experiences and system requirements of the ETS registries or EUTR databases. It could be a series of connected MS registries or an EU base registry e.g. operated by the EEA. In order to obtain the “EU approved stamp”, the mechanism issuing the mitigation outcome unit (credit, certificate, …) should adhere to the registry requirements and register all issued outcomes. The registry should ideally register all LMUs exchanged between two MS and between climate governance sectors of a MS (LULUCF and ESR, see Topic Note 7 on Flexibilities).

In the medium term, the registry should link GHG inventories, voluntary carbon farming (and possibly HWP based) initiatives and have mandate to scrutinize the MRV and origin of all registered mitigation outcomes. With a view to a post 2050 trading system, the registry could be further developed and extended.

8.7.1.4. Solution A24: issue an opinion legitimating “vertical” double-claiming

Vertical double-claiming occurs when one state and one non-state entity (e.g. a firm or an individual) simultaneously claim the “benefit” of the same emissions reduction action. For example, an agri-food firm claims that its products are climate-neutral because it has financed agroforestry projects and the MS where these projects take place reports increase removals in its LULUCF sector.

In principle, vertical double-claiming does not impair environmental integrity. The same way that emissions from cows are accounted both in the carbon footprint of the farm and in the national GHGI of the MS where the cows live, reduced emissions from improved cow management should be reported both by the relevant farm and MS.

However, this has not historically been the viewpoint of most international offset standards (e.g. Gold Standard, Verra) which in turn has hampered the certification of emissions reduction projects in the EU. Confronted with the implementation of the Paris Agreement, these international standards are revising their stance on vertical double claiming, but they have not yet removed it from their criteria.

EU could suggest certification schemes based on MS best-practices that assure environmental integrity by minimizing vertical double-claiming. The EU could support these initiatives by issuing a similar opinion.

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9. Topic Note #7: Governance of LULUCF Flexibility

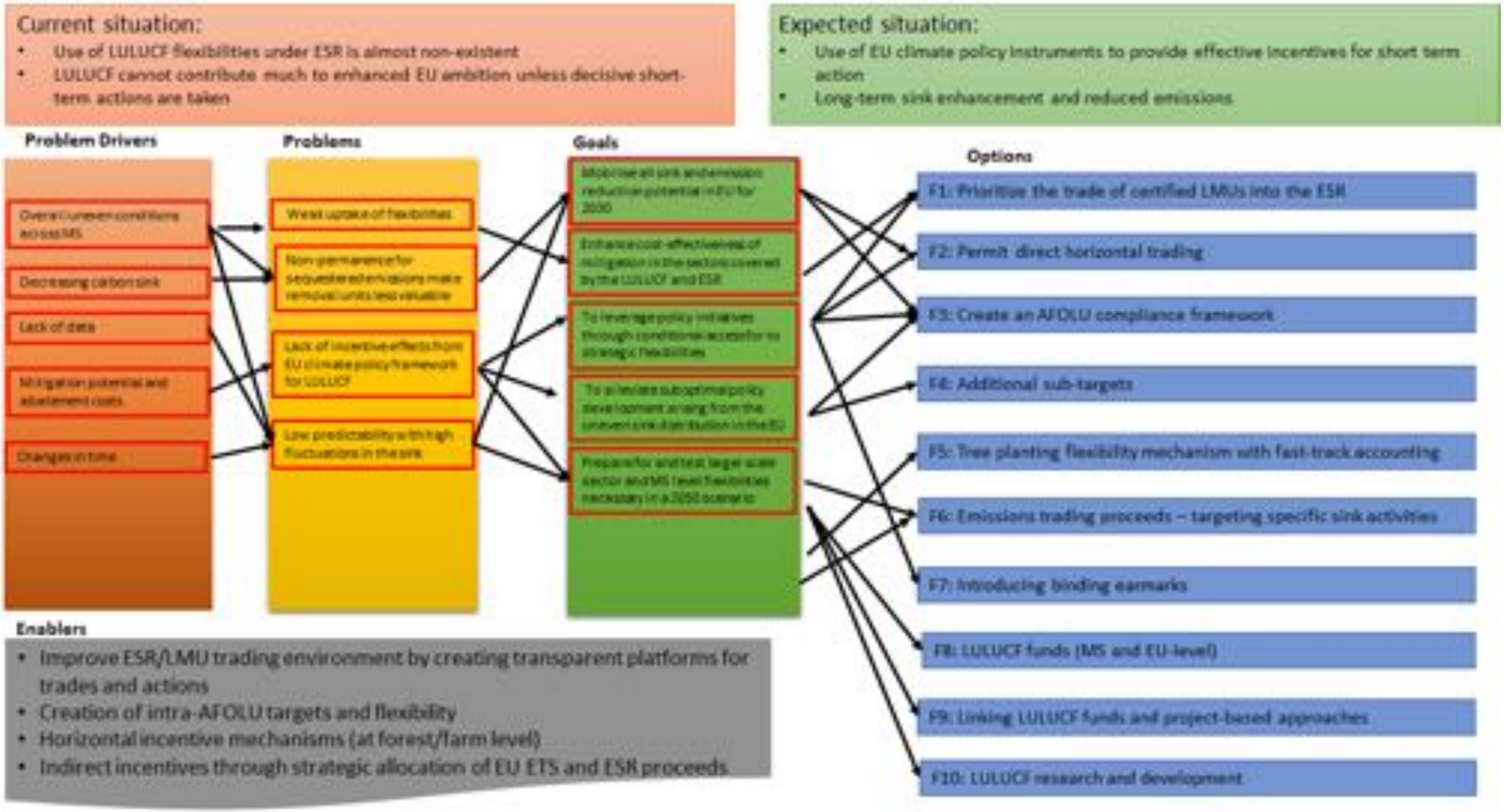
Content note:

This topic note discusses the potentials and opportunities for enhancing the relationship between the Land Use and Land-use Change and Forestry (LULUCF) Regulation[53] and the flexibilities available for the sector within the EU Effort Sharing Regulation (ESR).[54] The approaches for the governance of flexibilities could help to trigger a list of short-term actions to enhance the long-term contribution from the sector towards achieving the climate neutrality target for 2050. The note explores the current governance of flexibilities and identifies some existing problems, e.g. the uneven conditions across EU Member States with regard to data availability, mitigation potential and abatement costs. While there are already LULUCF flexibilities in place for the ESR, there are some signals that MS are finding it difficult to make use of them in any form. With the carbon sink decreasing across MS, it is also difficult to justify the trade of removal units from the sector. The note then provides ten possible options for the design of flexibility mechanisms.

[53] Regulation (EU) 2018/841 of the European Parliament and the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU, OJ L 156/1 of 19 June 2018.

[54] Regulation (EU) 2018/842 of the European Parliament and the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013, OJ L 156/26 of 19 June 2018.

Schematic Diagram: Topic Note 7



9.1. Introducing Flexibility

Flexibility, here understood as the transfer of accountable mitigation outcomes or allowances between sectors and across EU member states (MS) with different GHG targets, can reduce compliance costs. Flexibility can be measured on a scale from full unrestricted liquidity on one end to compartmentalized and ringfenced sectors or MS-based system tied to a MS-level target with no transfer allowed on the other end. Between the two extremes, there is a wide range of possible restricted flexibility options. This topic note explores the type of flexibility that could apply in a 2030 LULUCF governance system.

The figure below is a stylised representation of the sectors of EU climate policy with the currently available flexibilities depicted as green arrows. However, in principle, any two boxes at any level could be connected, and exchanges of accountable mitigation outcomes (or allowances) allowed, which then would constitute an available flexibility. In fact, full and unconditional flexibility between all sectors and MS (or one joint target), would minimise abatement costs, but at the same time reduce short-term incentives to address systematic or inherent challenges in a MS or sector.

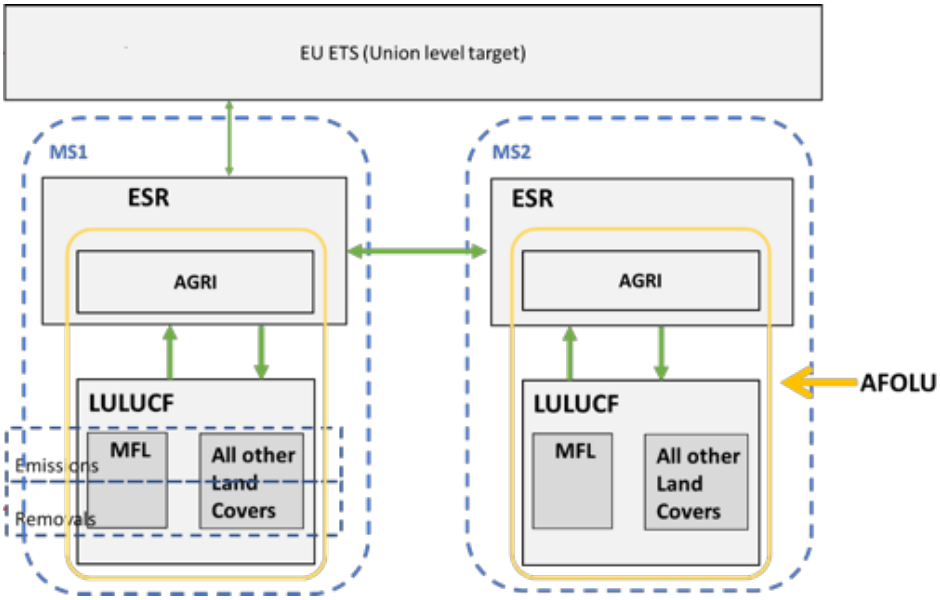


Figure 41: Stylised overview of current (green) flexibility flows available between sectors and MS in the current EU climate policy governance system. Own production, 2021.

Flexibility is perceived by some stakeholders as a low-integrity type of trading, allowing for watering down of or diluting mitigation obligations. In particular, where the traded amounts of emission reductions or future carbon dioxide removals, i.e. units representing the withdrawal of greenhouse gases (GHGs) from the atmosphere as a result of deliberate human activities (IPCC, 2018), originate from projects or actions that are not comprehensively, consistently, transparently and accurately MRVed. To address these concerns, work is ongoing to establish an EU Carbon Removal Certification mechanism to define what criteria and governance would be needed for high integrity units for carbon removals.

Flexibilities can be restricted along different parameters, for instance time, direction, level, amount, type, provenience and conditionality. For a typology of restrictions, see Table 20.

Table 20: Flexibility restrictions.

Type of restriction	Description
Time	Access to flexibility can be restricted to a certain period or time-window, or multiple fixed-frequency windows, e.g. linked to every international stocktake under UNFCCC Paris Agreement. Permanent access to flexibility is unrestricted time-wise.
Direction	A restriction on direction can mean that receivers in one sector or other category cannot supply flexibility to other actors. In other words, units from sector A can be used in sector B, but not the other way around. More precise conditional one-way flexibility can also be constructed by combining directional flexibility with any of the other restrictions. Two-way flexibility is in principle open both ways but can be combined with certain one-way restrictions or conditions as well.
Level	Flexibility can be offered to actors or entities at a certain level only, e.g. flexibility only between MS, between certain sectors, or between sectors within a MS only.
Amount	Capped flexibility, as is the system under the current ESR regulation, means that only a certain amount can be exchanged. The cap can be applied at union level, for a sector, for incoming transfer or outgoing, or relative to a target or baseline in percentage.
Type	Flexibility can be allowed for some types of mitigation outcomes, e.g. units from peatlands, forests, or certified lands, and excluded for other types
Provenience	Similar to the above, flexibility can be restricted or allowed for certain regions, partners or countries outside the EU (or even inside the EU) and ideally linked to conditions.
Conditionality	Access to flexibility can be made conditional on quality, completeness, transparency, certain actions, or implementation issues. For example, allowing access to outbound or supply flexibility only when mitigation outcomes are based on Tier 3 level reporting, or if made subject to third party expert verification (as for carbon markets).

9.2. Problem drivers: Uneven conditions

The question of whether and/or to what extent to allow flexibilities is closely linked to the question of how to define the target. With targets perfectly calibrated at all times to the situation of MS – targets that reflect equal ambition as much as potential, required emissions and sequestration pathways, that respond to innovation, changing costs of intervention, other changes over time, and viability at large – the need for, and interest in, flexibilities would be low. By contrast, targets that lack the level of perfect and continuous calibration across MS (whether initially or over time) will drive the demand for flexibilities. Flexibilities are a measure of and a fix to imperfection.

While perfect calibration may be a long-term goal, at present it is not realistic for lack of data, for divergence of mitigation potential and abatement costs, and given changes in time.

Lack of data: As explored in topic note 2 on soil data, most soil carbon stock changes in European soils are currently not being monitored, which is the most important blind spot of land-related climate policy. Mitigation potential is assessed via scenario projections which rely on many assumptions. This problem is conflated by the fact that it is difficult to foresee what tools of innovation will be at the disposal of landowners and developers and to what extent they will be picked up.

Mitigation potential and abatement costs: Variations in geography, habitat, climate and soils cause stark differences in mitigation options (see Figure 42) and also prices. For some MS, the availability of additional sink activities is low due to already very high forest coverage (e.g. SE, FI, EE, LT), or because of intensive land use with dominance of settlements and agriculture (i.e. DK, NL). For other MS, land is available, but carbon sequestration levels are comparatively low (e.g. CY, ML, HE, IT) or high (e.g. IE) due to biogeophysical and climatic factors.

On the other hand, in some MS (e.g. DE, DK, NL, PL, FI, SE), reducing emissions by restoring peatlands may present considerable potential, but the abatement costs are often high and the political viability complex.

In principle, these differences could be taken into account when setting MS specific targets. The regulatory practice, however, will have to respond not just to stark variations but also to diverging policy priorities among MS and industries and – given, in particular, economic heterogeneity laid on top of the geographical differences in mitigation potential – the need for political compromise.

Changes in time: Setting targets for several years, if not decades, gives regulatory predictability, but there is always the risk that over time economic, technological, legal and social conditions change, with new mitigation options becoming available in one MS but not in the other.

Flexibilities help navigate these challenges. They are conduits between sectors and MS, and they are meant to balance divergence in mitigation potential and between abatement costs, different speeds in climate action and innovation, and differing levels of climate priorities and ambition.

The Figure 42 below presenting 2030 LULUCF emissions and removals as reported in Member States' NECPs. The graph presents the emissions and removals in two variants With Existing Measures (WEM) scenario, With Additional Measures (WAM) scenario. Additionally, the light-coloured columns were based on the surrogate data, the data originating from different data sets covering the same area or activity.

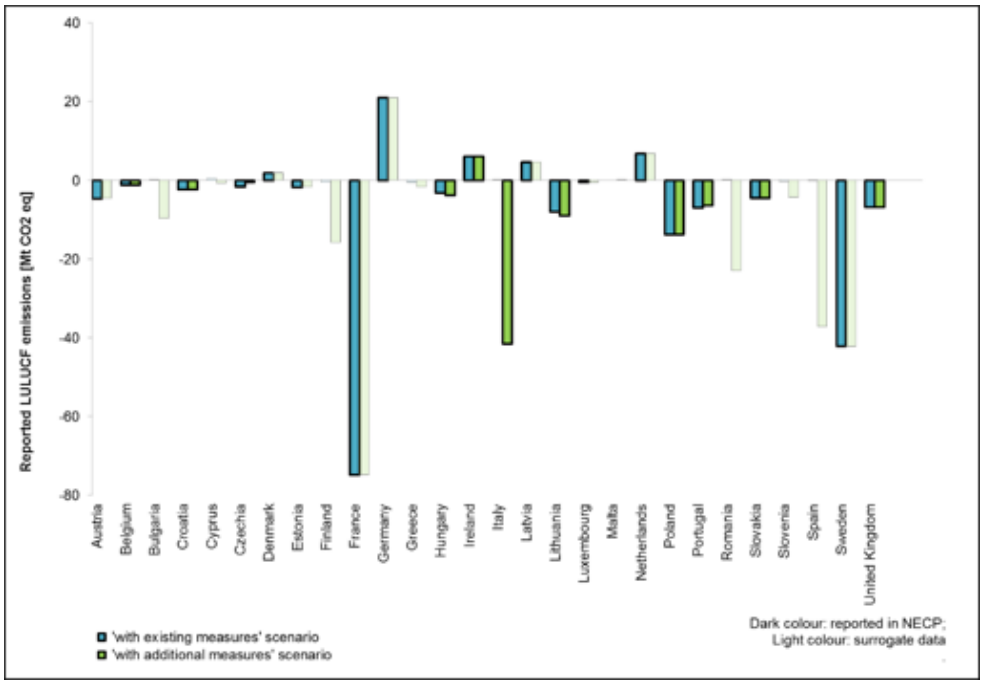


Figure 42. 2030 LULUCF emissions and removals as reported: With Existing Measures (WEM) scenario, With Additional Measures (WAM) scenario; Surrogate data Sources: Member States' NECPs, First interim report.

9.2.1. Today's targets and flexibilities

Under the ESR, MS have binding annual GHG emission targets for 2021-2030 for economic sectors that fall outside the scope of the EU ETS (but excluding LULUCF). The targets are calculated to achieve 30% emission reductions in the respective sectors across the EU, compared to 2005 levels.

Under the LULUCF Regulation, MS have to ensure that accounted GHG emissions from LULUCF are balanced by at least an equivalent accounted removal of CO_2 from the atmosphere in the period 2021 to 2030 ("no debit rule").

With the enhancement of the overall EU target from 40% below 1990 emissions by 2030 to 55%, both the ESR and the LULUCF targets are set to be strengthened in the coming years. As a consequence, the role of flexibilities within the regulations will only become more pronounced.

9.2.2. Flexibilities between ESR and LULUCF Regulation

Two types of flexibilities link the ESR and the LULUCF Regulation directly, namely:

1. ESR Flexibility (ESR to LULUCF): Where total LULUCF emissions exceed total removals, a MS can access units from its ESR account – annual emission allocation units (AEAs) – to balance the LULUCF debit (Article 12(1) LULUCF Regulation). Detailed rules for accounting of transactions under the Regulations are set out under the Union Registry – Delegated Regulation (EU) 2019/1124 amending Delegated Regulation (EU) 2019/1122 as regards the functioning of the Union Registry under Regulation (EU) 2018/842[55] and (once it is adopted) Delegated Regulation (EU) …/… amending Delegated Regulation (EU) 2019/1122 as regards the functioning of the Union Registry under Regulation (EU) 2018/841. The ESR Flexibility has no direct cap (restriction in amount);
2. LULUCF Flexibility (LULUCF to ESR): A MS may use credits from various LULUCF sectors – referred to as "land mitigation units" (LMUs) or "removal units" – to account against its ESR targets over the period 2021-2030 (Article 7 ESR). This flexibility is strictly capped for each MS (cf. Annex III of the ESR), with the total cap (all MS) set at 262.7 MtCO2eq over the 10-year period. Individual MS quotas are calculated and weighed according to emissions of the MS' non-CO_2 agriculture sector, assuming that emission reductions in this sector are particularly difficult, sensitive (in light of food security), and costly.[56]

It is important to note that the principle of 'vertical integration' applies under both flexibilities, i.e. each MS can trade its own ESR quota into its LULUCF quota, and vice versa, but a MS cannot trade horizontally into another MS' quotas across Regulations (i.e. it cannot buy LULUCF quotas from another MS for its own ESR compliance, and vice versa). This said, the ban of horizontal (from one MS to another MS) trades applies only to direct transactions. An MS may trade AEAs to another MS (under a separate flexibility, unrelated to the LULUCF Regulation), which may then trade said AEAs (now in its account) into its LULUCF framework. The LULUCF flexibility, for its part, allows LMU trading horizontally (from one MS to another). The buying MS, then, in principle, and subject to the limitations specific under Article 7(1) ESR, can use the traded quota for its own ESR compliance.

[55] OJ L 177, 2.7.2019, p. 66.

[56] Cf. recital 22 ESR; see also European Commission 2016.

9.2.3. Use of Flexibilities

While the rationale for introducing flexibilities is sound, their relevance in practice has so far been limited, especially with regard to the LULUCF flexibility. There are signals that MS are finding it difficult to make use of it in any form. As an EU-wide assessment of National Energy and Climate Plans (NECPs) shows (European Commission 2020b), most MS plan to ensure that their carbon sink will be large enough to avoid generating any debits (confirmation of no-debit rule), but very few of them give any indication in their NECPs of the extent to which they plan to generate and use LULUCF credits for ESR compliance.

Some MS noted the uncertainty of future sink achievements – Finland, for instance, will state its plans on using the LULUCF flexibility only at the time of first compliance check after the end of the first compliance period (in 2027). Another consideration is, however, that MS with high (or higher) LULUCF potential have few, if any, incentives to build this asset. Ireland is a good example. As one of the few countries that has indicated that it will use the LULUCF flexibility, it orients its LULUCF policies (afforestation; reduced drainage of organic soils; grassland and wetland management) exactly – and not beyond – towards its LULUCF flexibility quota of 26.8 $MtCO_2$.[57] In the case of Lithuania, there are expected high net gains for the sector regardless of additional measures. The NECP simply notes that there are "opportunities" for further mitigation, without specifying concrete targets. Spain clarifies that it seeks to "exceed" its LULUCF no debit level, while stating that it has no plans to-date to use the quota.

Still, a multitude of MS remain focused on achieving mitigation gains in the LULUCF sector, though without consideration necessarily of the use of flexibilities. Denmark considers agricultural support to provide farmers the incentive to transition to a more sustainable production and thereby supporting the green transition of the industry. France promotes "smart and sustainable management of forests." Germany focuses on carbon (?) preservation and accumulation on arable land as well as peatland protection. Spain seeks to regenerate silvopastoral systems and conservation agriculture. Several MS specifically refer to the Common Agricultural Policy (CAP) and its rural development programmes as tools to achieve future GHG benefits. Yet, this is mostly discussed outside the flexibility considerations between the ESR and LULUCF Regulation.

9.2.4. Observed problems with current flexibilities

The weak uptake of the flexibilities, in general, and of the LULUCF Flexibility, in particular is not altogether surprising. There are obstacles to trading. The ban on horizontal trading between MS and across Regulations is an important one, i.e. the requirement of vertical integration (within the same MS only) creates a formidable limitation to what otherwise would be a marketplace between 27 parties.

Lack of robust monitoring data, variability, and low predictability are also taking their toll. As Finland's statement in the NECP shows: MS are wary of tapping into an asset that remains unpredictable, which is also found to be the case at the global level (IETA, 2020). In the Finnish example, the variability of the sector is high (the sink contributions fluctuated each year between 1990 and 2017 between -14 and -33.7 Mt CO_2eq. annually, see also TN1 and TN2). High variability makes it hard for countries to make firm budgetary-style plans for the sector with clear earmarks for transfers to the ESR regime.

It is also noted that the accounting rules for the sector's key activity – managing forest land – have only recently been agreed (Commission Delegated Regulation of 28 October 2020). It is

[57] IE explains that the flexibility is needed precisely because it has high agricultural emissions that require partial offsetting.

only now that MS are on firm regulatory ground to plan their compliance exposure and excess budgets are available for trading.

On the implementation side, planning and implementing an ambitious mitigation strategy in the LULUCF sector remains a novelty for some Member States (as this sector only contributes to the EU climate target as of 2021). As the NECPs show, many governments have started piloting schemes, but few, if any, have outlined robust sink enhancement pathways. The difficulty, in some cases, to monitor these pathways is a roadblock to forward planning of using surplus quotas under flexibility instruments.

Then, exchanging, trading or transferring units based on land use actions remains contentious in the political discourse across the EU. The case against allowing a LULUCF flexibility into the ESR is made under the arguments that sink functions should be employed in addition to emission reductions and not as a replacement to them (Fern 2018; Carbon Market Watch 2015; CAN Europe 2016); that the use of removal units would delay the necessary transition to a zero-carbon economy (Sandbag 2018); that removal units are somewhat less valuable given the non-permanence risk for sequestered emissions (Cevallos et al. 2018); and that the overall ambition of the EU would lapse (Savaresi et al 2019). MS governments may have taken these criticisms, if not necessarily at heart, as a warning not to burn political capital by advocating the use of the flexibility whose relevance for compliance, in any case, remains overall small.

9.2.5. Options for design of flexibility mechanisms

The backdrop for the use of flexibilities in the context of climate policy and increased ambition levels in the EU, is the fact that carbon sinks across MS are decreasing due to ageing of forests, harvesting, intensive peatland use, depletion of the soil carbon stock and increasing natural disturbances. Aggregating the projection information included in the NECPs reveals that, according MS projections, around a third of the 2005 EU carbon sink could be lost by 2030. In some Member States, the LULUCF sector may continue to be or become a net emitter after 2030. In this situation, ensuring incentives to realise the full mitigation potential at the lowest total cost when potentials and costs are unevenly distributed across the EU, will require inter-MS and inter-sector flexibilities. In the long term, around 2050 and beyond, the potential commoditisation of carbon removals and creation of an EU-level common market could to some extent address these issues. At the same time it could make inter-MS and inter-sector flexibility mechanisms obsolete. Therefore, the flexibility mechanisms presented below are envisioned as temporary in nature (10-30 years) and defined by the sector and target architecture within which flexibility is needed. The target and sector architecture presented in the EC Impact Assessment for 55% is used as a basis and presented in the below sub-chapter, although this may have changed radically by 2050.

9.2.6. Basic assumptions

For the development of flexibility options following the text below, four overall principles have been applied. First, a firm separation between the European Emissions Trading Scheme (EU ETS) and the non-EU ETS sectors will remain. This also means that none of the flexibility mechanisms create a quantitative link between the EU ETS and the LULUCF sectors, allowing for exchange of accountable mitigation outcomes. There are however a set of ideas relating to the use of auctioning proceeds from the ETS presented in the end, that would pass over some costs of action in the LULUCF sector, without a corresponding transfer of mitigation outcomes for accounting purposes.

Secondly, it is assumed that the ESR target can increase or sector-coverage decrease. In both cases the mitigation pressure would increase on the activities in the ESR, which could foster changes in needs. It is assumed that national targets are maintained. Thirdly, it is assumed

that the LULUCF sector maintains its no backsliding principle with or without access to flexibility, or its assigned sector target, with the specific architecture still unknown.

Fourth, the flexibility concept as one in which the access to flexibility would allow parties of the exchange to mutually benefit from the exchange through, e.g. a financial transfer and lower abatement costs respectively, is to be reconfirmed. Flexibility can serve as an incentive for both the receiving and the supplying side. With the right design of a flexibility mechanism, the combination of an incentive and a targeted and strategic restriction or conditionality for the access to flexibility, the mechanism can serve as a policy instrument promoting certain action or policy objectives.

In short, the specific goals for the use of new or extended flexibilities could be:

- Mobilise all feasible and accountable sink and emission reduction potential in the EU
- Enhance cost-effectiveness of mitigation efforts in the sectors covered by the LULUCF and ESR
- Leverage certain policy initiatives or priorities through conditional access for MS to strategic flexibilities
- Alleviate suboptimal policy development arising from the uneven sink distribution in the EU
- Prepare for and eventually test larger scale sector and MS level flexibilities necessary in a 2050 carbon neutrality scenario

The following sub-chapters use the above categories of restrictions as tools to develop and present a range of possible flexibility mechanisms. The proposed options or solutions are idealized and presented as principal ways to address problems and promote the goals of EU climate policy for land use sectors.

9.2.6.1. F1: Prioritize the trade of certified LMUs into the ESR

Creating a taxonomy of sink interventions and offering a certification scheme to participating landowners would address several of the obstacles observed and would drive activities on the ground.

The basic idea would be to allow certified LMUs (or “carbon removal certificates”) to be freely traded into the ESR and without consideration to all or most of the current conditions set by Article 7.1 ESR.

This option would address the implementation deficit at MS level integrating farmers and forest holders through a certification scheme, likely supported by a credit compensation scheme triggering additional incentives to generate a sink. It would also address monitoring/data gaps and – with tight certification requirements in place – the still contentious political debate.

Arguably, at least for certain activities, an ESR cap on the use of LMUs for ESR purposes may not be needed at all. A strong case can be made in this context for restoration activities of degraded ecosystems (Meyer-Ohlendort 2020) and also for allowing emissions avoidance and reduction categories (rather than focusing exclusively on sequestration). Restoration activities also do not come with the same level of non-permanence challenges and score particularly high on ecosystem service provision at large (Joosten et al. 2016). The restoration (full or partial through the wet farming techniques) of drained peatlands – responsible for about 220 $MtCO_2eq$ across the EU every year (Tanneberger et al. 2020) – would likely be at the top of the list for potential emission avoidance.

9.2.6.2. F2: Permit direct horizontal trading

It is well documented that almost all MS have robust potential to deliver LMUs from enhanced mitigation action for Afforested Land and Agricultural land at fairly low prices (20eur/$MtCO_2eq$) (European Commission 2016). However, not all MS will require LMUs for their ESR compliance or will have the intention to use them for ESR compliance. Some MS will also have more potential to deliver LMUs than admitted under their cap, while others face a higher shortfall under the ESR and have a potentially higher demand for LMUs. Permitting MS to trade the LMUs across borders would improve the liquidity of the market as a whole.

That is, with the sale and purchase of distinct LULUCF categories allowed across MS, in any case – from the LULUCF sector in one country into the ESR sector in another, LULUCF credit demand and supply would be amplified. To safeguard the integrity of such trades or to leverage certain policy action or instrument, the European Commission could assume a vetting role concerning methodological and MRV approaches. Also, any authorization to lateralize removal units across MS could be made conditional.

9.2.7. Creating Intra-AFOLU targets and flexibility

While currently separated in different policy frameworks, the agriculture, forestry and land-use (AFOLU) sectors are naturally linked on various levels (including in terms of mitigation intervention, economic production, landscape planning, and other). The sectors are also connected indirectly at a climate policy level, i.e. through the calculation of the access to the LULUCF flexibility per MS based on the share of agricultural emissions.

These linkages can be used and further enhanced by targeting key categories in the agriculture (ESR) sector and by setting specific offsetting (climate neutrality) targets within what would constitute a broader AFOLU sector. This subsection offers a number of options that would facilitate AFOLU sector flexibility in various ways. They all assume that some restriction or separation of the UNFCCC Agriculture and LULUCF sectors are maintained for governance purposes.

The European Commission may be involved in a scheme vetting role concerning the definition of carbon farming quality and MRV standards.

9.2.7.1. F3: Create an AFOLU compliance framework

The basic idea is to create a common compliance framework for emissions from agriculture and emission and removals from LULUCF. Today, the LULUCF flexibility in the ESR is broadly calculated on the size of an MS' agricultural emissions. This option would both simplify and strengthen this approach. Each MS, in this option, would by design offset its agricultural emissions with LULUCF removals. The prospect of net emissions under the AFOLU compliance system, in turn, would trigger additional efforts to increase LULUCF sink and decrease agricultural emissions at the same time. The 'linking' obstacles between the sectors would disappear and, depending on the targets agreed – which may first calibrate towards no-debit between 2030 and 2040 and, then, move into negative terrain – setting ambitious sink milestones for the EU towards EU-wide climate neutrality.

9.2.7.2. F4: Additional sub-targets

Option F3 may be combined with jurisdictional and/or activity-specific targeting allowing MS to export any overcompliance or surplus using any of the flexibility mechanisms presented in this paper. In this section it is envisioned as an intra-AFOLU sector flexibility to ensure trees are

planted. This could be set up in principle without restrictions on where the credits would be used.

This could take the form of the below specific examples:

Jurisdiction version: Local and regional origination of LMUs

Specific targets – and climate neutrality targets – could be applied to the local or regional level. In this case, emissions would then have to be offset by LMUs generated through peatland restoration, improved grassland management or afforestation in the same jurisdiction (district, region, or state).

Activity version: Activity specific (climate neutrality) target through removal offsetting

A (climate neutrality) target could be applied for the livestock sector, where any residual emission, once removals on the land of the farmers subject to the target had been counted in, would have to be balanced by removals from afforestation or peatland restoration either in the same MS or outside. This would in practice internalize costs of GHG emissions from livestock production, but necessitate project level flexibility for the sector into forestry or peatlands.

9.2.7.3. F5: Tree planting flexibility mechanism for 3 billion trees offering fast-track accounting

As land availability and costs vary greatly among MS, a specific flexibility linked to tree planting could be envisioned, which would also promote action to support the current Commission's 3 billion trees ambition[58]. As a restricted and activity specific project based mechanism, tree planting (afforestation, reforestation and agroforestry) in a given MS but fully or partially financed by another MS should give the financing part access to MS level transfer of corresponding amounts of removal units between the project host country and financing country. This would necessitate corresponding adjustments in the AFOLU (or LULUCF, if today's separation remains) accounts of both MS. This project level flexibility could be subject to third party verification, and also made conditional on the quality/tier level of the activity reporting in the issuing MS.

9.2.8. Indirect Incentives: strategic allocation of EU ETS and ESR proceeds

Activities to enhance natural sinks can also be promoted indirectly, i.e. through the proceeds from sales or auctions of emission allowances.

The total revenues generated by MS from auctions of EU ETS allowances between 2012 and 30 June 2019 exceeded EUR 42 billion (European Commission 2019a). The 2018 revenues alone stood at 14 billion EUR; since then the allowance prices increased sharply.

While MS are free to determine the use of most of these funds, the EU ETS Directive instructs MS to "determine" the use of the revenues and to consider ("should be used") earmarking of at least 50% of them in accordance with a number of dedicated purposes (Art. 10.3 EU ETS Directive). These purposes have an emphasis on energy and international climate finance, but they also include "forestry sequestration in the Union." Other soil enhancement measures are not mentioned.

[58] Biodiversity strategy for 2030; https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX%3A52020DC0380

It would not require much regulatory or – it would seem – political effort to amplify the revenue use purpose provisions in Article 10 EU ETS Directive through more targeted earmarking.

9.2.8.1. F6: Emissions trading proceeds – targeting specific carbon sink activities

A revised Article 10 EU ETS Directive could add other sink activities beyond forest sequestration, namely improved soil management through the restoration of wetlands (including peatlands) and other degraded lands.

A similar prioritization of fund use may be included in the ESR whose current Article 5.6 makes only scant provision for the potential ("Member States may") of using revenues "to tackle climate change in the Union or in third countries."

However, the impact of any such specification in the relevant regulatory frameworks may be limited. There is not much evidence that MS have been using EU ETS auction proceeds to channel investments in the LULUCF sector despite the clear language on "forestry sequestration" (listed in Article 10 EU ETS Directive since 2009). A study found that during 2013-2015 only 1% of total MS auction proceeds went into forestry-related activities (Le Den et al. 2017).

9.2.8.2. F7: Introducing binding earmarks

To introduce binding earmarks, the EU legislator would have to resort to stricter forms of fund prioritization. The earmarking language could still leave discretion, i.e. 'x% of proceeds should go into forest and soil carbon removal activities.' Alternatively, the EU legislator can adopt binding earmarking provisions, i.e. 'x% of proceeds must go into forest and soil carbon removal activities.'

It is noted that this binding earmark approach was recently added to a legislative act by the European Parliament with respect to another sector, i.e. international shipping (European Parliament 2020).

9.2.8.3. F8: LULUCF funds (member state and EU level)

Any earmarking decision could further be combined with certain procedural and institutional requirements. MS would be obliged not only to dedicate a certain amount of auction (EU ETS) or sales (ESR) proceeds to specific LULUCF actions, but to set up dedicated (public, private or public-private) LULUCF funds that are operational and mandated to support projects or schemes that would deliver avoided emission or removals units. This could be balanced by the centralized fund, an EU LULUCF fund (similar to the EU's Innovation Fund).

The fund could be set up with the operational purpose to buy up or help create demand for carbon removal certificates, e.g. from carbon farming initiatives and others. Also, it could co-finance tree planting initiatives as outlined in F5 above and reserve the right of access to a limited amount of the resulting removal units for an EU level compliance buffer.

9.2.8.4. F9: Linking LULUCF funds and project-based approaches

The LULUCF funds could also be instructed to run credit purchase auctions from national or EU-wide project-based mechanisms. Auctions could be separated in slots, tranches or windows to account for different credit prices. It is noted that peatland restoration projects, in particular, may not be competitive in terms of price compared with forestry and a range of soil

enhancement practices. The voluntary standard MoorFutures has a price tag of US$ 40-80 per tonne. Max. moor charges around US$ 95 per tonne for peatland restoration in Switzerland (Von Unger et al. 2020). Ecological conditions for peat restoration vary sharply and so do prices of restoration (Artz et al. 2018; Glenk and Martin-Ortega 2018), yet average prices remain elevated.

9.2.8.5. F10: LULUCF Research and Development

In addition, or alternatively, the LULUCF funds could dedicate funding to improve data, technologies and MRV. MS could be obliged –though "LULUCF investment and development funds" – to target research, tech-development, and skills-building programmes to support LULUCF sector MRV improvements.

9.3. References

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10. Workshop I Report: LULUCF Reporting and Accounting Approaches

10.1. Overview

The workshop “LULUCF Reporting and Accounting approaches” was held on 18th November 2020. The workshop was organized under the study “Reviewing the contribution of the LULUCF sector to the Green Deal” commissioned by DG CLIMA to experts from COWI, Technopolis Group and Exergia.

The outcome of the workshop will inform the impact assessment on increasing the ambition of European climate target to at least 55% of greenhouse gas reductions by 2030.

The workshop information was published one month before the event through an Eventbrite webpage. In addition, official invitations were sent to targeted stakeholders in agreement with DG CLIMA.

10.2. Workshop Objectives

The workshop was the first one of the series of four workshops under the study” Reviewing the contribution of the LULUCF sector to the Green Deal commissioned by DG CLIMA. The workshop was structured in a way to enable interactive debates with the audience, with the objective of introducing and initiating discussions on future policy design in the LULUCF sector, in the context of the impact assessment on increasing the ambition of European climate target of 55% of greenhouse gas reductions by 2030.

The workshop was designed and dedicated to participants who should be familiar with one or several of the fields to be discussed and feel confident to make concise forward-looking interventions. Each broader topic was opened by a short inspirational introduction, followed by life polls to kick off open discussions.

The workshop was also aimed to initiate a discussion and greater use of full insights from stakeholders how to strengthen greenhouse gas reporting and how to adjust accounting methodologies to ensure that the LULUCF sector can effectively, efficiently and reliably deliver to the new target setting.

10.3. Introduction

Asger Olesen (COWI) introduced himself as the moderator for the first part of the workshop. He welcomed the participants and introduced some guidelines for the workshop. He presented the agenda for the day as described in Figure 44.

Agenda: LULUCF Accounting and Reporting approaches	
10.30 – 10.45	Welcome and introduction – Simon Kay, DG Clima (C)
	Part 1: LULUCF Accounting Moderated by Asger Olesen (COWI)
10.45 – 10.50	LULUCF Accounting- Paulo Canaveria, Portuguese Environment Agency
10.50 – 11.55	Interactive discussion and poll questions
11.55 – 12.00	Forest Reference Level - Valentin Bellassen, INRAE
12.00 – 13.00	Interactive discussion and poll questions
13.00 – 14.00	Lunch break
	Part 2: LULUCF Reporting Moderated by John Van Aardenne (EEA)
14.00 – 14.05	LULUCF Reporting – Hannes Böttcher, Oeko Institut
14.05 – 15.00	Interactive discussion and poll questions
15.00 – 15.05	Wall-to-wall data for LULUCF reporting – Martin Herold, Wageningen University
15.05 – 15.45	Interactive discussion and poll questions
	Part 3: Policy Options Moderated by Christian Holzleitner (EC)
15.45 – 16.25	Interactive discussion
16.25 – 16.30	Closing remarks - Christian Holzleitner, Head of Unit DG CLIMA (C3)

Figure 43: Agenda

10.4. Participants

Overall, the workshop was limited to 70 participants from different stakeholders groups.

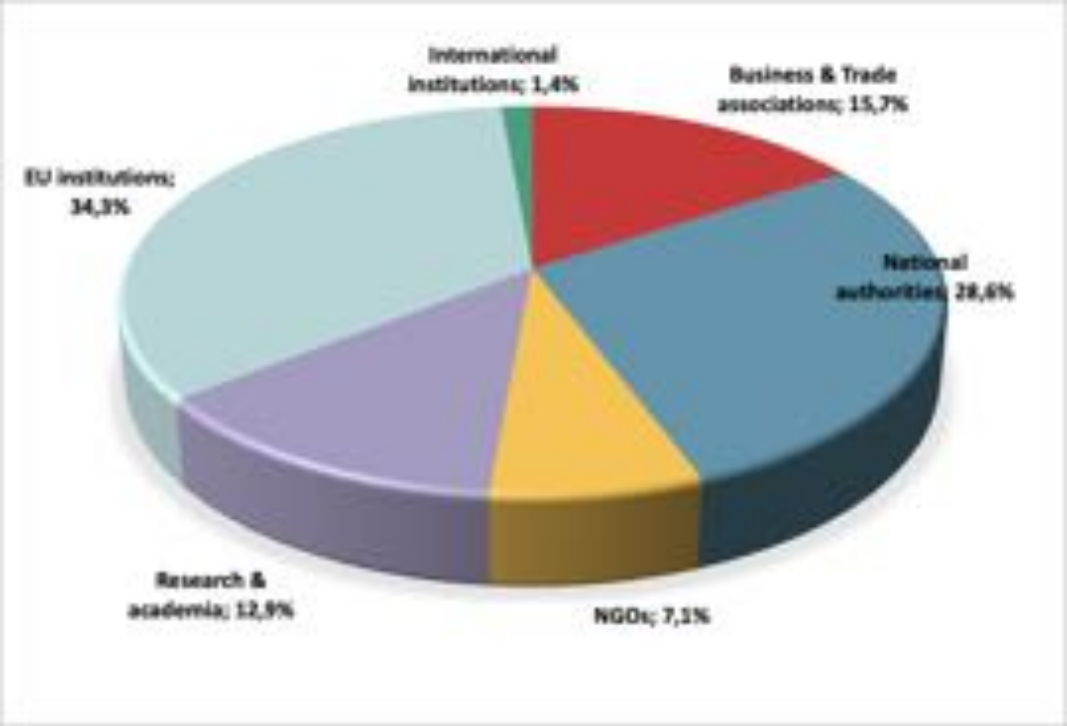


Figure 44: Participants by stakeholder category

10.5. Welcome and setting the scene

Simon Kay (DG CLIMA) provided an introductory presentation to set the context for the workshop.

He provided an overview of where the EU stands and the vision for the future, starting with the EU's objective to become carbon-neutral by 2050, as presented in the EU Long-term Strategy in March 2020. Such an objective fits with other international objectives, such as the Paris Agreement, and fully reflects the European Commission's political priorities since the election of President Von der Leyden.

He made a clear reference to the Climate Law and the Climate Target Plan – including the revision of 2030 targets to at least 55% of emissions reductions – as moving towards making the climate-neutrality objective a legally enshrined target. Both proposals use a metric which includes emissions and removals of GHG from land.

A graph of the pathway to climate neutrality was presented, showing how the metrics have been aligned to reach the objective by 2050.

He then provided an overview of the potentials for the LULUCF sector, namely, to increase the land sink to 300MtCO2e by 2030, to significantly reduce non-CO2 emissions including agriculture by 2030, and to reach climate neutral/bioeconomy by 2035.

Simon Kay invited the audience to participate in the consultation process of the ongoing "Fit for 55" review. The consultation has just started and will remain open until the 5th February 2021.

He concluded his presentation by introducing the key questions that the workshop aimed to address. He stated that the workshop aims to provide a better vision on what needs to happen with action on land. The purpose of the workshop was to discuss the simplification of accounting rules and being sure that the accounting approaches used are "fit for 55". As regards reporting, the emphasis was on completeness as well as comparability..

10.6. Part 1: LULUCF Accounting

The first part of the workshop challenged some of basic ideas on LULUCF accounting and what changes can be made. This part of the workshop included two presentations, each followed by an interactive discussion session.

10.6.1. LULUCF accounting

Paulo Canaveira (Portuguese Environment Agency) provided an overview of the current situation in relation to the use of LULUCF accounting rules as well as a historical perspective on the origin of such rules.

The presenter started his intervention with a brief historical overview on the origin of the accounting rules, from the Berlin Mandate in 1995 and the Kyoto Protocol in 1997. The Kyoto protocol was decided in the context of limited information on emissions. In particular, there was little GHG inventory experience and limited knowledge about LULUCF emissions.

Paulo Canaveira then moved the focus of his presentation to the present. The LULUCF accounting rules present some challenges due to their complexity, which constrain the participation of the sector. The LULUCF Regulation is based on the complex Kyoto Protocol system. While more experience has been achieved on GHG inventories and on how LULUCF emissions work and their trends, this has not been reflected in the way we approach LULUCF.

Following such overview, the presenter introduced the Paris Agreement, as based on a system which takes full emissions into account, including LULUCF. He reflected upon two possible options, namely, to keep our current approach to LULUCF with the risk of rules getting increasingly complex, or to embrace the Paris Agreement and simplify the EU system.

Two scenarios were presented to include LULUCF in the Effort Sharing. The first one showed the same LULUCF sink for 1990 and 2010, which implies a reduction in all sectors except LULUCF. The second one showed a decreasing LULUCF sink which requires more of non-LULUCF sectors to compensate for this. He explained that in this scenario, including LULUCF in the target would increase the ambition in the other sectors.

Paulo Canaveira concluded his presentation emphasizing the importance of LULUCF in Effort Sharing to correct a system that is flawed, to embrace the Paris Agreement and move to a simplified and more transparent system, and to account for trade-offs between sectors.

10.6.2. Interactive polls

The interactive discussion session developed on six poll questions which were directed to the audience via an interactive online software (Mentimeter).

The first poll aimed to categorise the respondents under specific stakeholder categories. 40 stakeholders participated in this poll.

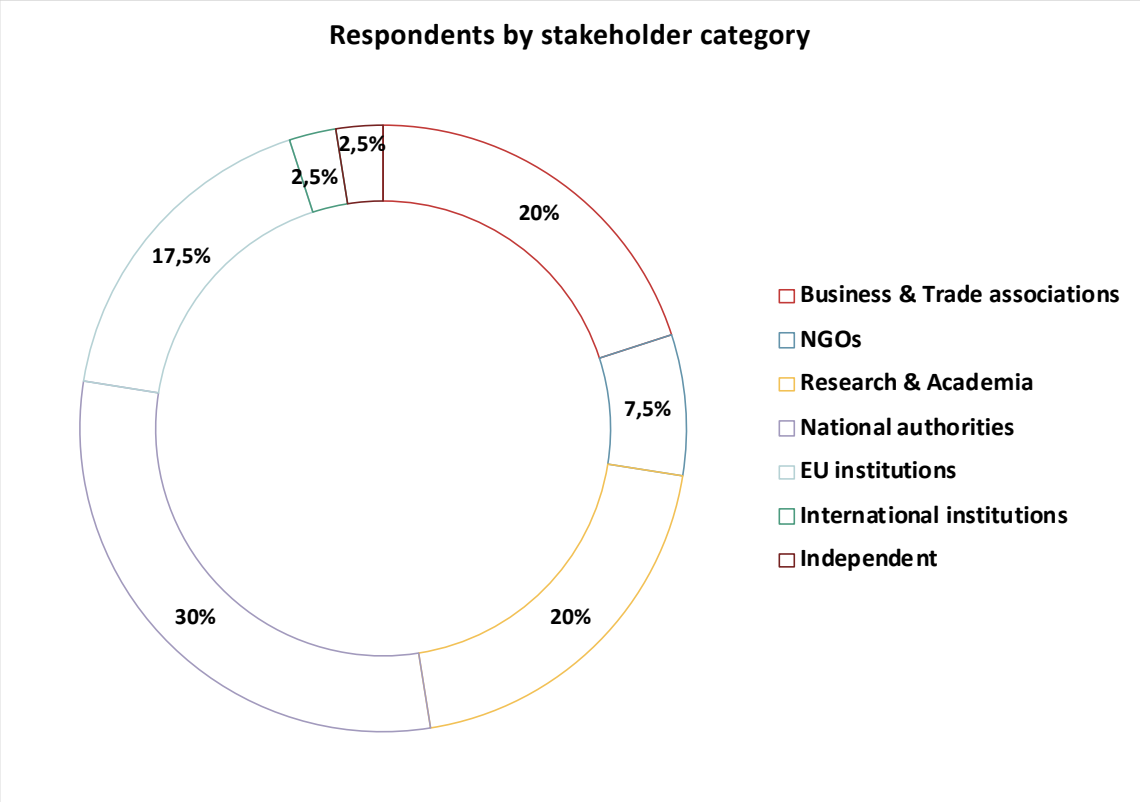


Figure 45: Respondents by stakeholder category

The second poll question investigated whether there should be more stringent targets for the LULUCF sector. 43 stakeholders participated in this poll, with 26 responding affirmatively.

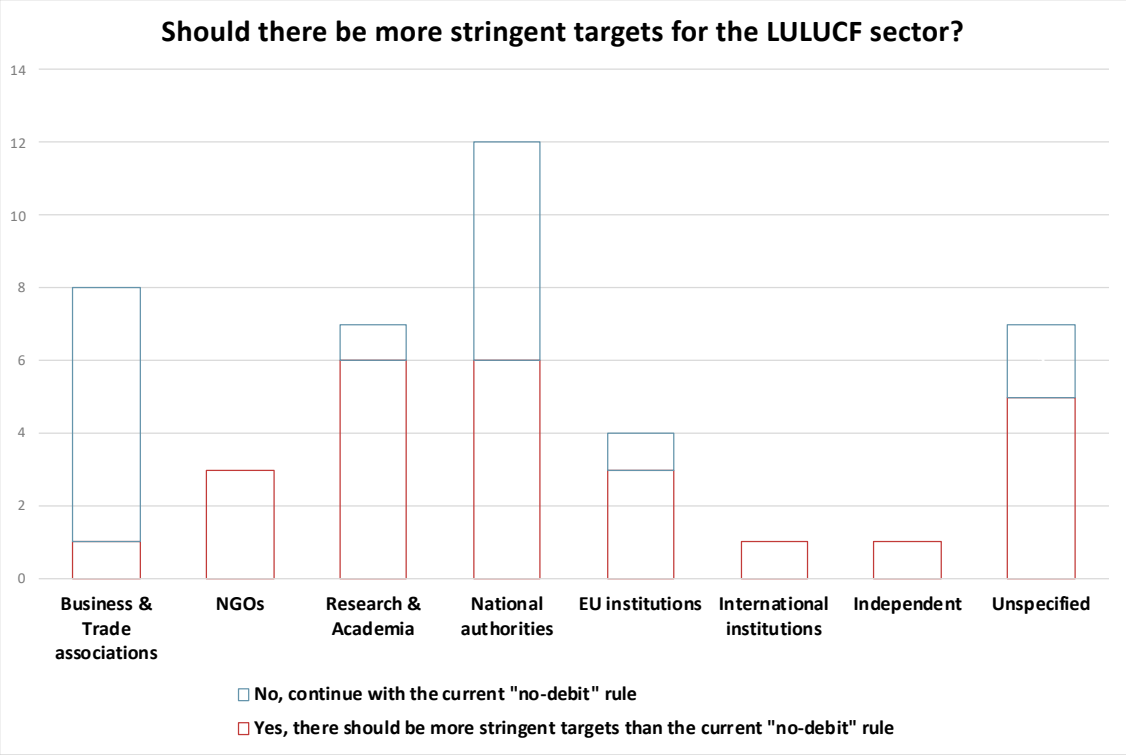


Figure 46: Responses by stakeholder category (poll N°2)

The third poll question asked the audience, in the case there would be national targets for the LULUCF sector, how these should be calculated. 34 stakeholders responded to this poll, with the majority (19) answering with “A target proportional to the Member State’s potential to increase the net sink in a cost-efficient way”.

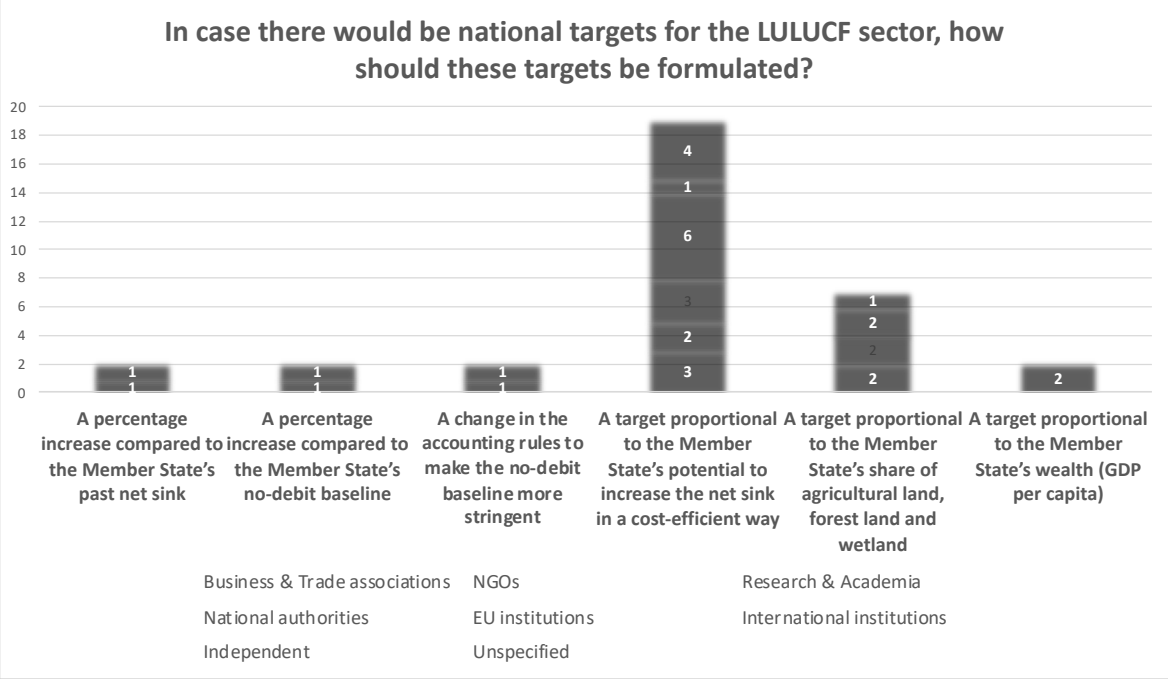


Figure 47: Responses by stakeholder category (poll N°3)

The fourth poll question investigated how accounting can be changed to achieve a good balance between simplification and higher climate ambition. 37 stakeholders responded to this poll, showing that the preferred option is “Apply gross-net accounting to total LULUCF”, followed by “Apply net-net accounting to total LULUCF” and “Other”.

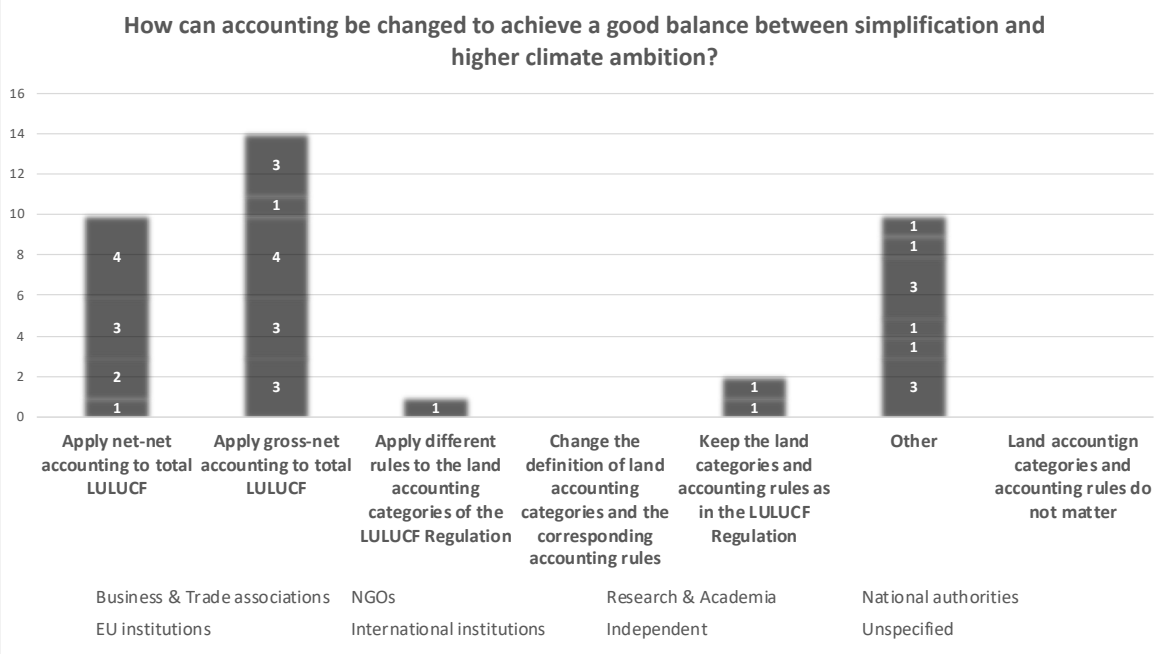


Figure 48: Responses by stakeholder category (poll N°4)

The fifth poll question asked which specific action in the LULUCF can be incentivised by accounting and how. 27 stakeholders participated in this poll. “Afforestation by applying gross-net accounting” was the preferred option. Multiple responses were allowed.

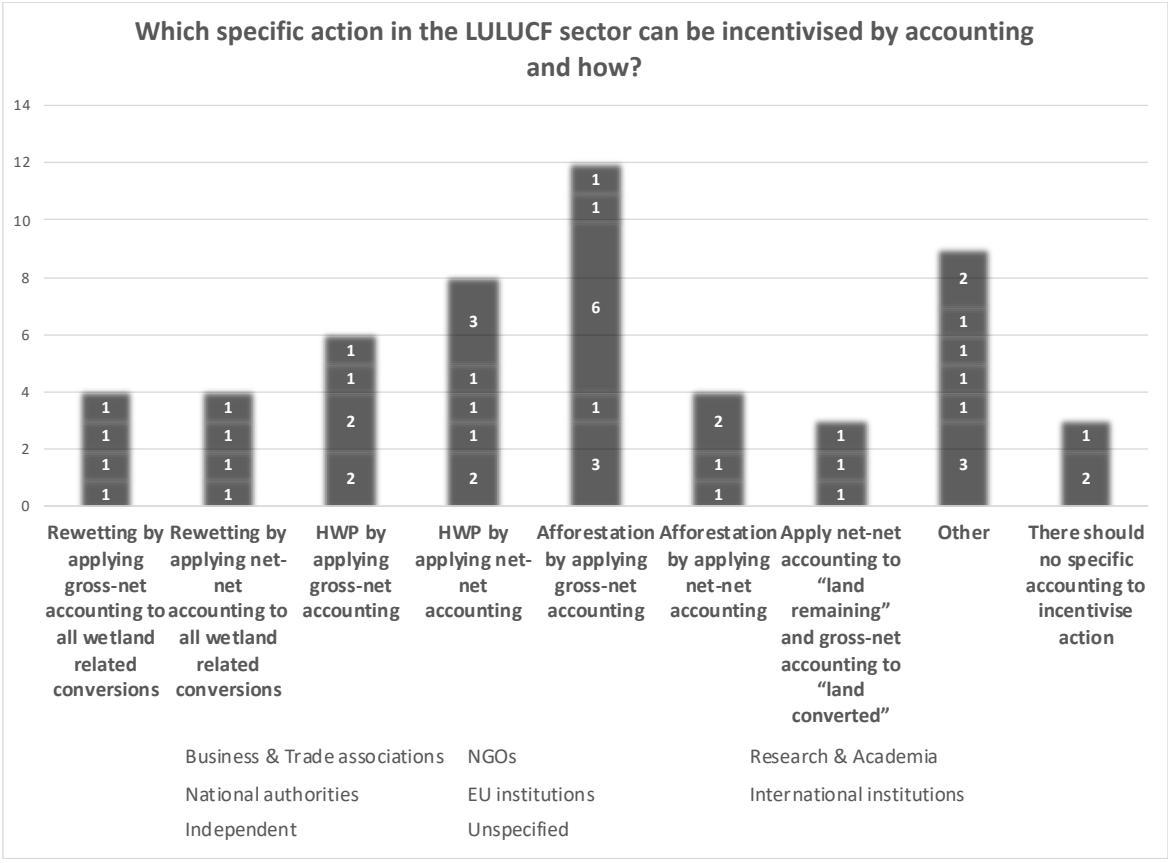


Figure 49: Responses by stakeholder category (poll N°5)

The sixth and last poll for this session asked which specific accounting elements should be revised in a simplified accounting framework. 30 stakeholders participated in this poll. "Cap on credits, e.g. from forest" resulted the most selected answer. Multiple answers were allowed.

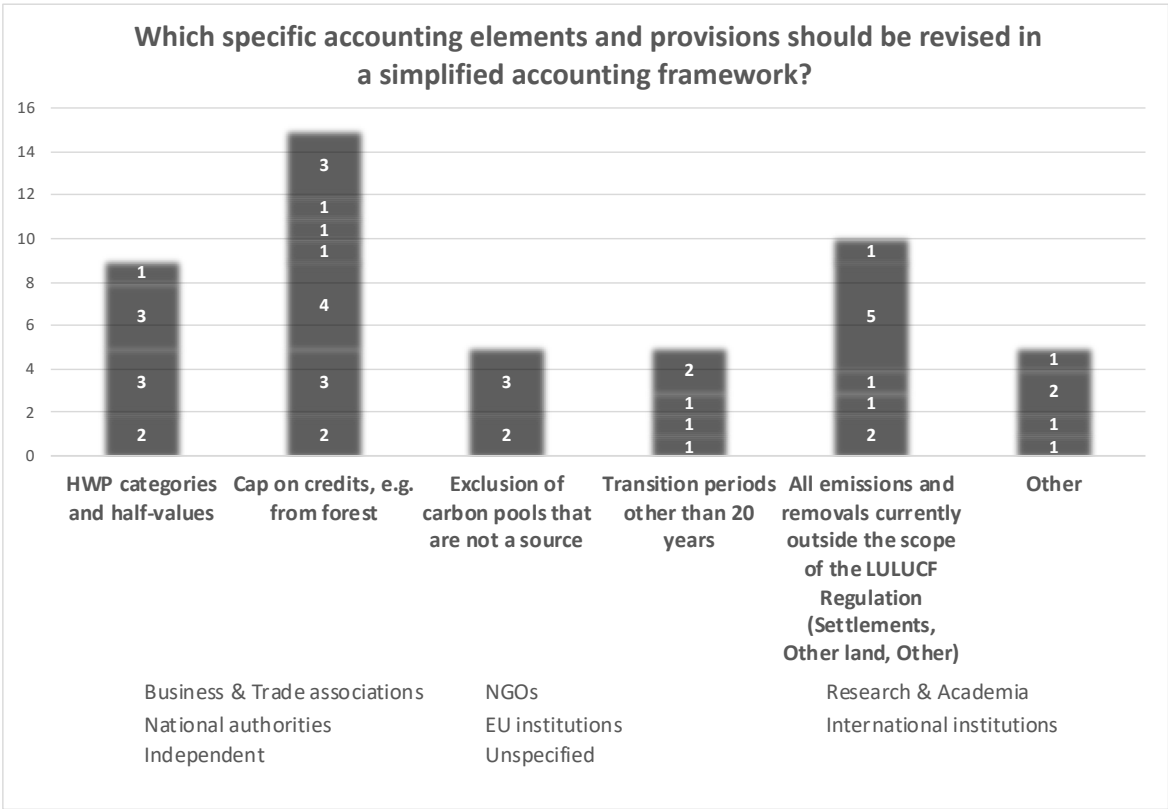


Figure 50: Responses by stakeholder category (poll N°6)

10.6.3. Discussion

A **national authority stakeholder** asked if an indication could be given on the base year or period in net-net accounting.

A **national authority stakeholder** clarified that there is uncertainty around how much will be asked from ETS. Calculations are based on 2005 numbers. As there was no ESR in 1990, it was not possible to calculate relating to 1990. The revised ETS and ESR will maintain 2005 as base year, so if we treat LULUCF with ESR we would keep 2005. It will go hand in hand with how other regulations change.

A **national authority stakeholder** asked if gross-net accounting would be with a cap. A **national authority stakeholder** responded that it is not the idea to propose a gross-net, but a net-net approach (as in other sectors) comparing 2005 ESR emissions (including LULUCF) with 2030 ESR emissions (including LULUCF), so there would be no need for caps or other instruments constraining the sector.

The **moderator** asked what the pros and cons would be of having a joint ESR with a net-net approach when we look towards 2050 and the climate neutrality objective, having to balance removals and emissions in other sectors.

A **national authority stakeholder** clarified that this approach would be in combination with the ETS, so that the sum of ETS and the expanded ESR would be zero.

A **research & academia stakeholder** asked what the target for LULUCF would be and if bringing this into an ETS world with higher ambition levels would imply watering down targets.

A **national authority stakeholder** responded that the notion of watering down targets comes from the current system. It was discussed not to have sector-specific targets, and therefore not a LULUCF target, but rather an ESR target which would be set in the same way and include also LULUCF emissions. This would not be reducing ambitions as all countries would have to do more than what they are currently required to do. LULUCF could be addressed in domestic policies, through which one can decide whether to invest more or less in different sectors. This is already the case for countries to comply with ESR.

A research & academia stakeholder concluded by stating that when constructing the integrated ESR target, we have to assume something on the development of LULUCF (e.g. constant sink, declining sink), which implies that there are some assumptions on the LULUCF ambition level.

A **business & trade association** stakeholder asked how we could ensure that embedding LULUCF and ESR together, and possible compensation mechanisms, do not negatively impact wood harvesting, and if in addition, there are any considerations to take into account for the substitution of fossil-based raw materials.

The **moderator** clarified that these issues are also relevant to reconsider how we do wood products accounting, which might also be an issue to open up and discuss.

A **national authority** stakeholder responded that there would not be negative impacts of harvesting. The proposed idea would include everything, including HWP, implying that the trade-off between more harvesting and HWP could be captured. Current trends point out that the sink is being reduced, implying that the pressure on other sectors is increased.

A stakeholder from **research & academia** welcomed the proposal as an improvement of the current state of affairs but explained that expanding the current ESR targets per Member State might be too simplistic, because these targets were designed without considering population density. When including LULUCF, the amount of land per inhabitant becomes an important criteria to consider. The peraticpant added a justification for the preference of the gross-net approach, stating that the LULUCF sink in 1990 becomes somewhat irrelevant to consider

what the target for a country should be in 2030 or 2050. Instead, there is an EU level target that includes LULUCF, or even an EU level target specific to LULUCF, whether we start from net-net or gross-net to decide how to share the target between Member States becomes a detail.

A **national authority** stakeholder responded that using gross-net could create a problem. When using net-net, all countries can do better or worse, regardless of how much forests or LULUCF they have. On the contrary, when using gross-net, the differences between Member States would be astronomical which could lead to very serious allocation problems to distribute targets across Member States.

An **international institution** stakeholder commented that the accounting happening in LULUCF is not necessarily enough to provide incentives for higher climate ambitions. For example, in the production of harvested wood products, the substitution effect is important and if we only look at the LULUCF sector, we are missing this.

An **NGO** stakeholder asked how to justify the issue of treating different emissions in sectors which are similar both in respect to the permanence of the sinks and the origin of different emissions. When there is an aspirational target in LULUCF, the question of what accounting principle to use is more related to how the target is set than the level. The participant also stressed the importance of considering how to share the burden fairly in the LULUCF sector and added that there is a lot of merit in having separate incentives in the LULUCF sector based on the different nature of removals.

A **national authority** stakeholder responded that permanence would not represent an issue and explained that if the permanence of stock is not ensured, one would have to account for it, report and compensate it with other sectors.

A **research & academia** stakeholder asked whether net zero in 2050 is defined as an accounted net zero (i.e. based on net-net accounting rules for LULUCF) or as a net zero based on reported emissions/removals as reported to the UNFCCC.

An **EU institution stakeholder** responded that the pathways for LULUCF have been calculated as in the other sectors. When arriving in 2050 and looking at a within-year assessment, we do not act in respect to the base year. The participant raised the important question of how to frame a certain level of ambition. This could be set by determining an amount of removals as a pre requisite. The participant concluded by stating that the question remains on how to set the ambition for 2050.

10.7. Forest Reference Level

Valentin Bellassen (INRAE) provided some reflections on the Forest Reference Level (FRL) accounting approach.

He explained that the FRL approach should not be continued after 2030 because there are key weaknesses, such as: difficulty to reconcile with the 2050 carbon neutrality target; potential unreliability of projections as we get further away from the 2000-2009 reference period; resource intensity of modelling and reviewing FRL; vulnerability to information asymmetry.

Nevertheless, he mentioned also some of the strengths of the approach, such as that it allows to account for age-related trends in target setting.

He continued his presentation by presenting a possible replacement for LULUCF accounting. As we have an EU-wide goal of reaching -425MtCO2e/yr in 2050, the question that remains is how to share the target. This could be called gross-net accounting; however, it is not understood in the same way as in the Kyoto Protocol for forest management. He proposed the Effort Sharing subdivisions between Member States, keeping in mind that several criteria are to be defined and the overall target setting should be open to discussion and political negotiations.

He provided some thoughts on how to assess the consistency of FRL with GHG inventories. From the NFAPs in 2018, it is clear that this assessment has been done heterogeneously. He proposed some solutions to improve the consistency, by assessing the consistency in trend and in level. For the former, he proposed to facilitate the use of pre-existing and published models and projections, to mandate the JRC to provide country specific FRL, and to mandate a narrative of the key drivers of the trend. For the latter, he proposed to provide more specific requirements on how to assess consistency and a consistency assessment tool in tabular format.

10.7.1. Interactive polls

The interactive discussion session developed on five poll questions which were directed to the audience via Mentimeter.

The first poll question investigated on the audience's opinion regarding the continuation of the use of the reference level concept. 33 stakeholders participated in this poll, with the majority (18) answering "No, compare the net sink in existing forests to a historic baseline ("net-net" accounting); such baseline corresponds to a larger sink than FRL".

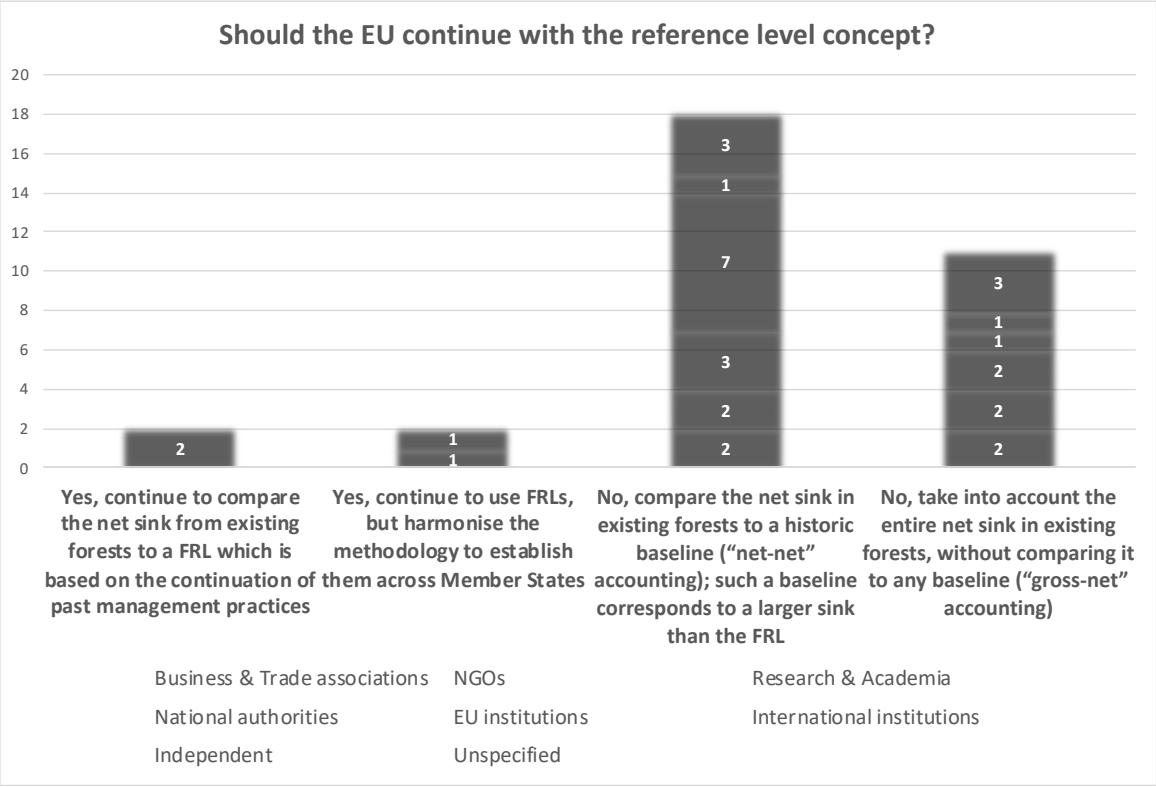


Figure 51: Responses by stakeholder category (poll N°1)

The second poll question asked the audience their opinion regarding FRLs as implemented under the LULUCF Regulation. 27 stakeholders answered this poll, with the majority indicating that "The FRL review process is not stringent" and that "The FRL review process is too burdensome and costly". Multiple answers were allowed.

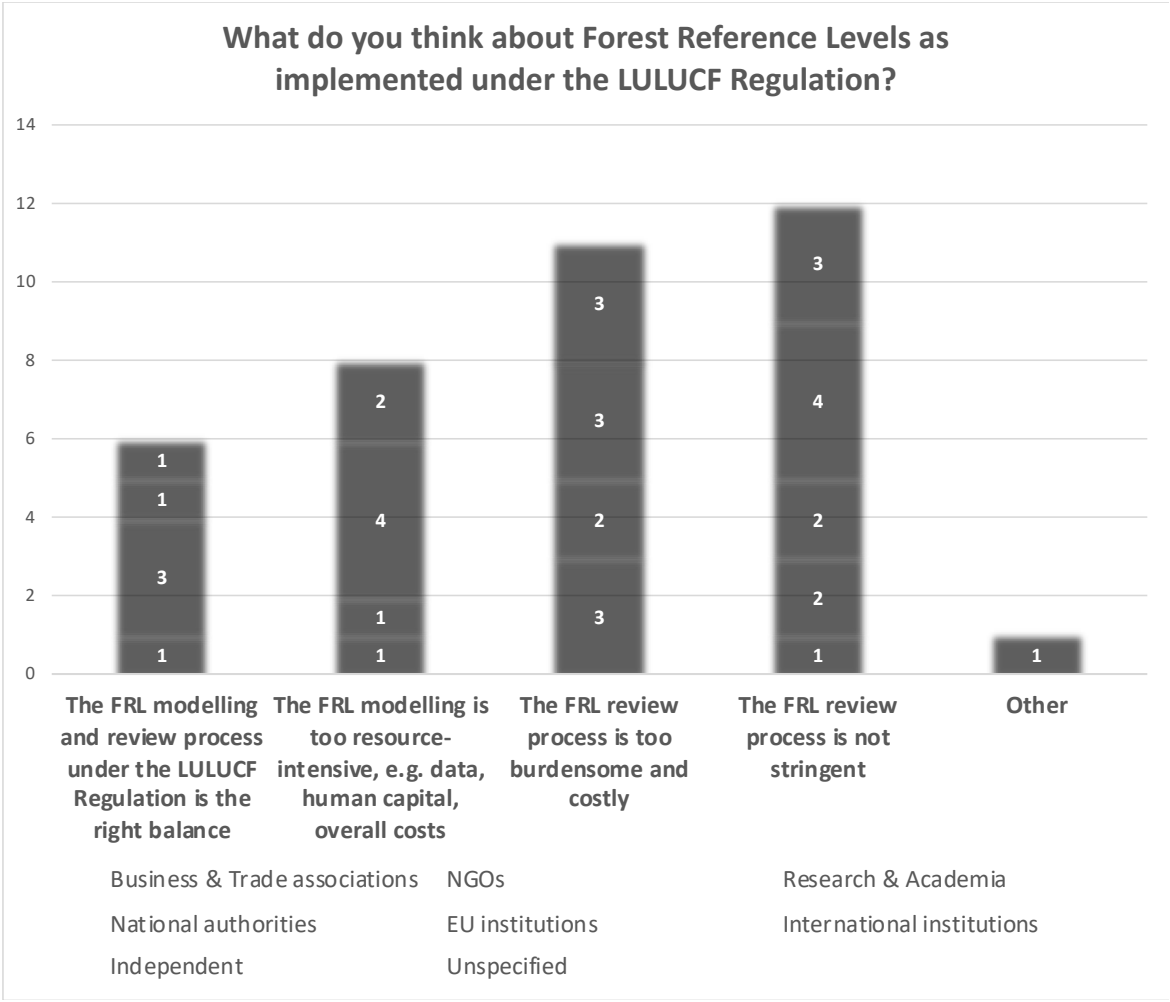


Figure 52: Responses by stakeholder category (poll N°2)

The third question asked the audience how important a uniform application of the reference period is for setting FRLs. 29 stakeholders answered, with the great majority (21) indicating that “best available data should be used”.

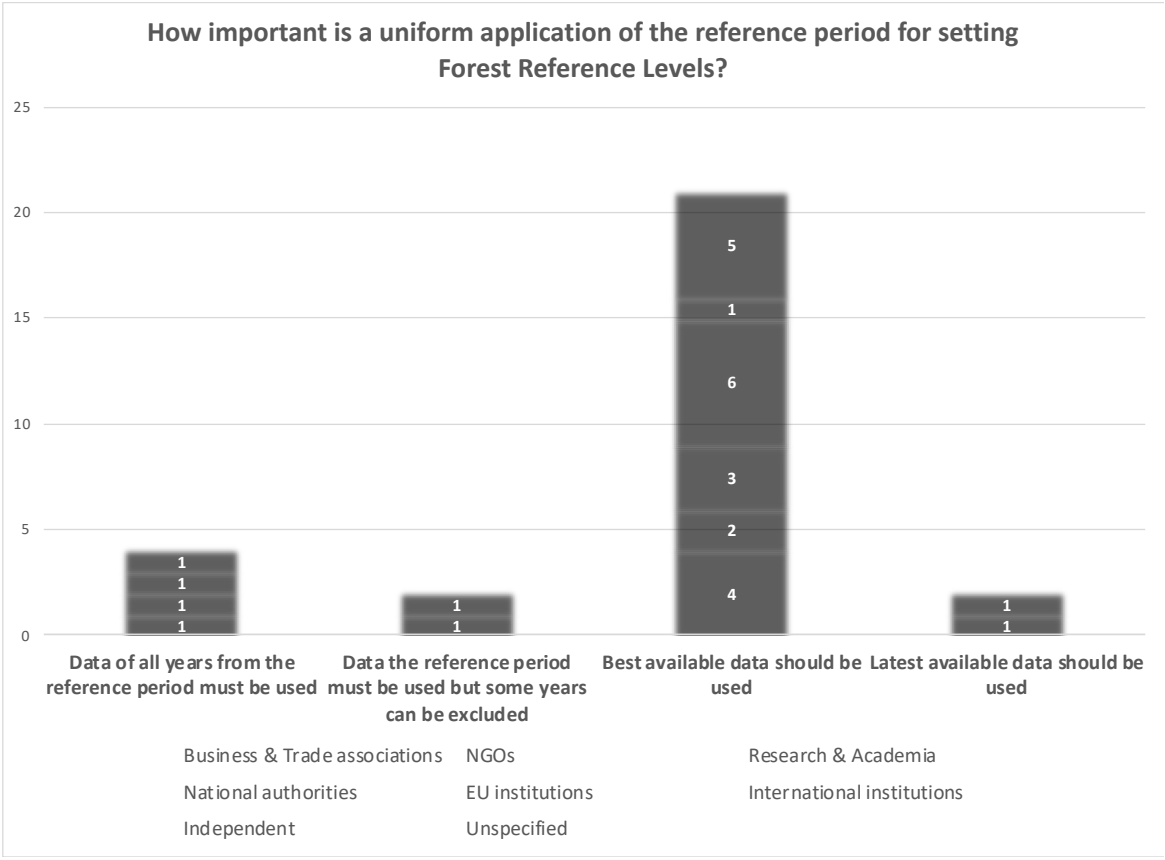


Figure 53: Responses by stakeholder category (poll N°3)

The fourth question investigated on how management/harvest intensity should be defined. 21 stakeholders participated in this poll, with the preferred option resulting in “there can be multiple definitions”, followed by “Harvest per increment”.

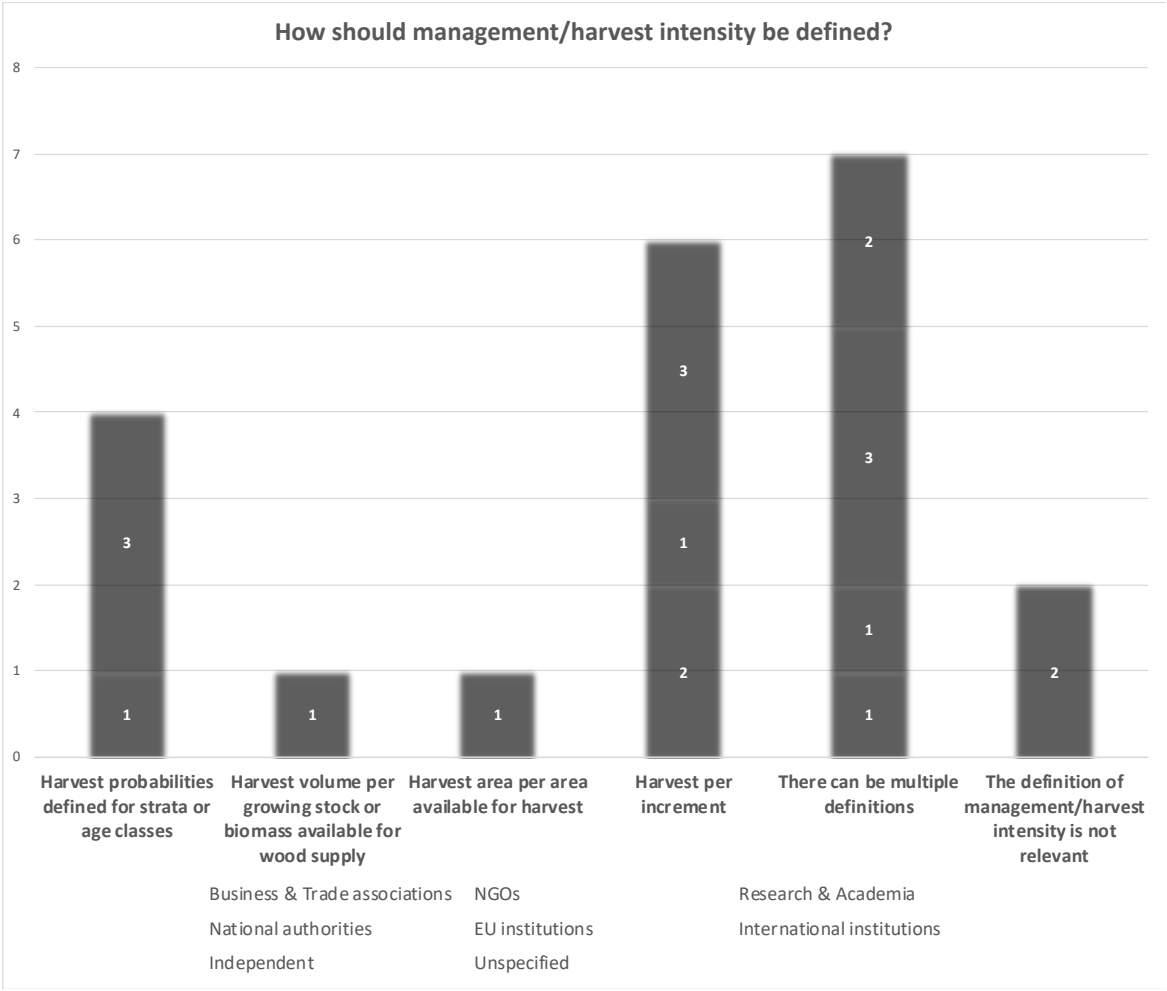


Figure 54: Responses by stakeholder category (poll N°4)

The last question investigated on how consistency of the FRL should be presented. 21 stakeholders answered this poll, with the majority (13) indicating “quantitatively with statistical measures”.

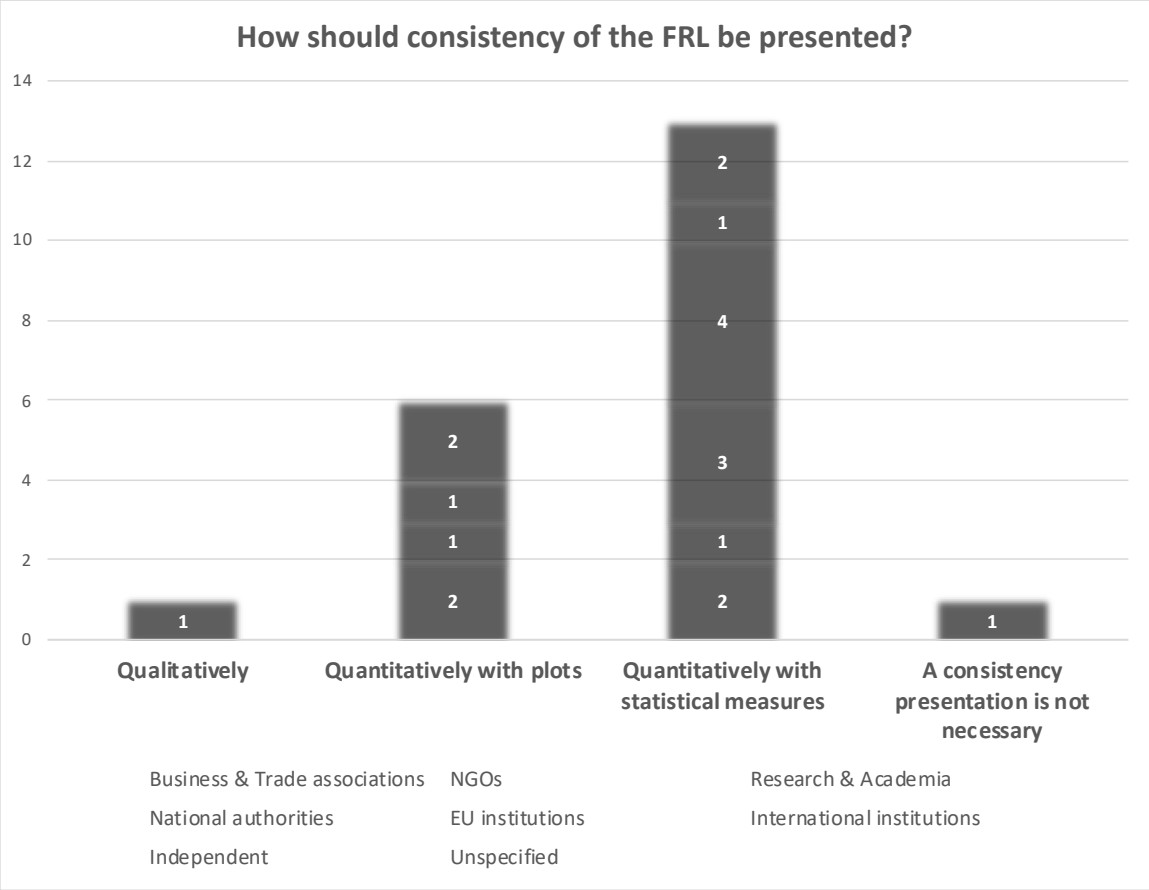


Figure 55: Responses by stakeholder category (poll N°5)

10.7.2. Discussion

An **NGO stakeholder** commented on the Reference Level concept and stated that generally, the more ambitious the target Member States need to cope with, the more they assume the appropriate incentives to enact it. Net-net is the closest to this approach, but one could also have an aspirational target for all countries and share the burden across.

The **moderator** asked the audience to express their opinion on two options when not using FRL, namely compare the net sink in existing forests to a historic baseline (net-net accounting) and take into account the entire net sink in existing forests without comparing it to any baseline (gross-net accounting).

An **EU institution stakeholder** responded that if the LULUCF sink is the base, then accounting fully becomes a net-net. LULUCF is increasingly seen as being the base, therefore the distinction between gross-net and net-net should disappear.

A **research & academia stakeholder** agreed with the previous statement and added that if LULUCF is included in the accounting, the only difference between the two approaches is the entry point to negotiate the target for each Member State. The participant asked the audience why, if starting with the LULUCF balance in 1990, this year is the most relevant starting point compared to other starting points (e.g. amount of land per inhabitant), keeping in mind that we are thinking of a long-term sink.

An **NGO stakeholder** confirmed that the discussion should go beyond net-net and that the distinction between the two approaches becomes small.

An **international institution** stakeholder commented that the reference level was introduced for Kyoto Protocol 2 because the cap for forest management used for Kyoto Protocol 1 did not provide incentives at all. The participant explained the rationale in the context of the Kyoto

Protocol that accounting should exclude removals from 1) elevated CO2 concentration; 2) indirect nitrogen deposition; and 3) the dynamic effects of age structure resulting from activities and practices before the reference year. This should also be seen in the context that LULUCF was added after the targets were agreed. If this was known before, maybe targets should have been more ambitious, but there was a lack of knowledge on the potential back in 1997 in Kyoto.

The **moderator** asked the audience their opinion about the reference level review, and the costs and stringency concerns over the EU process.

An **international institution** stakeholder answered that it has been agreed that for NDCs there will not be any UNFCCC review. Countries submit what they want to achieve and what indicators they will use to determine their progress, and these indicators will be reviewed.

An **EU institution** stakeholder commented that current FRLs have been designed to factor out the impact of age dynamics. However, age dynamic is still the main driver of sink decline in the medium term. The participant asked the audience whether, given the preference for net-net emerging from the discussion, we could put the considerations on age dynamics aside.

A **national authority** stakeholder responded that I light of the previous discussion the total sink in LULUCF is small relative to ESR, and therefore having a target for the two would not be complicated to manage.

A **research & academia** stakeholder added that when looking over the long-term, we do not only aim at a climate-neutral EU in 2050 but also afterwards, therefore age-dynamics become less relevant. In other sectors the age dynamics have not been included as technically as in the LULUCF (e.g. consider the age of buildings and of power plants), which implies that there is a less technical way for taking age-related dynamics into account.

A **national authority** stakeholder commented on the importance of a uniform application of reference period for setting FRLs. While we may not need FRL going forward, if we are to use it we would have to use the best available data but the question that remains is whether we are talking of best available data in a free period or a constrained period. The former would be complicated going forward and the latter would be better to ensure continuity and comparability. Regardless of the use of FRL, all efforts would remain to report all emissions and removals. Therefore, the accounting may be simplified, but the burden is not taken out of reporting.

A **research & academia** stakeholder raised a question on the age dynamics issue previously addressd and asked why it remains an EU concern, given that many developed countries are not using FRLs.

An **EU institution** stakeholder responded that it is not very clear what other developed countries are doing on NDCs and suggested to direct these questions to Member States.

An **international institution** stakeholder added that very few updated NDCs have been received, making it difficult to conclude what other countries will do. New Zealand might use an FRL approach, US and Canada are keen on a net-net approach, while Russia has been using a gross-net approach.

A **research & academia** stakeholder further reflected on the NDCs and added that there is a difference between an integrated target proposed by countries or a separate LULUCF target. For the latter, a finer accounting tool would be needed. Many countries opt for a full inclusion, making the LULUCF sector more prominent. This goes back to the question on the ambition levels, whether we include semi neutral or indirect effects into accounting for targets, and the same applies to accounting for disturbances.

An **NGO** stakeholder commented that what matters for the climate is how much carbon is in the ecosystem (e.g. forest ecosystem), rather than in the atmosphere. Therefore, there should be some flexibility over time regarding the timing of the sink when there is more carbon in the ecosystem. What matters is the stock, and this should be considered when providing incentives for substitution.

A **research & academia** stakeholder commented on the issue of consistency and stated that if we are to opt for statistical measures of consistency, there should be guidelines and specific requirements on what these measures should be. Given the limited resources of the teams that deal with FRLs and inventories, a tool should be provided to implement the recommended statistical tests.

An **EU institution** stakeholder concluded the Part 1 of the workshop by providing some reflections on the discussions. The participant thanked the two presenters for their contributions and highlighted some takeaways:

- The 55% reduction should be a net comparison with a base year, but there is no need to call it this way as other sectors don't. This provides scope for discussion on what purpose accounting rules have in a sector.

- FRLs are an EU affair and the reason why they were introduced is because we had very divergent situations between Member States and fragmented ways to look at LULUCF questions. We had to deal with bringing LULUCF into the Kyoto Protocol framework which took time.

10.8. Part 2: LULUCF Reporting

The second part of the workshop was moderated by John Van Aardenne (EEA) and focused on LULUCF reporting needs, completeness and accuracy as well as on wall-to-wall data as a cost-beneficial means for land monitoring. This part of the workshop included two presentations, each followed by an interactive discussion session.

10.8.1. LIFE Reporting

Hannes Böttcher (Oeko Institute) provided a presentation on opportunities and challenges of reporting in LULUCF.

He reflected on the role of existing independent/international data produced by different data communities (e.g. remote sensing, flux net, modelling), who are not necessarily aware that such data would be used for inventories. He explained that there are opportunities for improving completeness, consistency and comparability of the inventories. However, challenges persist, such as issues of definitions and matching reporting categories with model variables. He therefore called for a closer collaboration among the scientific communities on reporting.

He introduced the issue of visibility of mitigation measures in reporting and explained that, while not necessarily meant to report on progress of mitigation measures of different stakeholders, reporting is often used for assessing this progress. As there is an increasing demand for sinks and flexibility with other sectors is increasing, he stressed the need for a comprehensive inventory for the LULUCF sector. He added that there is a need for science to produce emissions factors that are reflecting mitigation measures on the ground, to make inventories ready for tracking mitigation action and setting more incentives for management changes.

Lastly, he commented on the need for reporting to be complete and accurate enough to reflect all changes in time and space. He proposed the use of a proxy inventory based on best available data, as it exists for other sectors.

Hannes Böttcher concluded his presentation by calling for constant improvement and development of reporting methods to ensure adequate target setting.

10.8.1.1. Interactive polls

The interactive discussion developed on five poll questions, asked to the audience via Mentimeter.

The first poll aimed to categorize the respondents under specific stakeholder categories. 26 stakeholders participated in this poll.

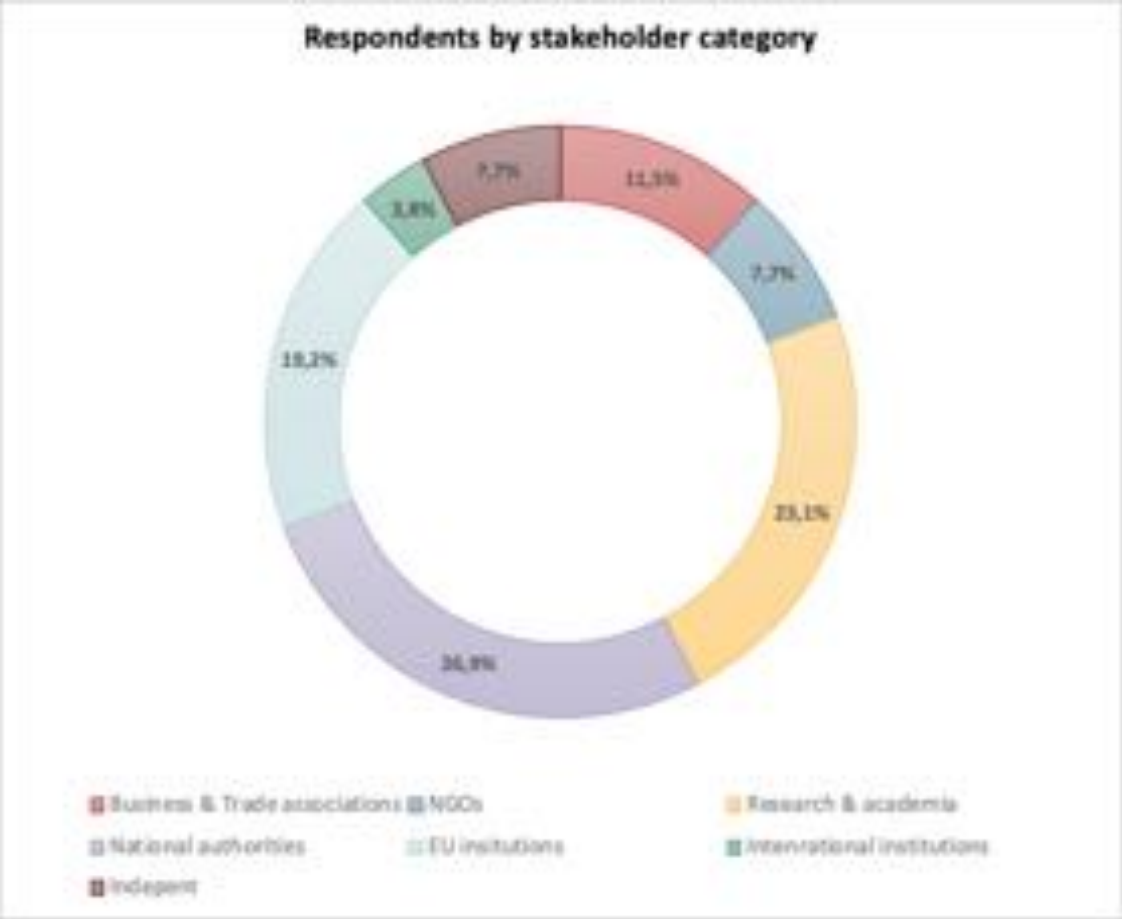


Figure 56: Respondents by stakeholder category

The second poll investigated on the most pressing needs for improving LULUCF reporting. 25 stakeholders responded to this poll. The preferred answer was “activity data availability”, followed by “emissions factor data quality” and “emissions factor data availability”. Multiple answers were allowed.

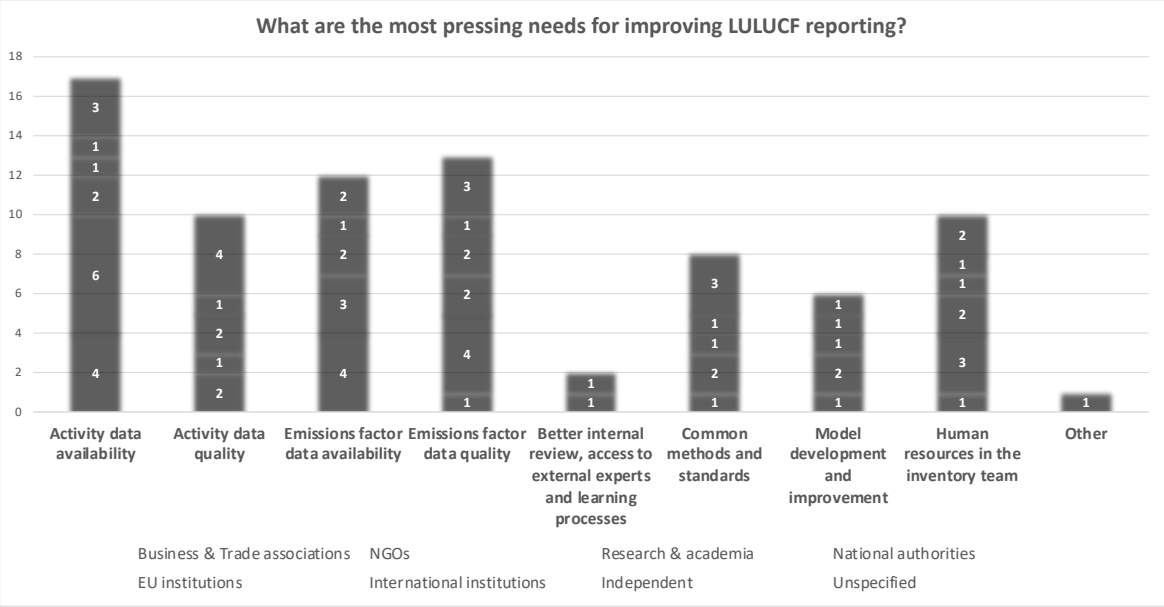


Figure 57: Responses by stakeholder category (poll N°2)

The third poll asked the audience whether all emissions and removals should be reported. 25 stakeholders answered this poll, with the majority (16) responding affirmatively.

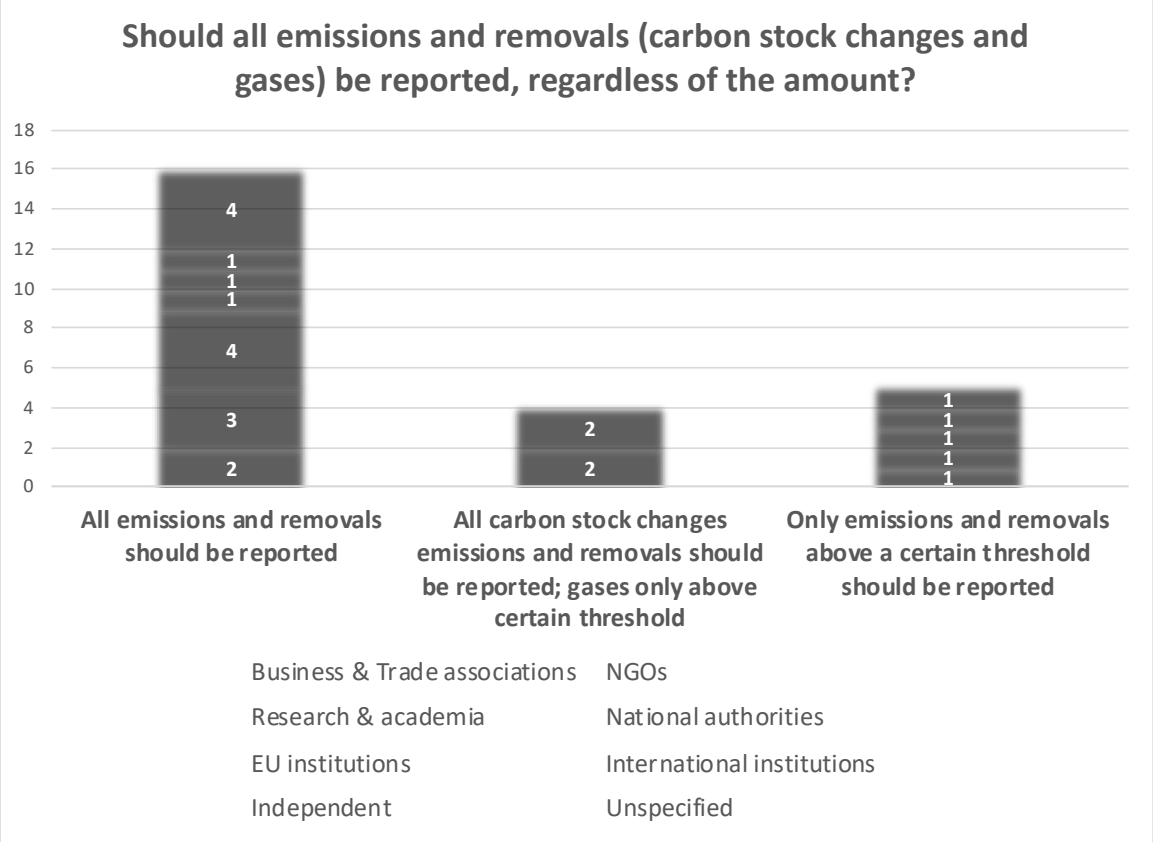


Figure 58: Responses by stakeholder category (poll N°3)

The fourth poll asked the audience which carbon stock changes, emissions and removals should be reported at least at tier 2. 18 stakeholders responded to this question, with the majority (11) responding “only above a certain threshold”.

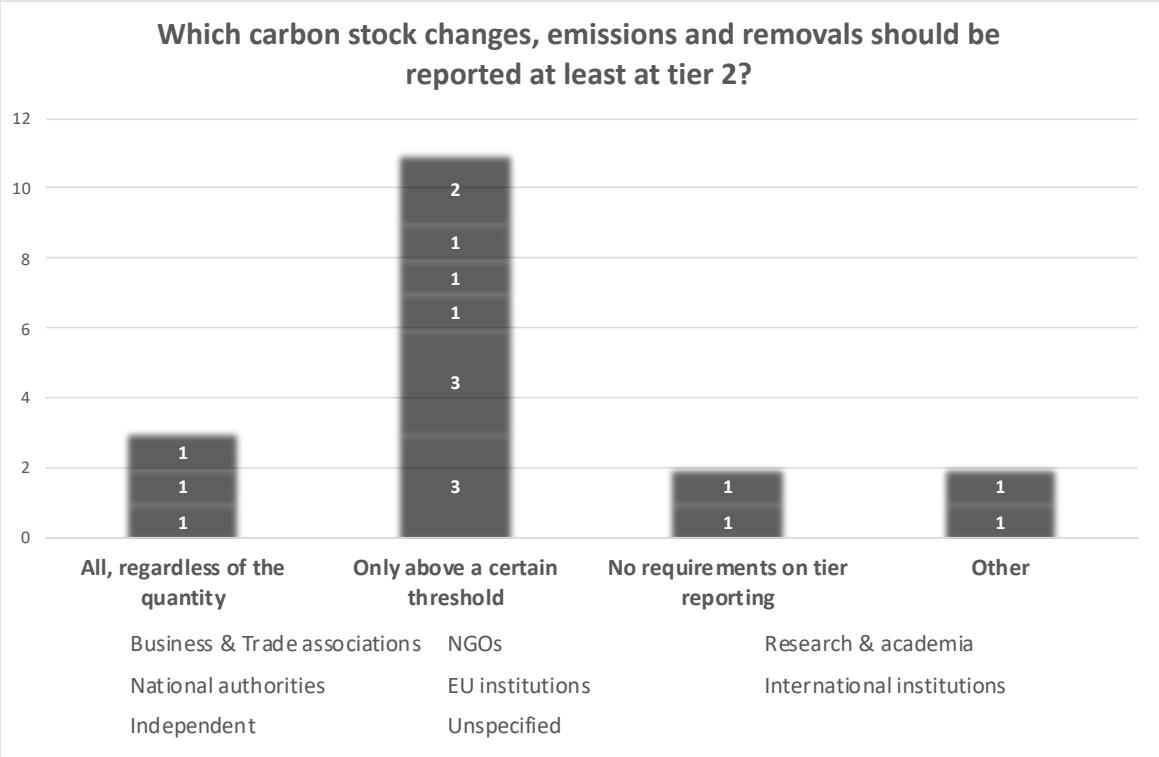


Figure 59: Responses by stakeholder category (poll N°4)

The fifth and last poll asked how the accuracy and uncertainty of LULUCF estimates can be improved and verified. 19 stakeholders answered this poll. “Remote sensing data and products” and “statistical and geostatistical modelling” resulted the preferred options. Multiple answers were allowed.

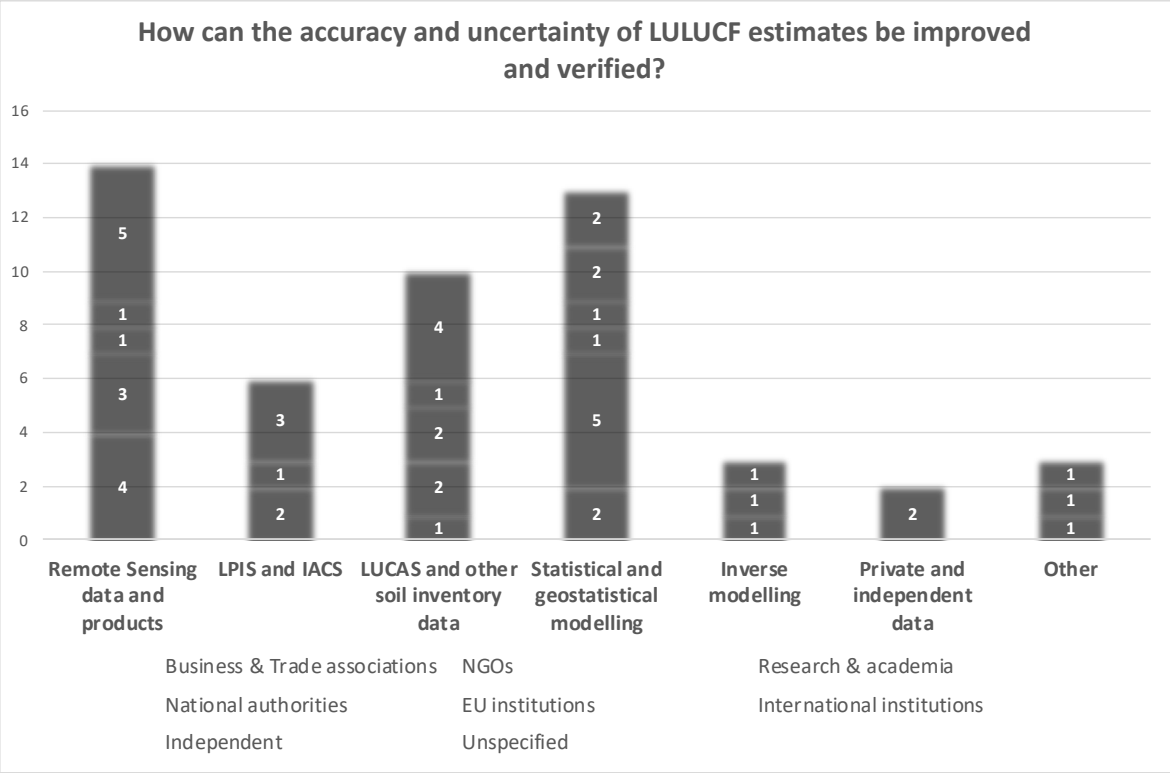


Figure 60: Responses by stakeholder category (poll N°5)

10.8.1.2. Discussion

A **national authority stakeholder** commented on the previous presentation, stating that, while providing useful information, the role of inventories is not to characterise the relevance of policies and measures. The focus of inventories should be to get as good a picture as possible of what is going on in terms of emissions and removals. The inventory alone will need some additional analysis. As regards the incentives, these are the role of policies, rather than of the inventories.

A **research & academia stakeholder** emphasized the link to policy and a need for inventories to be updated. More information is needed for tracking mitigation measures and progress, but if the inventory does not have enough resolution and granularity to detect changes (e.g. cropland areas changing but not changing management), then no change will be detected against the baseline.

A research & academia stakeholder agreed that the link between scientists and inventories is not as tight as it could be and asked if there are concrete suggestions on how to improve their collaboration.

A **research & academia stakeholder** responded that this can happen at different levels: at the inventory compilation level, if there is a consistent data set and similar definitions or at the EU level, where the initial checks can be supported by satellite data and check plausibility of results to improve accuracy. Modelling data from inverse modelling can be used to get an envelope around the sector where the net total can be determined at national boundaries.

A **research & academia stakeholder** added that there is a need to rethink how data can be integrated, rather than thinking of science and inventories.

The **moderator** invited the audience to comment on the most pressing needs for improving LULUCF reporting, particularly on activity data availability.

A **research & academia stakeholder** commented that soil carbon is critically lacking activity data. While some practices that improve soil carbon sequestration have been identified, many

Member States are lacking tools to record the data and this creates a blind spot in the current inventory.

An **EU institution stakeholder** asked for further reflections on what is stopping the collection of this type of data.

A **research & academia stakeholder** explained that one element is the fact that soil inventories would not be conducted by inventory teams, and what constitutes an obstacle is the lack of soil inventories in Member States. Another element is that more use could be made of LIPS and IACS data, as some of the practices that improve soil carbon is subsidised by the CAP, yet we don't see this data being used.

A **research & academia stakeholder** added that in some Member States having accurate soil maps is an issue because of the lack of adequate soil inventories. When dealing with reporting, the question that arises is how much to invest if the emissions or removals are very small.

A **national authority stakeholder** responded that the link between science and reporting could be useful if data were to be combined and used to calibrate models, rather than having a soil inventory in each Member State.

A **national authority stakeholder** drew the attention on the category of settlements, where there are many difficulties in finding data on soil carbon content, and there seems to be a gap in the guidelines on how to deal with this.

An **EU institution stakeholder** provided an institutional perspective on reporting. Forestry has been receiving support in the last 15 years through many ways, including the LULUCF workshop at ISPRA. However, soil monitoring had not been supported and what we managed to achieve for forests was not achieved for agriculture.

The **moderator** asked to comment on whether all emissions and removals should be reported, or whether a threshold should be considered.

A **research & academia stakeholder** stated that the UNFCCC regulation gives a threshold to other sectors, but it is also suitable to be used for LULUCF.

An **EU institution stakeholder** commented that we cannot say that the pool is significant if it is not reported. One approach could be to use as a proxy the significance of the pool used by other/neighbouring Member States. It was stated that the steps should evolve for such an approach to assess first the significance to set a threshold and later request the reporting.

An **international institution stakeholder** concluded that regarding the threshold, Member States must show that they are under the threshold for their country in the GHG review.

The **moderator** asked the audience to comment on potential issues with knowledge shortcomings in inventories.

A **research & academia stakeholder** responded that a short-coming is given by the resourcing issue and the fact that money is invested in research but does not reach the inventory. Projects should be run by the inventory agency.

A **national authority stakeholder** commented that everything related to cropland and grassland is less developed than for forest land. Some of the products suggested to improve the accuracy and uncertainty of LULUCF reporting do not necessarily resolve the issue (e.g. remote sensing data). There is a great improvement from Copernicus in the data being produced, but it is not fully understood how it can improve reporting.

The **moderator** asked the audience to comment on the improvements of the accuracy and uncertainty of LULUCF estimates.

A **research & academia stakeholder** commented that remote sensing and statistics go together, as it is the combination of the two which provides estimates.

An **EU institution stakeholder** added that in order to identify areas for improvements it is important to compare countries with similar ecological regions and management practices. Might serve the inventory compilers to challenge their own numbers and verify their data.

An **NGO stakeholder** commented that in many countries the issue is human resources as there seems to be reluctance to work on open-source tools across countries.

10.8.2. Wall-to-wall data (e.g. Satellite-based remote sensing, aerial photography, polygon layers at very fine level of details) for LULUCF

Martin Herold (Wageningegn University) provided a presentation on remote sensing and spatial data for GHG estimation and reporting.

He showed that there is already a widespread use of remote sensing data, particularly when it comes to forest area and change estimation. He further explained that the uptake of remote sensing and spatial data provides a way to contribute to the existing data sources and information. As the focus is on change, this data can be used for stratification and sampling measurements in the areas that are changing.

He concluded his presentation by informing the audience of an ongoing survey for GHG inventory agencies on the need for spatially explicit estimations. He showed that the main motivation for their use include LULUCF mitigation policy development related to land management and tracking of activities.

10.8.2.1. Interactive polls

Mr. **Christian Holzleitner** (DG CLIMA) also provided the closing remarks on the workshop. He stated that the workshop has given an overview of the overall market size for carbon removal and what it will look like in the future. There is a need to continue to push this discussion forward.

He remarked about the importance of finding a balance between food production and carbon farming. Carbon removals should be a business integrated into European sustainable farming and provided with additional funding mechanisms that ensures further progression in the field. Ongoing initiatives from the European Commission will further incentivise action for carbon farming schemes.

He concluded by confirming that it will not be a low-cost transition and that funds need to be mobilised from different sources, such as from major polluters, from the CAP budget, abd from the better use of the revenues from the Emission Trading System (ETS).

The discussion developed on four poll questions, asked to the audience via Mentimeter.

The first poll asked the audience for their opinion on the role of wall-to-wall/seamless geospatial data in LULUCF reporting by 2030. 28 stakeholders responded, with the majority responding either “key” (11) or “supplementary” (8).

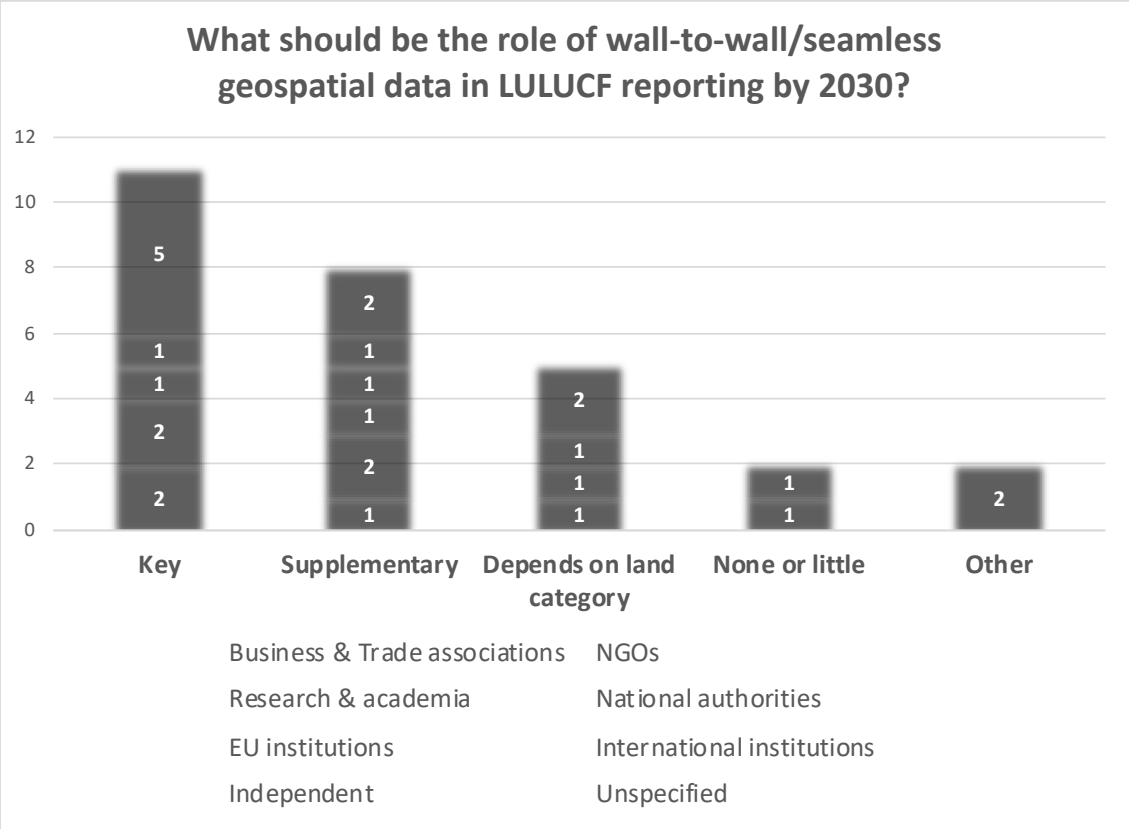


Figure 61: Responses by stakeholder category (poll N°1)

The second poll question investigated on the barriers for using wall-to-wall geospatial data in LULUCF reporting. 24 stakeholders participated in this poll. The most common barrier identified was “time series consistency with historic emission reporting”. Multiple answers were allowed.

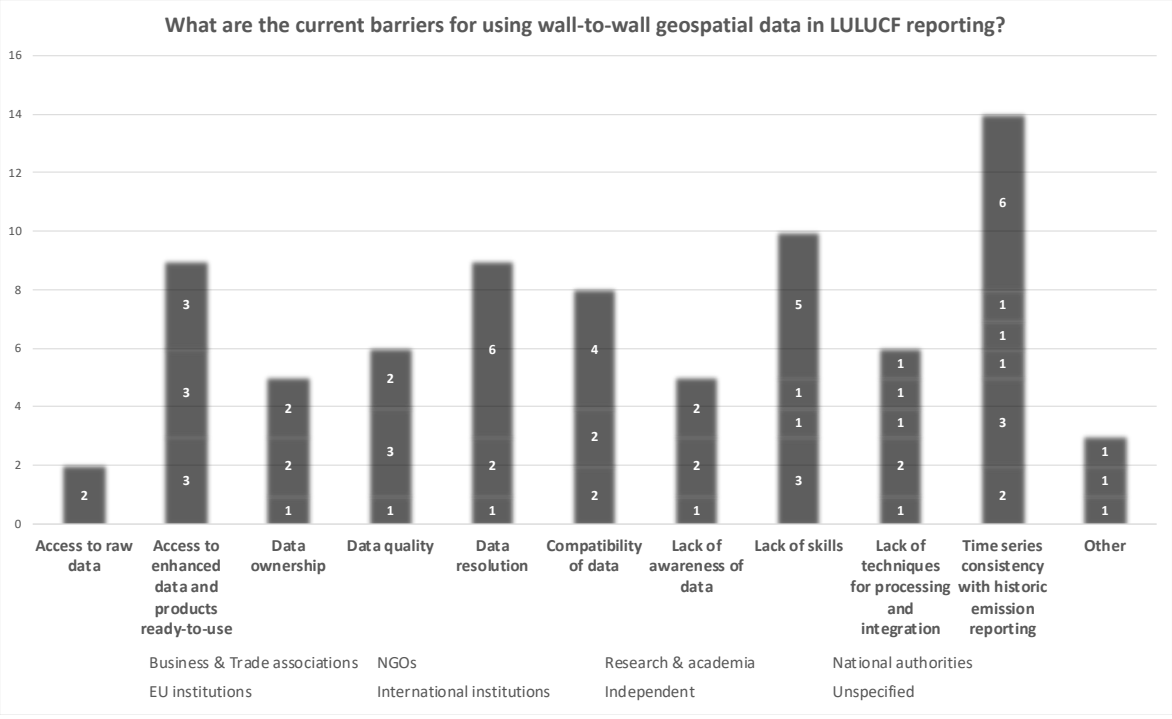


Figure 62: Responses by stakeholder category (poll N°2)

The third poll question asked the audience whether wall-to-wall data would be used as activity data for mapping land use and land use change and/or land use management practices. 23

stakeholders responded to this poll. The preferred answer were “yes, together with inventory data”, followed by “yes, together with statistical data”. Multiple answers were allowed.

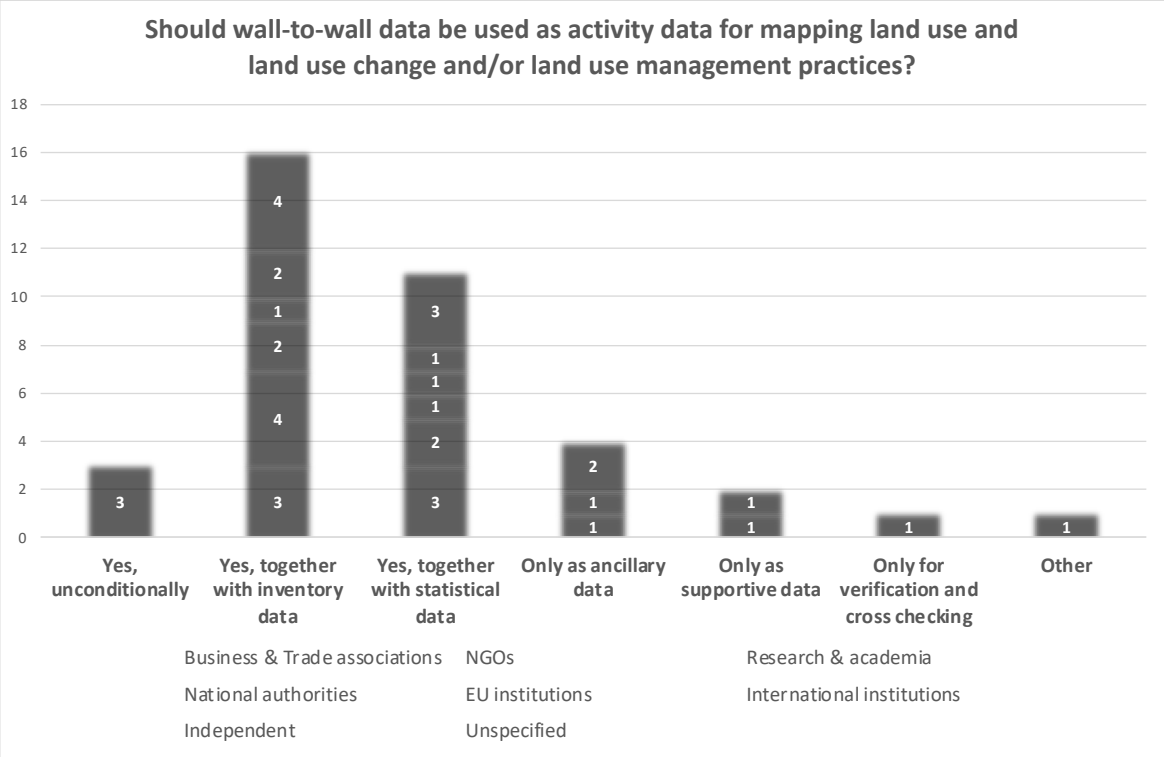


Figure 63: Responses by stakeholder category (poll N°3)

The fourth and last poll asked the audience their opinion on the greatest benefit of using wall-to-wall data. 21 stakeholders responded to this poll. The preferred answer was “The results will help me targeting mitigation action”. All other options were considered as relevant benefits of the use of wall-to-wall data. Multiple answers were allowed.

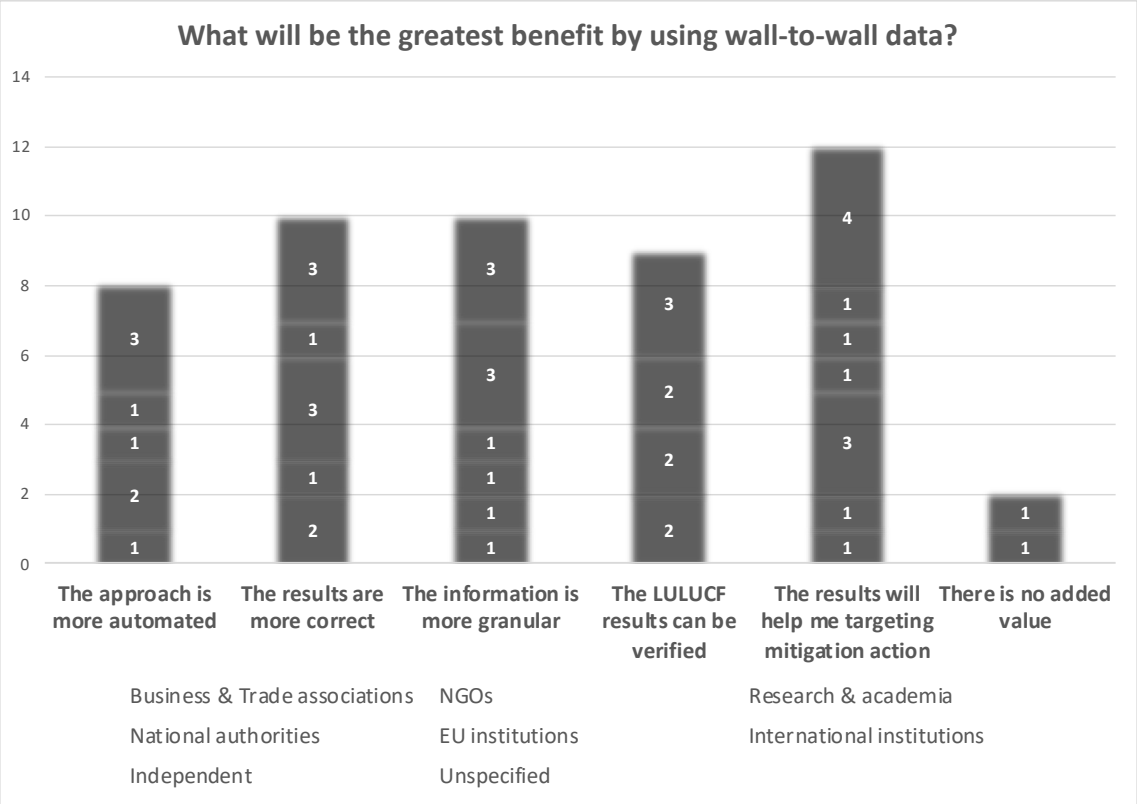


Figure 64: Responses by stakeholder category (poll N°4)

10.8.2.2. Discussion

The **moderator** asked the audience to comment on the role of wall-to-wall/geospatial data in LULUCF reporting.

A **research & academia stakeholder** commented that from the Earth observation side, there is limited information that can be provided on soil and the best approach is to use models.

A **research & academia stakeholder** added that remote sensing can be very useful and that inventory agencies should develop the capacity to use it, keeping in mind divergences in classification and regional differences.

The **moderator** asked the audience to comment on the barriers for using wall-to-wall/geospatial data, especially time series consistency with historic emission reporting.

A **research & academia stakeholder** commented that for Earth observation, the availability of data is limited in 1990 and suggested 2005 as a better starting point for availability of better quality remote sensing data.

A **research & academia stakeholder** added that reporting requirements should look at what data is available and which period we can accurately report on. Starting from 1990 might not be sensible.

A **research & academia stakeholder** commented that there is not one approach for all situations and that achieving ownership and understanding of a new tool requires an approach at the country level. The participant stressed the importance of integrating the tool in the country's current system. When the requirements indicate a need to improve the quality of data, national agencies will open to new data sources, to be able to turn satellite data into useful information.

An **EU institution stakeholder** asked the audience their opinion on the use of wall-to-wall data to provide a better planning tool for action.

A **research & academia stakeholder** responded that this is possible, but that the tools should have the capacity to derive useful information.

10.9. Part 3: Policy options

The third part of the workshop was moderated by Christian Holzleitner (DG CLIMA) and focused on policy options. This part of the workshop included one presentation followed by a discussion with the audience.

10.9.1. Overview of stakeholder categories

Christian Holzleitner provided a presentation to conclude the discussions of the day and showed how the European Commission aims to go forward with the review of the LULUCF Regulation by June 2021.

He introduced the current challenge that we are facing, namely the decreasing carbon removals from the land sector. He stressed the need for carbon removals to balance the non-CO2 agriculture emissions to reach carbon neutrality and concluded that this would allow us to reach carbon neutrality in the whole land sector at EU level by 2035

Christian Holzleitner presented two key questions currently being addressed. The first referred to setting more ambitious targets for LULUCF and agriculture. Here, he stressed the need to provide more support to Member States and better incentives to use a higher share of their CAP budget for carbon removals. The second question referred to bringing better incentives to farmers and foresters and create a better business model for them. Here, he stressed the importance of making it more attractive for them to store carbon and informed the audience that the European Commission is looking into the role of carbon farming and a certification of carbon removals. In addition, he mentioned the Innovation Fund as a useful tool which can support technical solutions for carbon removals.

He continued his intervention by explaining the three policy options of the Impact Assessment of the review of the LULUCF Regulation, namely: a more ambitious LULUCF target; a review of the flexibility with the ESR; and merging the LULUCF and non-CO2 emissions from agriculture into a single sector.

Christian Holzleitner concluded his presentation by providing an overview of ongoing activities. He mentioned the ongoing work with DG AGRI on recommendations on how to make the CAP more climate friendly. He highlighted the importance of carbon farming initiatives as blueprint (especially rewetting drained peatland). He mentioned the creation of a certification of carbon removal credits for the EU. Finally, he referred to a number of strategy documents that are particularly relevant to the discussions of the day, such as the Farm-to-Fork Strategy (focusing on a sustainable value chain for food), the Methane Strategy (on non-CO2 emissions in livestock) and the Forest Strategy (relevant to carbon removals).

10.9.1.1. Discussion

A **research & academia stakeholder** commented on the three policy options for the Impact Assessment. On carbon farming, the participant raised the issue of making sure the environmental integrity of having private actors funding carbon removals, and to ensure there is no double counting. Private actors' sources might eventually dry up as they reduce their emissions, and this might have impacts on farmers. With regards to trading, there is still reluctance from Member States to see it as an option as they need to reach net-zero by 2050. Lastly, the participant welcomed the AFOLU option and asked whether there have been any thoughts on setting up an EU wide ETS-like trading system, rather than another ESR sector with national targets.

An **EU institution stakeholder** responded that private companies want to become carbon neutral over their entire lifetime and therefore they might have to compensate in the future for their past emissions. The definition of good quality standards needs to be done carefully, to get the incentives right. The question on how to get to a removals trading system remains and that it can provide an efficient way to develop the bioeconomy concept.

10.10. Summary

Christian Holzleitner concluded the workshop by thanking the speakers and the participants for their valuable contributions. He invited the audience to provide comments on the Inception Impact Assessment, participate in the public consultation and comment on the Commission's "Fit for 55" proposal including the review of the LULUCF Regulation.

11. Workshop II Report: The Role of Agriculture and Land-use Sectors in a Climate Neutral EU in 2050

11.1. Overview

The following report contains a summary of the second workshop that was held as part of a four workshop series under the study "Reviewing the contribution of the LULUCF sector to the Green Deal" commissioned by DG CLIMA to experts from COWI, Technopolis Group and Exergia. The workshop entitled, "The role of agriculture and land-use sectors in a climate-neutral EU in 2050" was held on the 25th of February 2021.

The background information on the workshop was published one month before the event through an Eventbrite webpage and official invitations were distributed to specific stakeholders connected to the topic and DG CLIMA.

11.2. Workshop Objectives

As the second in a series of four workshops, the objective was to extract key information on the role of the land-use sectors in contributing to a climate neutral EU in 2050. The main topics in the workshop were the vision for 2050, exploring the role of agriculture and land-use sectors in reaching climate-neutrality in the EU, including the role of farmers, of private markets, and data and technology. The workshop was structured in a conference style, including keynote speeches and a panel debate.

11.3. Introduction

The workshop began with an introduction from the moderator, **Asger Olesen** (COWI). He welcomed the participants and introduced some guidelines for the workshop. He presented the agenda for the day as presented in

.

Agenda	
10:00 – 10:05	**Introduction** • Asger Olesen, COWI, Moderator
10:05 – 10:10	**Welcome and Setting the stage** • Christian Holzleitner, DG CLIMA, European Commission
10:10 – 10:20	**Carbon Farming in the EU: Pilots and Potentials** • Asger Olesen, COWI
10:20 – 10:30	**Ongoing work to support the design of an EU carbon removals certification mechanism** • Christian Heller, UBA
10:30 – 10:50	**Q&A session**
10:50 – 11:00	**Break**
11:00 – 11:50	**Inspirational speeches** Moderator: Asger Olesen • Samuel Masse, CEJA • Imke Lubbeke, WWF • Bart Vandewaetere, Nestle • Simon Henry, IETA • Inge Jonckheere, FAO
11:50 – 12:20	**Panel discussion** Moderator: Asger Olesen, COWI
12:20 – 12:30	**Closing remarks** • Christian Holzleitner, DG CLIMA, European Commission

Figure 65: Agenda of the workshop.

11.4. Participants

Overall, 429 stakeholders registered to attend and participate in the workshop, representing different stakeholder categories. A total of 332 stakeholders participated in the workshop and provided their association beforehand, which is presented in the figure below.

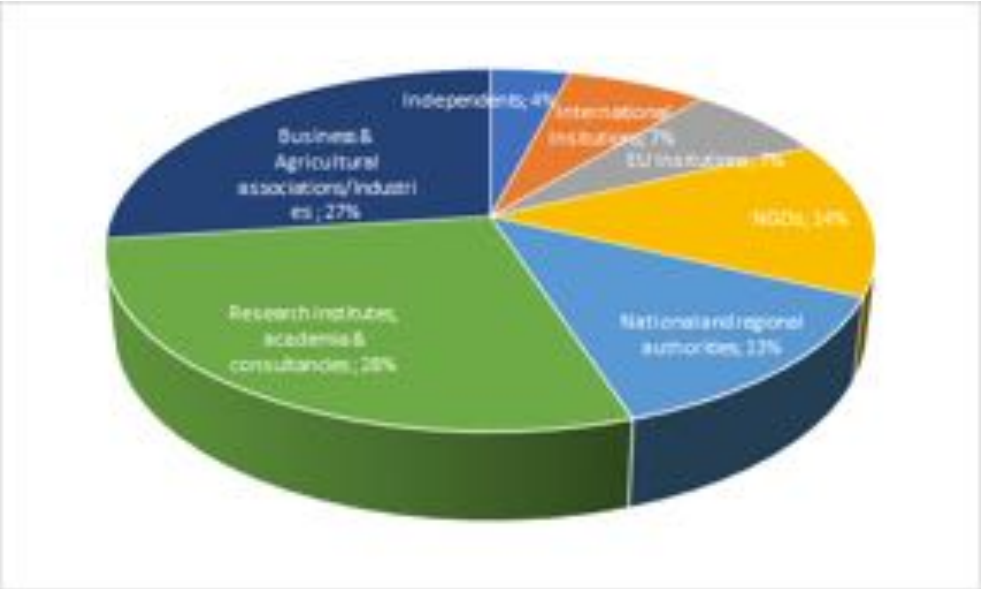


Figure 66. Makeup of the stakeholders participating in the workshop.

11.5. Welcome and setting the scene

Christian Holzleitner (DG CLIMA) provided an introductory presentation to set the scene for the workshop. He emphasised the overarching objective of the workshop to discuss how climate policy will look like in 2050.

Mr. Holzleitner painted a picture of the vision for 2050, which will see an economy where most fossil fuels will have been phased out and where the remaining emissions will derive primarily from the bioeconomy (e.g. from livestock and the use of fertilisers); at the same time, the land sector will contribute to climate neutrality via the sequestration of CO_2. Therefore, climate policy in 2050 will place the bioeconomy into the spotlight.

In order to achieve climate-neutrality in 2050, the capacity of land to capture CO_2 will have to increase so that there can be a balance with remaining emissions. Technology also plays an important role in this transition, such as Carbon Capture and Storage.

He then presented what the European Commission is currently doing in this context. Firstly, he mentioned the review of the LULUCF Regulation - in the framework of the Fit for 55 Package – providing an opportunity to simplify and modernise it towards the objective of climate neutrality by 2050.

Additionally, he referred to two EU initiatives which aim to bring further incentives for land managers, in order to create better business models for more climate friendly agriculture and forestry. The first initiative is about carbon farming, which promotes private or regulated business models for providing incentives for carbon removals. The second initiative regards a certification mechanism for carbon removals, which focuses on a high-quality market for carbon removals.

11.5.1. Interactive discussion

In order to stimulate the discussion, an interactive software – Mentimeter – was used to gather the stakeholders' views through a number of poll questions. The first poll question asked the participating stakeholders to select their stakeholder category.

136 stakeholders participated in the poll with the same breakdown of participant categories as presented below.

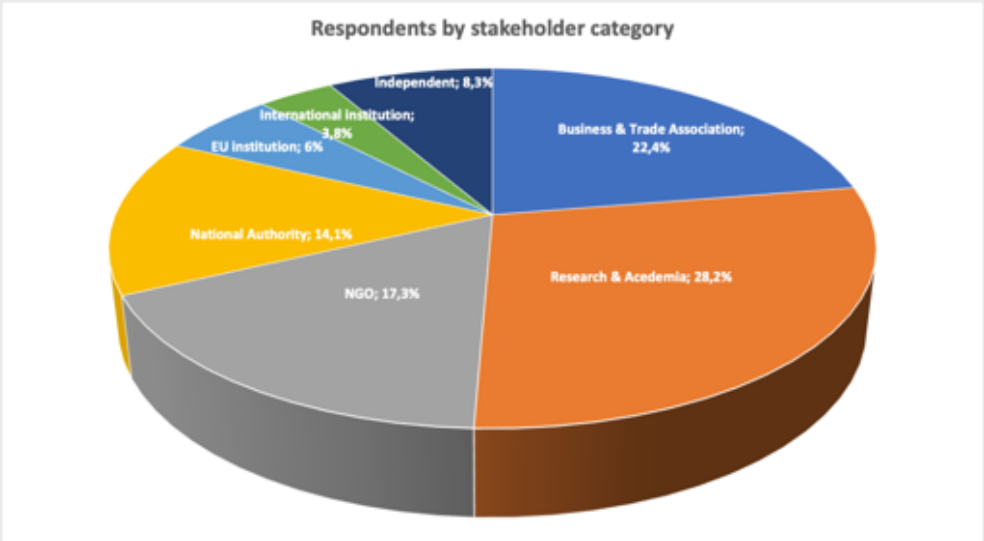


Figure 67: Breakdown of respondents by participant categories.

The **second poll question** asked the participating stakeholders how they felt about stronger financial incentives for the reduction of GHG emissions and the increase of carbon removals in the land sector.

162 stakeholders participated in this poll.

The large majority of respondents – representing all stakeholder categories, with a majority of Business & Trade Associations and Research & Academia - indicated that they feel positive about stronger financial incentives for the reduction of GHG emissions and the increase of carbon removals in the land sector.

Very few respondents – representing Business & Trade Associations, NGOS and unspecified categories - indicated that they feel negative.

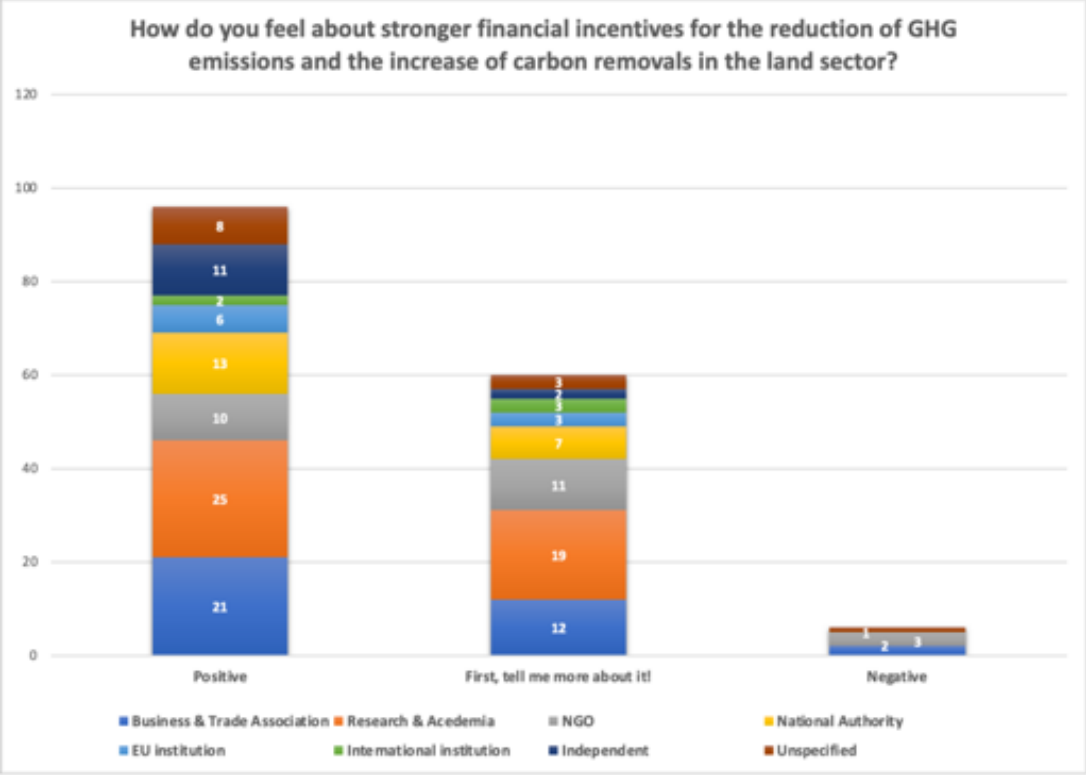


Figure 68: Respondents' answers to poll question 2.

11.6. Keynote #1: Carbon farming in the EU: Pilots and potentials

Asger Olesen (COWI) introduced the concept of carbon farming and presented a study on carbon farming carried out by COWI, IEEP and Ecologic for DG CLIMA.

The study applied an open understanding and definition of carbon farming, made of three components:

- It is about managing carbon flows in farming and forestry
- It turns carbon sequestration and GHG emission reductions into a business for land managers.
- It provides result-based incentives at farm or forest level

The study had the objective to explore how carbon farming could be adopted in the EU, what the global experiences on similar schemes are, and what can be learnt from these. Five case studies were carried out to test and validate solutions and delivery models for carbon farming

in the EU. A technical guidance handbook was produced on how to operationalise carbon farming in the EU. The Handbook together with the final report on the case studies will be published at the end of March 2021.

Mr. Olesen concluded his presentation by providing an overview of the advantages and challenges of carbon farming as identified in the study. Examples of advantages include increased investability and access to markets, flexibility for the farmers, and a clear link between carbon benefits and payments, among other. Challenges to carbon farming include a potential higher risk exposure for farmers, higher transactions costs, and inadequate monitoring, reporting and verification (MRV) systems.

11.7. Keynote #2: Ongoing work to support the design of an EU carbon removals certification mechanism

Following Mr. Olesen's presentation of the carbon farming project, **Christian Heller** (UBA) presented the ongoing project supporting the European Commission in the design of an EU carbon removals certification mechanism (CRC-M) carried out by UBA, Ecologic, Rambøll and Carbon Counts.

All the scenarios that are consistent with 1.5 degrees decarbonisation and net-neutrality require some sort of carbon removals. In the context of the European Green Deal, a CRC-M is proposed in the Circular Economy Action Plan to incentivise the uptake of carbon removals and increased circularity of carbon, and in the Farm to Fork Strategy as a way to enable payments to farmers and foresters for the carbon sequestration they provide.

The project aims to provide an overview of existing CRC mechanisms and solutions and provide a set of design options for an EU CRC-M, assessed for their advantages and disadvantages.

Mr. Heller laid out the objectives of the different tasks of the project:

- Task 1 will look at existing CRC mechanisms and methodologies to form the basis of the design and development of an EU-wide CRC-M. The task will assess different aspects of the mechanism architecture (e.g. governance, participants, scope, and coverage of carbon removal solutions, etc) and of the methodologies (e.g. scope, MRV rules, permanence management).

- Task 2 will look broadly at selected nature-based solutions, such as afforestation/reforestation, agroforestry, and sustainable forest management, and technology-based solutions, such as Direct Air Capture and Storage (DACCS), Bioenergy Carbon Capture and Storage (BECCS), and Carbon Capture and Utilisation (CCU). The analysis in this task will focus on different aspects, such as the maturity and future costs, the EU removal potential, permanence/reversibility, among others.

- Task 3 will involve stakeholders to give them the opportunity to share views and experience on the potential of CRC-M and validate interim results, through an expert roundtable, a survey, and a conference.

- Task 4 will gather the findings of the previous tasks and propose options for a CRC-M, focusing on the scope, the certification rules and governance.

- Task 5 will provide a pilot phase to develop design elements and accompanying monitoring.

He concluded the presentation by informing the audience that the results of the study are expected for Q1 2022.

11.7.1. Interactive discussion

Another set of poll questions were raised using Mentimeter to stimulate the discussion among the audience. The **third poll question** asked the participants what the focus of climate policies in light of the 2050 climate neutrality objective should be today.

153 stakeholders participated in this poll.

The large majority of stakeholders - representing all stakeholder categories, with a majority of Research & Academia, Business & Trade associations and National authorities – responded that the focus should be both on decreasing emissions and increasing removals.

A smaller number of stakeholders – representing primarily Business & trade associations, Research & Academia and NGOs – responded that the focus should be only on decreasing emissions.

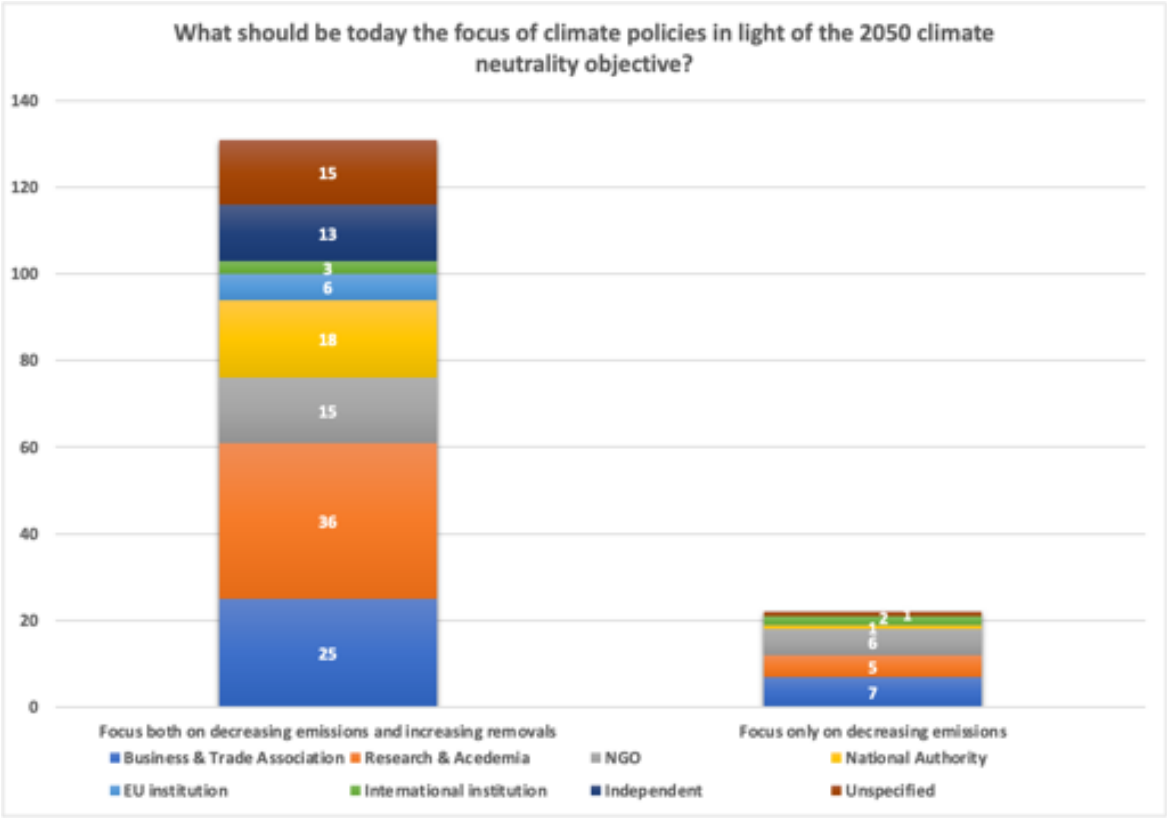


Figure 69: Poll answers to question 3.

The **fourth poll question** asked the stakeholders their views on the best type of policy to promote better financial incentives (carbon farming) in the land sector. Multiple answers were allowed.

146 stakeholders responded to this poll.

The majority of stakeholders – representing primarily Research & academia, Business & Trade associations and National authorities - indicated that subsidies at the national level (e.g. CAP) are the best type of policy, followed by an EU-wide carbon pricing for the land sector (e.g. emission trading including non-CO2 emissions and LULUCF removals and emissions).

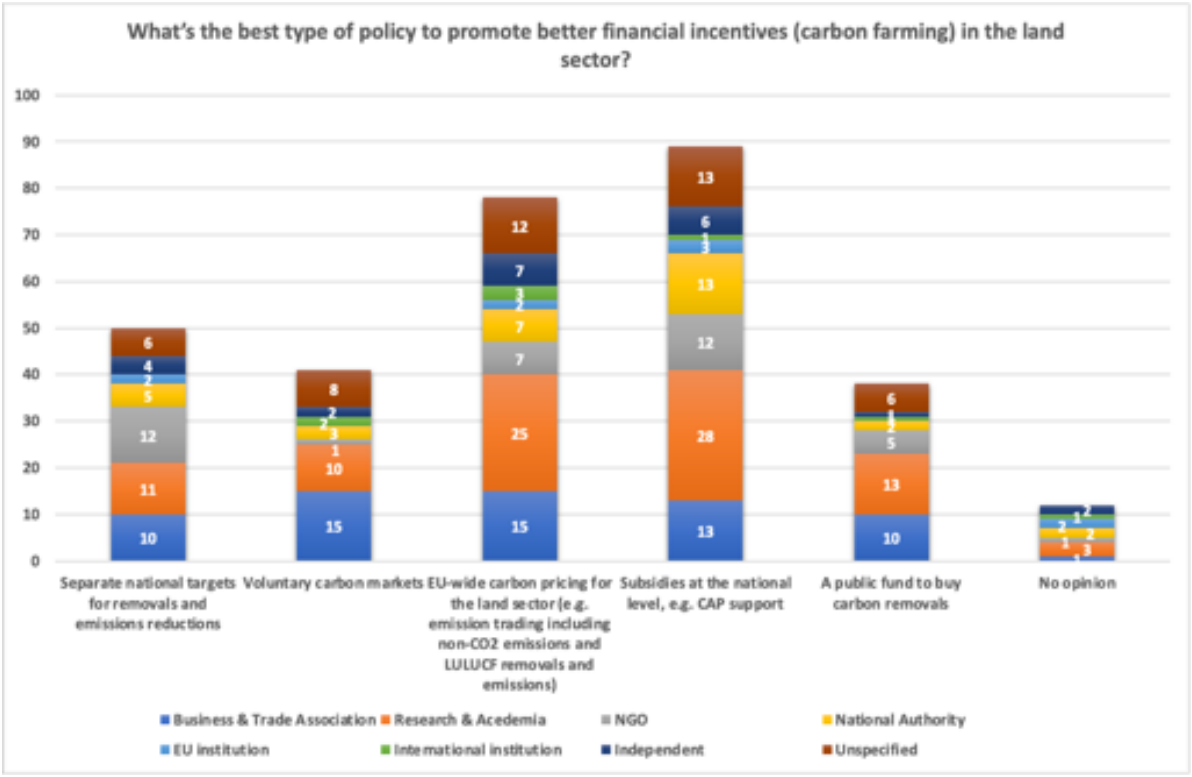


Figure 70: Responses to question 4.

11.8. Inspirational speeches

The moderator, Asger Olesen, introduced five speakers to provide inspirational speeches on their vision for 2050.

11.8.1. Inspiration speech #1: Samuel Masse (Ceja)

Samuel Masse (Ceja) presented his vision for agriculture in the EU in 2050, representing the generation that will enable the achievement of the objectives for 2050.

The presenter painted a picture where, in 2050, most objectives of the green transition will be reached with the help of new technologies, research and innovation but also by protecting agricultural land. He proceeded to emphasise the role of the agricultural sector for climate action in 2050.

Firstly, climate action will be embedded into business actions, indicating that diversity of farming practices will be a strength and there will be several pathways for climate action. In order to enable agriculture to sequester carbon, a mix of public and private funds will be made available, including contributions from other industries. By 2050, a framework for carbon farming schemes will be put in place. In addition, by 2050 we will have found a way to remunerate farmers through the market for land-use management practices useful to climate action (e.g. recognition of high-value nature agriculture).

The socio-economic obstacles to climate action will be considerably reduced. There is a high probability that by 2050 farmland will be a very rare resource, a reality which young farmers are already confronting. But by 2050 we will have fixed inadequate access to land through land property and long-term leasing contracts to ensure long-term climate action, and access to finance to invest in land and its management. Biodiversity and agricultural production will no longer be opposed.

11.8.2. Inspiration speech #2: Imke Lubbeke (WWF)

Imke Lubbeke (WWF) started her presentation by stressing the importance of the road to 2050, and of the steps to be taken in the next two decades.

It is clear that all sectors have to reduce emissions rapidly, including agriculture. In particular, the restoration of ecosystems was mentioned as crucial for many of the set objectives, including addressing the biodiversity crisis, and for carbon removals. WWF is advocating for 50% of land to be restored and to help with carbon removals.

The importance to focus on ecosystem restoration was mentioned against a full reliance on the role for technology approaches, which the presenter considered likely to remain expensive, speculative, and high-risk.

The presenter also mentioned the risk of focusing too much on offsetting emissions with carbon removals. The way forward requires climate action to be done and supported by citizens, policy makers and farmers in order to make a change.

Bioenergy was mentioned as relevant for biodiversity and sustainability issues but the impact of bioenergy in terms of emissions was challenged by the presenter who called for the need to avoid locking ourselves into using forest biomass and agricultural land to produce biofuels. Consistency of policies and practices was mentioned as a crucial aspect.

Imke Lubbekke emphasised the need to incentivise farmers to into carbon removals activities. The Common Agricultural Policy (CAP) was mentioned as a very powerful instrument, which could be used in a smarter way. She called for the need to make sure that the CAP encourages farmers to restore marginal or abandoned land into carbon and biodiversity-rich landscapes.

Lastly, the role of farmers was stressed in terms of emission reductions to make the difference, while recognising that they are also impacted the hardest by changes in the sector.

11.8.3. Inspirational speech #3: Bart Vandewaetere (Nestlé)

Bart Vandewaetere (Nestlé) started his presentation with a flashback to the past, showing that in the agricultural sector there is now more awareness on the need for action to address climate change and biodiversity loss.

He presented Nestlé's plan to halve their emissions by 2030 and reach net-zero by 2050. He emphasised that the focus is no longer simply on mitigating the negative impacts of food production, but it is about recovery and regeneration of soil and water by using nature-based solutions.

This is the biggest transformation ever for the food sector and it is clear that not taking any action would translate in the disruption of the supply chain, the costs and availability of raw materials. In addition, consumers are also challenging the sector and their needs cannot be disregarded.

He stressed the importance of the action of policymakers, keeping in mind planetary boundaries and the well-being of people.

In the carbon footprint of Nestle, 70% is linked to agricultural raw materials. For this reason, Nestlé supports regenerative agriculture and the need to work with farmers.

Bart Vandewaetere concluded his contribution by presenting the LENS initiative (Landscape Enterprise Networks) which brings businesses together interested to procure all sustainability outcomes from regenerative agriculture.

11.8.4. Inspirational speech #4: Simon Henry (IETA)

Simon Henry (IETA) provided an optimistic view about the role of carbon markets to achieve a climate-neutral EU in 2050. One of the benefits is that carbon markets can simultaneously put a price on emissions but also place a value on removals. The EU is a global leader on carbon markets, but the land sector has broadly been excluded.

Simon Henry pointed out lessons that can be learnt from other countries' experiences. For instance, the Emission Trading System in New Zealand integrates the forestry sector and has proved successful in providing a strong source of income for removals. The presenter encouraged the European Commission to look at similar examples, including Australia, California, Colombia, and Canada (Alberta).

Discussion are ongoing on how the EU can incorporate the land sector in carbon markets, through the creation of a new regulated sector for agriculture, forestry and land use to become climate-neutral by 2035 and then generate more removals than emissions. One policy tool that could work is a new Emission Trading System for this sector, setting an emission cap that goes negative after 2035. CRC-M could then be deployed to verify removals in the EU.

The question that arises if we set an emission cap that goes negative after 2035 is where the demand could come from. Simon Henry mentioned that the obvious option is the EU ETS, otherwise he proposed that removals could be bought by governments. Lastly, as a more ambitious scenario, the presenter suggested that removals could be exported from Europe. As the EU is ahead of the world on decarbonisation, this could become a new export industry for Member States.

He concluded his intervention by stressing that the end goal is not climate neutrality in 2050, but there is a need to go beyond net zero and therefore think about would need to happen after 2050 - for instance, how removals from other technologies could be incorporated.

11.8.5. Inspirational speech #5: Inge Jonckheere (FAO)

Inge Jonckheere (FAO) introduced the work of the FAO, focusing on food security in developing countries. Her intervention focused on the potential of technological development in 2050. Innovation was mentioned as the central driving force behind a world free of hunger and malnutrition.

The speaker presented different tools being used in developing countries, such as FAO Digital, aiming to develop climate resilient food systems, OpenForis and SEPAL, to enable advanced data collection and processing.

As regards to tools, remote sensing has become much more accessible and feasible compared to the past, as since 2011 remote sensing data has become an open archive. Remote sensing is widely applied in the land sector, and it can enable farmers to monitor their GHG footprints. For this reason, having accurate monitoring, reporting and verification (MRV) systems in place is key, which is one of the building blocks towards 2050.

Inge Jonckheere agreed with the previous speakers on the objective for the EU to go beyond net zero, to become net-negative. In the context of technological development, she stressed the need to keep investing in data, as well as in its proper use. She concluded her intervention by emphasising the unlimited role of technology.

11.8.6. Interactive discussion

A last set of poll questions were raised to gain feedback from the audience.

The **fifth poll question** asked the stakeholders how synergies between climate action and biodiversity can be promoted. Multiple answers were allowed

116 stakeholders participated in this poll.

The majority or stakeholders – representing primarily Research & Academia and Business & Trade associations - responded “integrated incentive payments”, followed by “integrated monitoring”, “targets and standards” and “Integrated planning”.

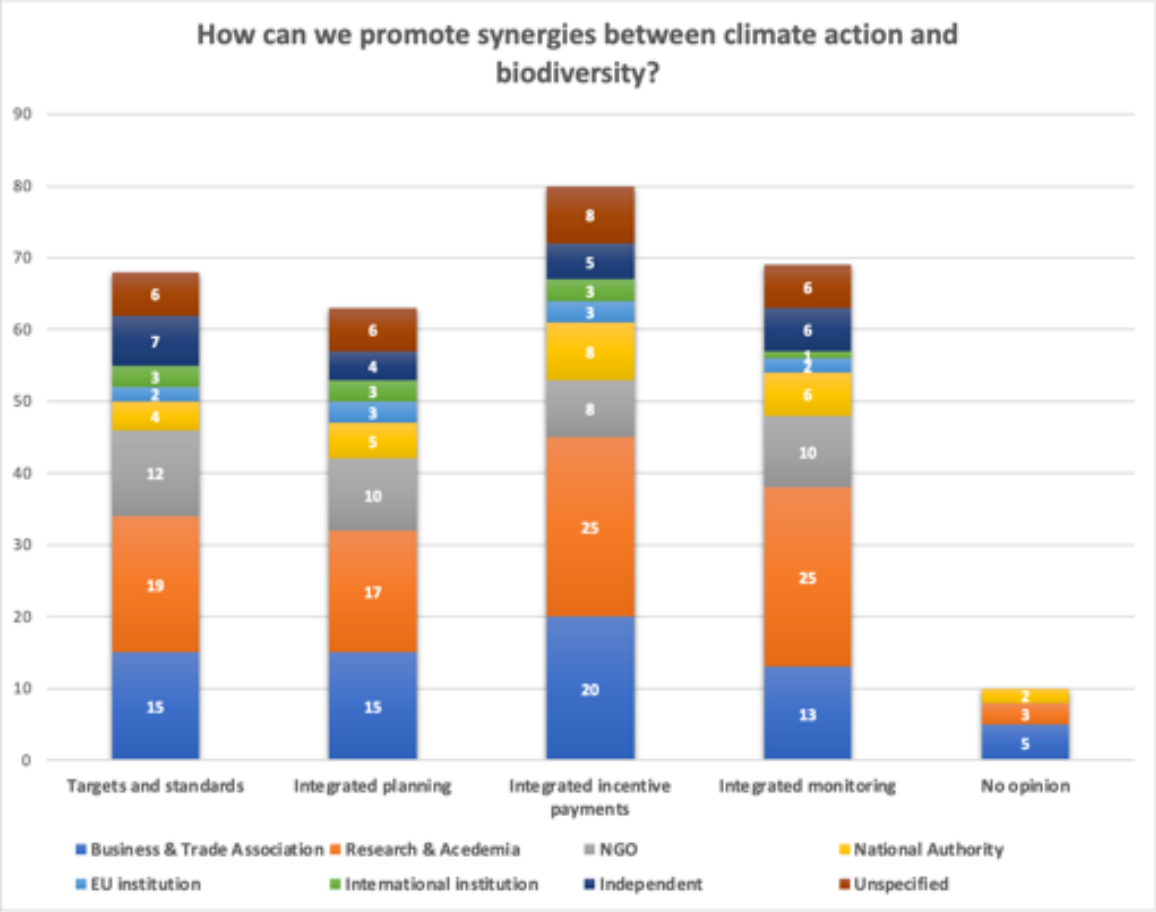


Figure 71: Answers to poll question 5.

The **sixth poll question** asked who should pay landowners for the climate and environmental benefits that they provide. Multiple answers were allowed.

120 stakeholders responded to this poll.

The preferred option for who should pay landowners for the climate and environmental benefits they provide was “polluters, via regulated carbon markets”, selected by the majority of stakeholders, representing primarily Research & Academia and Business & Trade associations.

The second preferred option was “public subsidies (e.g. CAP, national schemes)”, followed by “users of biomass (e.g. bioenergy plants, food producers).

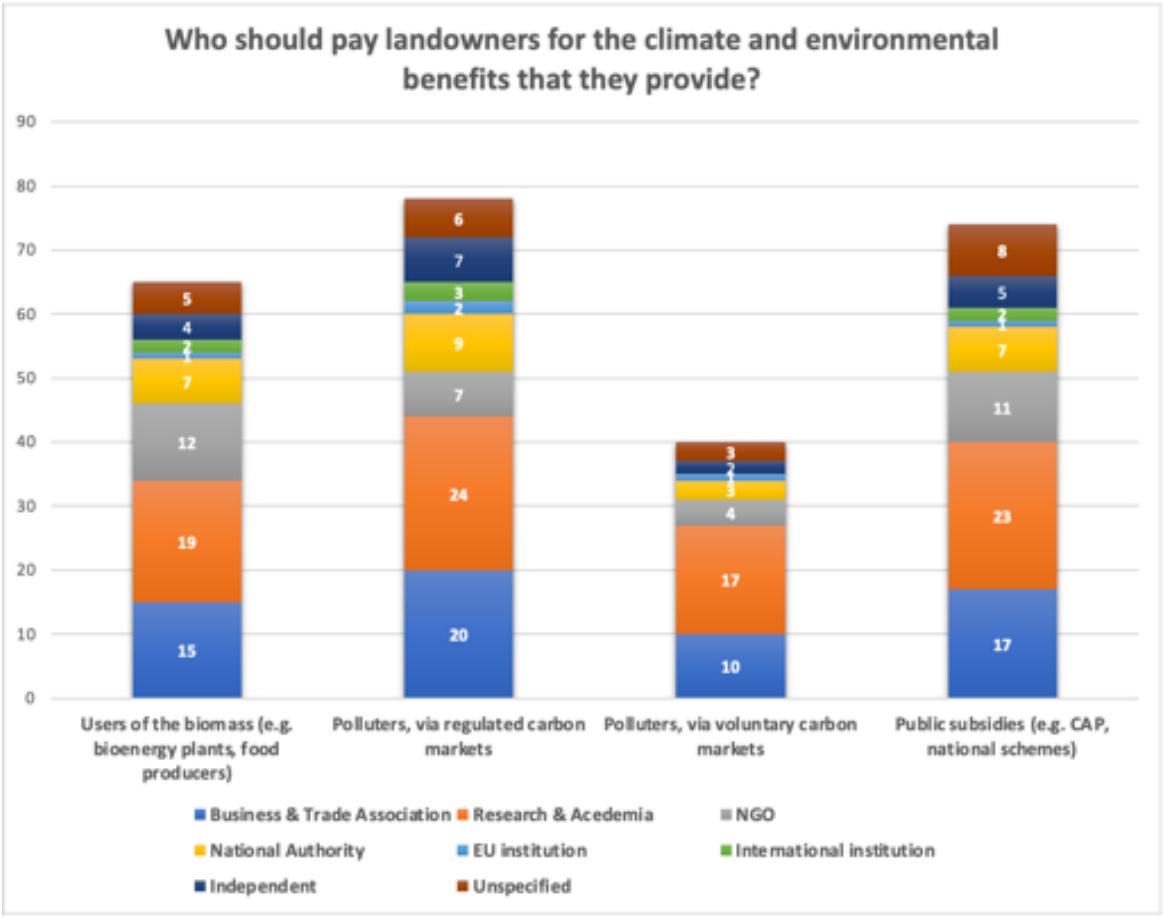


Figure 72: Answers to poll question 6.

The **seventh and last poll question** asked the stakeholders whether additionality is relevant in an economy-wide climate-neutral 2050 scenario.

95 stakeholders responded to this poll.

The large majority of respondents – representing primarily Research & Academia, Business & Trade Associations and unspecified categories - indicated that additionality is always relevant.

A smaller share of respondents indicated that additionality will only be relevant for emission reductions. Fewer respondents indicated that additionality will not be relevant at all.

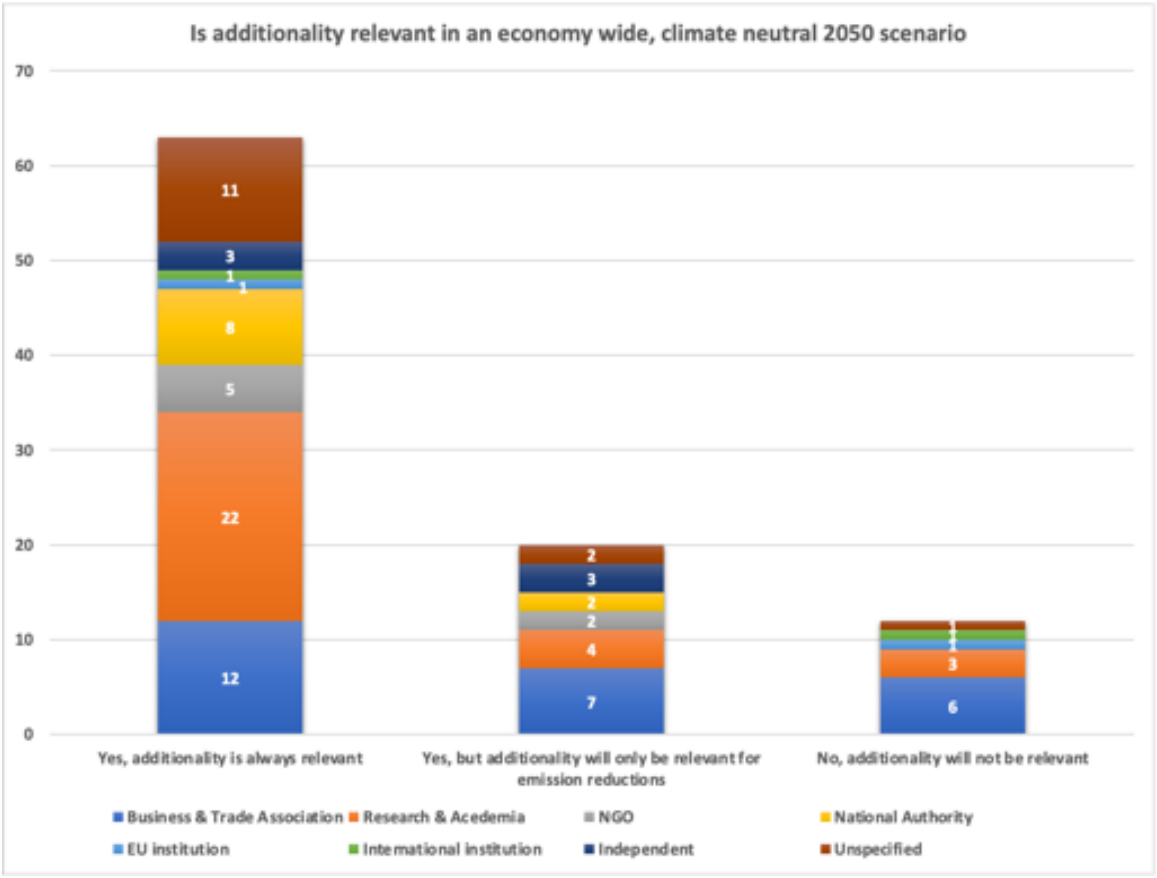


Figure 73: Answers to poll question 7.

11.9. Panel discussion

Following the inspirational speeches, a panel discussion took place, moderated by Asger Olesen (COWI).

Asger Olesen, the moderator, directed the first question to **Inge Jonckheere** (FAO) and asked her view on whether we will have in 2050 high-resolution, high-frequency, digital, low-cost, field-level MRV through a combination of tools and technologies for all land uses.

Inge Jonckheere responded that from a technical point of view it is more than possible, especially by looking at what is already possible in countries such as Africa. Whether this will be achievable or not in 2050 is a political question. She added that a factor to determine in the future is whether there will be willingness to pay for data and how it will be organized.

The moderator asked **Samuel Masse** (CEJA), from the point of view of farmers, what would be the opportunity of new business models if all required data was made available.

Samuel Masse responded that data needs to be better managed but the issue to be defined is data ownership. He added that the major problem, especially for young farmers, is getting financial access to these new technologies, which are often very expensive.

Imke Lubbekke (WWF) commented on the data issue and agreed on the importance of data (e.g. for monitoring of carbon removals from farmers) and on the issue of data ownership. She added that the focus should also be on the need of farmers to change the way they manage data to ensure environmental benefits and work towards climate neutrality.

Imke Lubbekke added a comment in relation to previously mentioned examples of emission trading systems, such as Australia and California, to point out that these are hotspots for forest fires. Therefore, the nature and permanence of their carbon removals is very different.

The moderator asked **Simon Henry** (IETA) to articulate on his understanding of climate neutrality in 2050 for the land sector, for a business or a value chain.

Simon Henry responded that from an EU point of view, climate neutrality by 2050 implies all sources of emission being balanced by an equivalent number of removals. However, there will still be emissions which will have to be balanced with removals. The question that persists is how emissions will be regulated in the next 30 years. He explained that the ETS helps regulating emissions by setting a cap, but the challenge of the system is that it covers only half of the emissions. He proposed that one solution could be to include more emissions into the ETS or alternatively to create another ETS.

The moderator asked **Bart Vandewaetere** (Nestlé) whether 2050 company-level, supply-chain level or footprint-level carbon neutrality can be seen as a key part of the policy framework.

Bart Vandewaetere responded that Nestle has committed as a company to net-zero which is based on “insetting”, referring to action inside the supply chain to create ownership as well as to onboard the consumers. He stressed importance of regenerative agriculture, as well as standard setting at European level.

The moderator asked **Samuel Masse** (CEJA) to articulate his views on the feasibility of setting climate neutrality at farm-level.

Samuel Masse responded that there is a lot of diversity in farms, depending on the location and weather impacts, which would make it difficult to implement climate neutrality at farm-level. He added that there are already challenges for farmers to know exactly what the current situation in terms of neutrality is. He concluded by stating that the target should go beyond landowners, but rather focus on land users as well.

The moderator asked **Inge Jonckheere** (FAO) her undersndating of climate-neutrality for the EU.

Inge Jonckheere responded that for the UNFCCC climate neutrality is seen at country-level, but a much smaller scale can be considered if data is available. She agreed on the diversity of farms and the difficulty to look at the level of the farm. She explained that, from a data perspective, there is no limit on the level of sub-aggregation below country-level we can reach but we should ask ourselves what it makes sense to focus on. She stressed the importance to integrate different sectors when we speak of climate-neutrality, rather than focusing on agriculture alone.

The moderator asked the panelists what would be the role of subsidies and market incentives in 2050 to ensure balance.

Imke Lubbekke responded that ambitious targets should be set at Member State level but should be separate from the emission side, avoiding to create one pillar. The Climate Law was mentioned as an important element for climate neutrality. Regarding subsidies, she added that the CAP can play an important role as a powerful instrument, but that pollution avoidance should be the main goal. There is clear need for support to farmers, to incentivize carbon dioxide reduction and organic farming.

Samuel Masse mentioned the example of the French region of Normandie where a low carbon label recognition was implemented at farm-level and questioned the feasibility of implementing this in all farms. He added that farmers now have access to several opportunities to get income, including through carbon sequestration. The best way would be to involve both the public funding and private funding from companies for payments for carbon sequestration, which could be achieved by 2050. However, he warned that there could also be negative side effects to this approach, such as the impact on the price of land, as well as potential impacts on landscape if farmers are incentivized to move to pasture.

The moderator asked **Bart Vandewaetere** (Nestle) how incentives could be transferred from producers to consumers.

Bart Vandewaetere responded that some consumers are ready for the transition to net-zero and Nestle is already trying to provide less carbon intensive products. The objective is climate neutral products, but this should be connected to ongoing discussions on products' environmental footprints and labels. He called for a framework to be set at EU level and stressed the important role to be played by governments in this direction.

11.10. Closing remarks

Christian Holzleitner (DG CLIMA) provided some closing remarks on the event. He stated that there is a need to push this discussion forward, on how the land sector should look like in 2050, in terms of production of food, of biomass and biodiversity.

He mentioned that a lot of change has already been achieved, for instance in diets, which has a significant impact on land use. There is a need to mobilise public money and give better incentives from more sustainable farming.

He referred to some ongoing initiatives from the European Commission, such as the Farm to Fork Strategy to explore how to get more sustainable food production across the value chain, the Forest Strategy, and the Fit for 55 Package.

He concluded by confirming that it will not be a low-cost transition and that funds need to be mobilised from different sources, such as from polluters, from the CAP budget of from better use of the revenues from emission trading systems.

12. Workshop III Report: gathering Ideas on the Next Steps for Carbon Farming

12.1. Overview

The following report contains a summary of the third workshop that was held as part of a four workshop series under the study "Reviewing the contribution of the LULUCF sector to the Green Deal" commissioned by DG CLIMA to experts from COWI, Technopolis Group and Exergia. The workshop entitled "Gathering ideas on the next steps for carbon farming" was held on the 21st of April 2021.

The workshop was structured as a targeted event with breakout rooms. The relevant stakeholders were selected to participate based on an expression of interest process.

12.2. Workshop objectives

The objective of the workshop was to extract key information on the next steps for carbon farming on the following main topics: linkages between biodiversity and carbon removals, monitoring carbon removals and the policy framework.

12.3. Introduction

The workshop began with an introduction from the moderator, **Tomasz Kowalczewski** (COWI). He welcomed the participants and introduced some guidelines for the workshop. He presented the agenda for the day as presented in Figure 74.

Agenda	
10:00 – 10:05	**Welcome & housekeeping rules** • Tomasz Kowalczewski, COWI
10:05 – 10:15	**Policy context and objectives of the event** • Christian Holzleitner, DG CLIMA, European Commission
10:15 – 10:20	**Explanation of breakout rooms** • Tomasz Kowalczewski, COWI
10:20 – 11:45	**Parallel breakout rooms** • BR1: Linkages between biodiversity and carbon removals • BR2: Monitoring carbon removals • BR3: Policy context
11:45 – 12:05	**Break**
12:05 – 12:50	**Main takeaways** •BR1: Tomasz Kowalczewski, COWI •BR2: Peter Sølling Jørgensen, COWI •BR3: Karolina Sara Kenney, COWI
12:50 – 13:00	**Closing remarks** Valeria Forlin, DG CLIMA

Figure 74: Agenda of the workshop

12.4. Participants

Overall, 113 stakeholders expressed interest in the event and 77 were selected to participate, representing different stakeholder categories, as presented in the figure below.

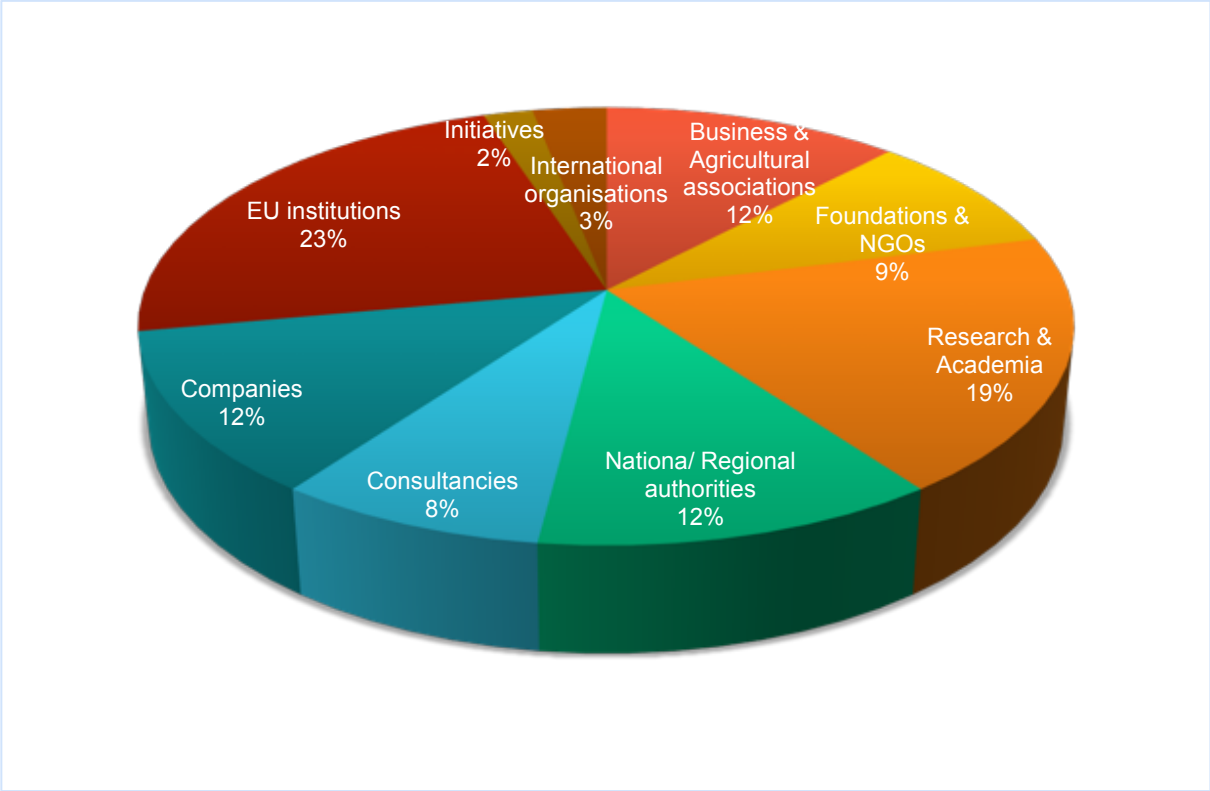


Figure 75: Participants by stakeholder category

12.5. Welcome and setting the scene

Christian Holzleitner (DG CLIMA) provided an introductory presentation to set the scene for the workshop. He informed the participants about the Climate Law, including the climate-neutrality target for 2050 and the 55% reduction target for 2030.

Mr. Holzleitner described the vision for 2050 with an economy where most fossil fuels will have been phased out and where the remaining emissions will be balanced out by carbon removals. He then provided an overview of the role of the LULUCF sector, of agriculture and of the bioeconomy. The remaining emissions in 2050 will derive primarily from the bioeconomy (e.g. from livestock and the use of fertilisers) and will have to be balanced by carbon removals.

In this context, the LULUCF sector will play a central role towards the objective of climate neutrality as it has the potential to reach net carbon removals of up to 300 million tonnes CO_2eq and to reduce non-CO_2 emissions from agriculture by 20% by 2030.

He then presented what the European Commission is currently doing in this context. First, he mentioned the review of the LULUCF Regulation - in the framework of the Fit for 55 Package – which has the objective to modernise and simplify the current Regulation and to adapt it to the climate neutrality target for 2050.

Additionally, he referred to two EU initiatives which aim to bring further incentives for land managers, in order to create better business models for more-climate friendly agriculture and forestry. The first initiative is about carbon farming, which promotes a new business model for providing incentives for carbon removals. The second initiative regards a certification mechanism for carbon removals, which focuses on a high-quality market for carbon removals.

A number of policies are in place that have the potential to create better incentives for farmers and foresters, as presented in the figure below.

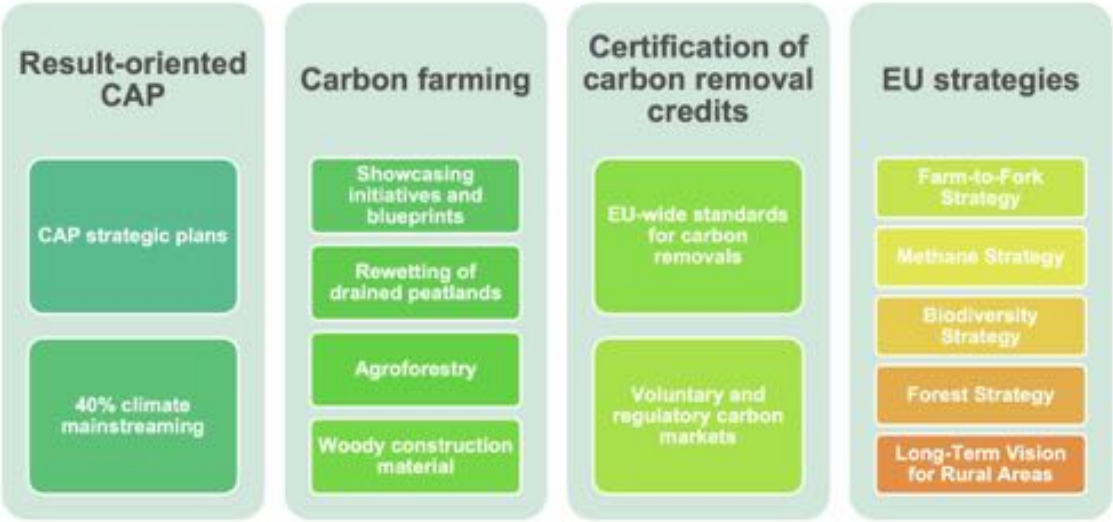


Figure 76 : Overview of policies

Mr. Holzleitner concluded his presentation by introducing the three main topics of the event, to gather ideas on the next steps for carbon farming:

- Linkages between biodiversity and carbon removals
- Monitoring carbon removals
- Policy framework

Three breakout groups were formed to discuss the abovementioned topics.

12.6. Main takeaways of breakout rooms

Tomasz Kowalczewski (COWI) introduced the moderators and rapporteurs of the breakout rooms and invited them to present the main takeaways.

12.6.1. BR1: Linkages between biodiversity and carbon removals

The first breakout room was moderated by **Florian Clayes** (DG CLIMA) and **Tomasz Kowalczewski** (COWI) acted as rapporteur. The breakout group had 18 participants representing environmental NGOs, forest certification organizations, research institutions as well as civil servants.

The discussion was structured around three main questions, namely:

- How to value the biodiversity co-benefits of carbon removals in carbon farming?
- How to ensure that carbon farming activities do not significantly harm biodiversity?
- What tools and data could be mobilized to monitor impacts and co-benefits on biodiversity from carbon farming?

Overall, there was agreement that carbon cannot be the only goal and carbon markets are not the best tools for biodiversity conservation. There is a need for an integrated approach at farm system level or landscape approach. Nature has a long-term perspective, and this should be taken into account.

In addition, farmers should be involved to integrate their practical knowledge into policy. Ensuring policy consistency was considered key to avoid overlapping objectives, including within, e.g. the CAP and within EU nature restoration targets59.

How to value the biodiversity co-benefits of carbon removals in carbon farming?

The discussion showed a consensus to jointly act on climate and biodiversity. In addition, the focus for carbon farming should be on ecosystem integrity.

There is a need to incorporate the ecological dimension in the current economic signals (e.g. credit discount related to biodiversity performance).

The relevance of engaging with insurance companies was stressed to reflect the biodiversity potential to reduce risk.

Lastly, participants agreed that there is a need to promote win-win solutions through agroecology, agroforestry, conservation agriculture, organic farming, close-to-nature forestry and wetland rewetting.

How to ensure that carbon farming activities do not significantly harm biodiversity?

In order to ensure that carbon farming activities do not harm biodiversity, there is a need to ban or avoid pervasive practices, such as monoculture, synthetic fertilizers and peatland drainage.

Market signals should not be the only ones to drive biodiversity conservation on land.

There is a need to explore and strengthen the ecological dimension in models of sustainable forest management and sustainable land management.

Lastly, there is a preference for long-term carbon removals rather than short-term, the latter being generally detrimental to biodiversity.

What tools and data could be mobilized to monitor impacts and co-benefits on biodiversity from carbon farming?

The importance of regular auditing was emphasized by participants, alongside the possibility to rely on existing certifications of sustainability.

Monitoring should not only be based on remote sensing, but also on surveys and field data.

There is a need for an integrated system of indicators, rather than focusing on single indicators, such as species counting.

Participants agreed that while there are currently enough technologies and datasets to get started, there is a continuous need for improvement.

Several existing schemes were mentioned which could provide a basis for future developments, such as the low-carbon label (Label bas carbone) in France, the carbon calculator in Finland, and peatland experience in Germany and in the Netherlands.

The conceptboard of the discussion is provided in Appendix A.

12.6.2. BR2: Monitoring carbon removals

Breakout room two was moderated by **Nicola Di Virgilio** (DG AGRI) and **Peter Sølling Jørgensen** (COWI) acted as rapporteur.

The discussion was structured around three main questions:

[59] The legislative proposal which is one of the key measures announced in the EU's 2030 Biodiversity Strategy. It will propose legally binding nature restoration targets, subject to an impact assessment. The publication of this initiative is expected for 4th quarter of 2021.

- What are some examples of monitoring schemes and methodologies?
- How can issues linked to costs of monitoring and implementation be addressed?
- What is the right monitoring for the right land-use?

What are some examples of monitoring schemes and methodologies?

Six examples of methodologies were mentioned, including:

- A cyber infrastructure approach in Finland. The infrastructure is part of the Carbon Action Platform, which is developing a measurement and verification system. This system is available for implementation even though there is not sufficient data availability. The Observatory is an open-access online platform for visualizing measurement data from 20 pilot carbon farms and intensive study sites, as well as the results of carbon calculations.[60]
- The French certification framework, Voluntary Carbon Land Certification project (VOCAL), to monitor GHG emissions introduced a novelty approach to discounts based on uncertainty[61]
- Indigo's remote sensing approach for agricultural mineral soils[62]
- The Australian OpenGeoHub using remote sensing (for a 30/30 meter)
- Two tools from Wageningen University: one for grassland monitoring and one for peat soil monitoring[63]
- IFEU fast navigation program, a calculation tool for GHGs at farm level

How can solutions linked to costs of monitoring and implementation be addressed?

Initiatives for bringing down costs were discussed. For instance, it was mentioned that while remote sensing can bring down costs, it is not a silver bullet. Additional initiatives referred to soil sampling in the initial phase and lean administration. In addition, soil spectroscopy was discussed and its potential to create open calibration libraries to share knowledge.

What is the right monitoring for the right land-use?

The discussion revolved around grassland, forests and peatland. For grassland, remote sensing can be very useful, but more research is needed. Regarding forests, the discussion focused on permanence.

For peatlands, permanence is easier to monitor but there are difficulties concerning the fact that volume changes and it requires deep measurements such as LIDAR to catch changes in flux. Groundwater-based measurements could be used to measure peatlands, integrating both soil type and groundwater.

The importance of uncertainties was also discussed. It was mentioned that uncertainties also occur due to asymmetry of information. These uncertainties are not necessarily linked with the efficiency of a scheme.

The conceptboard of the discussion is provided in Appendix B.

[60] https://carbonaction.org/en/front-page/
[61] https://www.i4ce.org/go_project/project-voluntary-carbon-land-certification-vocal/
[62] https://www.indigoag.com/atlas-insights
[63] https://www.wur.nl/en/Research-Results/Research-Institutes/plant-research/show-wpr/Aerial-monitoring-for-more-biodiversity-.htm

12.6.3. BR3: Policy framework

This breakout room was moderated by **Valeria Forlin** (DG CLIMA) and **Karolina Sara Kenney** (COWI) acted as rapporteur.

The concept board was developed in such a way to reach concrete policy solutions from observed issues. The discussion started with problems and barriers to implementing carbon farming approaches. Then, objectives or goals and targets that stem from these problems were discussed. Finally, participants discussed some concrete solutions to these problems and proposed options for a carbon farming policy framework.

The eleven problems that were identified can be grouped under four overarching themes. The **first problem theme** concerned the lack of knowledge among land managers, for example the risk of a high administrative burden in entering a carbon farming scheme. In line with this is the fact that there is a lack of training or advisory services.

With regard to this problem, participants noted that policies must help farmers assess their net carbon balance (both emissions and removals) as well as the specificities of their land areas. Proposed solutions to achieve these goals included a wide-reaching knowledge campaign, making sure that good practices are encouraged through the CAP, for instance through advisory systems (including "training the trainers"). This knowledge campaign could also be fine-tuned to fit different geographical regions and soil conditions, so that farmers receive tailored advice about what works on *their* farm.

The **second problem theme** concerned understanding the impacts, and more precisely ensuring that farmers are made aware of the benefits of carbon farming practices (including financial benefits). In general, the issues of farmer awareness were the most poignant throughout the entire brainstorming session.

Goals with regard to this lack of understanding are to alter misconceptions of the financial benefits and make sure that landowners are aware of both the long-term and short-term benefits. Proposed solutions for farmer awareness are encompassed within the knowledge campaign suggested under the first problem. A specific issue was the profitability for the farmer, given that the costs of participating in carbon farming activities may be higher than the value of carbon credits; public/private interaction was presented as a solution, e.g. the CAP sets minimum quality standards and provides financial support for implementation of certain practices (thus driving down costs for the farmer), while private markets pay for very high-quality carbon credits beyond the CAP (ambitious) baseline. The UK LENs approach was also mentioned as an example of public/private cooperation. In addition, it was proposed for the costs of MRV to be covered by public support and not at the cost of the landowner.

The **third problem theme** concerned the need for high-quality MRV, which also measures co-benefits for productivity and adaptation and ensures good balance between action-based versus result-based payments. Some participants mentioned that the main challenge is not measurement in itself, but rather the establishment of baselines and additionality. MRV does not need to be very expensive, as the example of the project Moor Futures has shown. Generally, however, it was concluded that there is a lack of harmonised, user-friendly and cost-efficient tools to certify carbon removals.

One of the objectives within this theme is achieving collaboration across institutions such that underlying science is the basis for policy. Proposed solutions included public sector support (e.g. through the CAP) to farmers to invest into and learn how to use high-quality MRV tools, while credits would then be bought by the private sector. In addition, it was proposed that the public sector could provide a common methodology, keeping in mind regional differences. The importance of coordination between private companies was stressed to ensure the purchase of high-quality credits. In terms of timing, it was mentioned that the lack of "perfect" emission / sequestration factors for some practices should not stop the development of carbon farming approaches: policy signals and carbon farming schemes need to be created now, while

mitigation impacts and payments can be fine-tuned later, within an ongoing research and calibration process.

The **fourth problem theme** concerned perverse incentives and legal barriers. It was stressed that a regulatory framework which ensures the authenticity of removals is critical in order to ensure high-quality carbon credits.

Solutions proposed included to halt perverse incentives, e.g. some of the subsidized practices within CAP, and to raise the minimum climate baselines in the CAP. One suggested solution was the application of the polluter-pays-principle. Some participants noted that tthe agricultural sector remains a source of emissions, so it is important to prioritise the reduction of emissions before looking into carbon removals.

The conceptboard of the discussion is provided in Appendix C.

12.6.4. Closing remarks

Valeria Forlin (DG CLIMA) thanked the participants for the active participation and invited them to check the DG CLIMA web-page for updates on carbon farming.

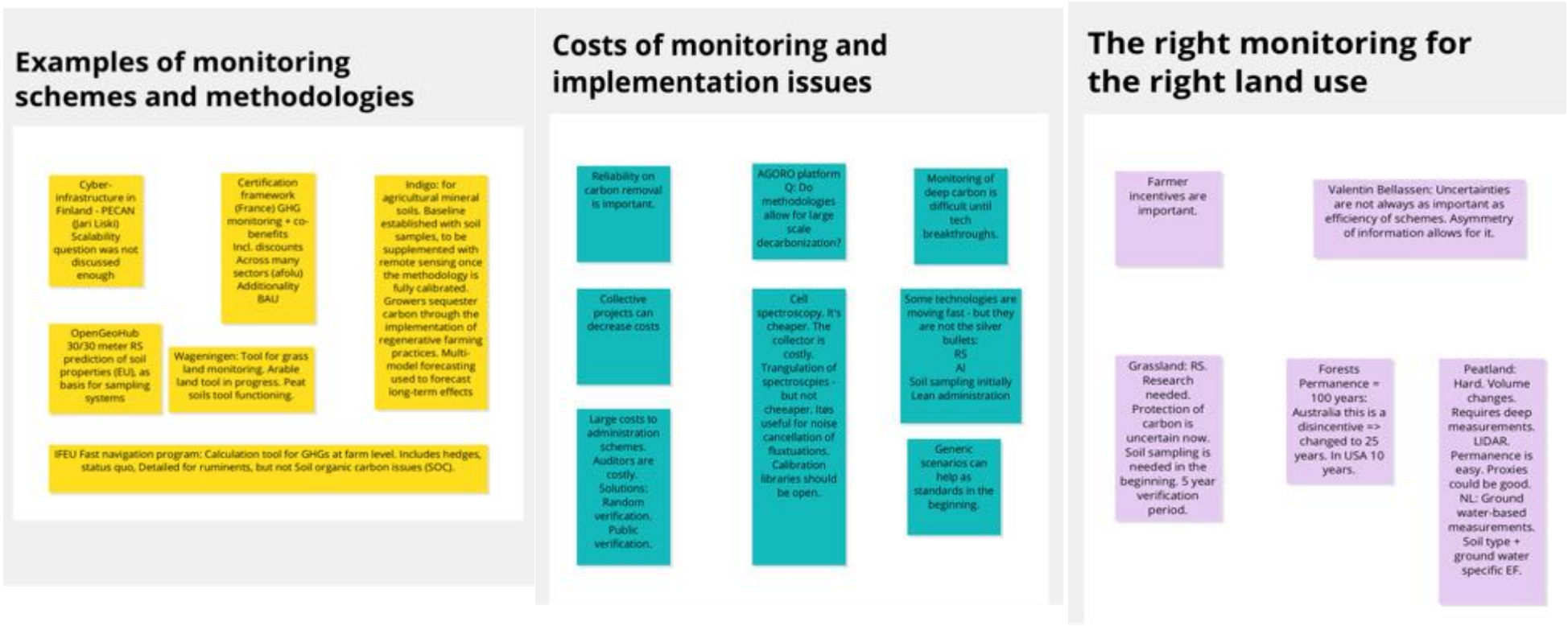
She informed the audience of the next workshop to be held on May 25th, which will focus on carbon farming in the CAP Strategic Plans. In addition, it will present the publication of the final report of a two-year study on how to set up and implement carbon farming in the EU: https://ec.europa.eu/clima/news/commission-sets-carbon-farming-initiative-motion_en

Appendix A Breakout Room 1: Linkages between biodiversity and carbon removals

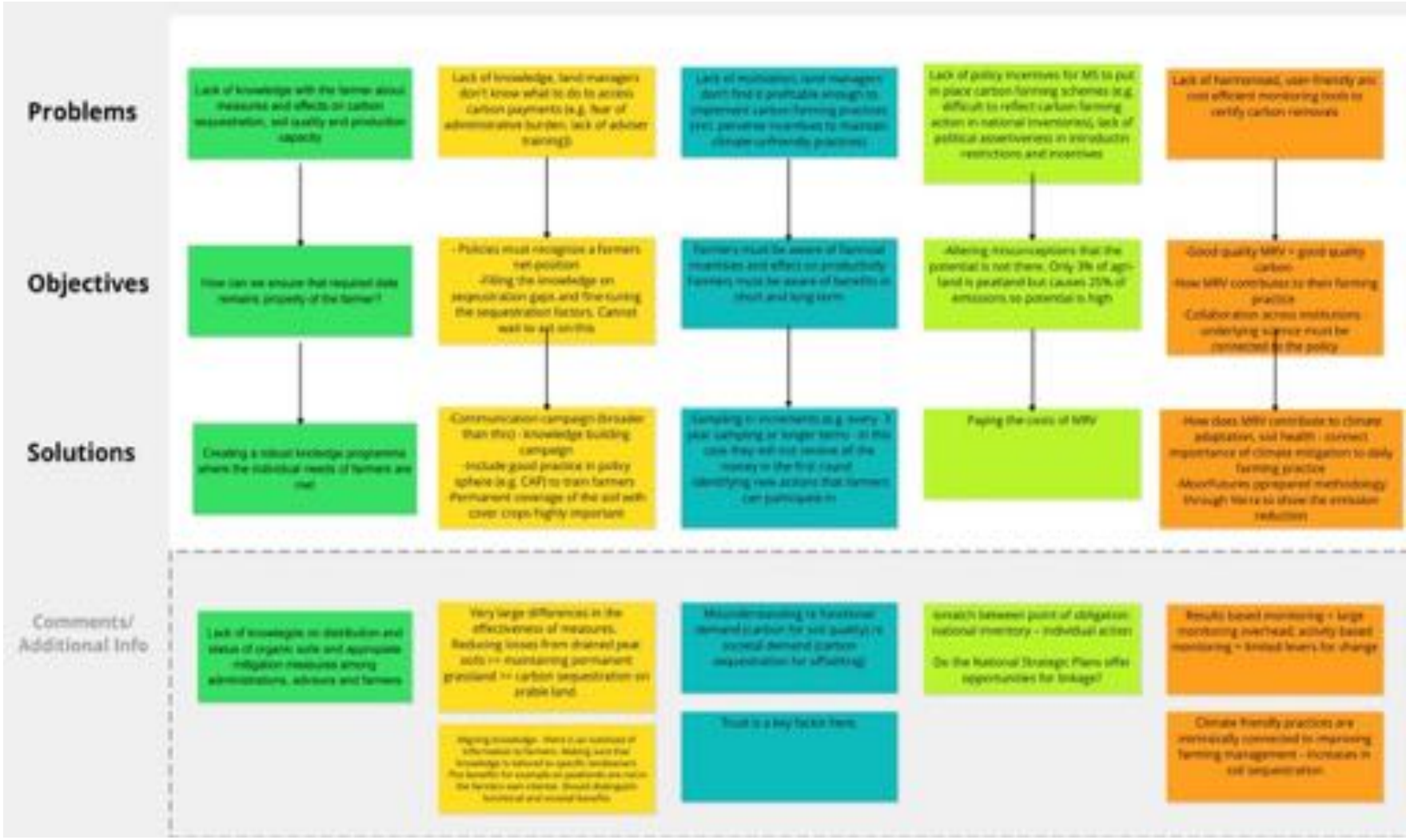
2. How to ensure that carbon farming activities do not significant harm biodiversity?

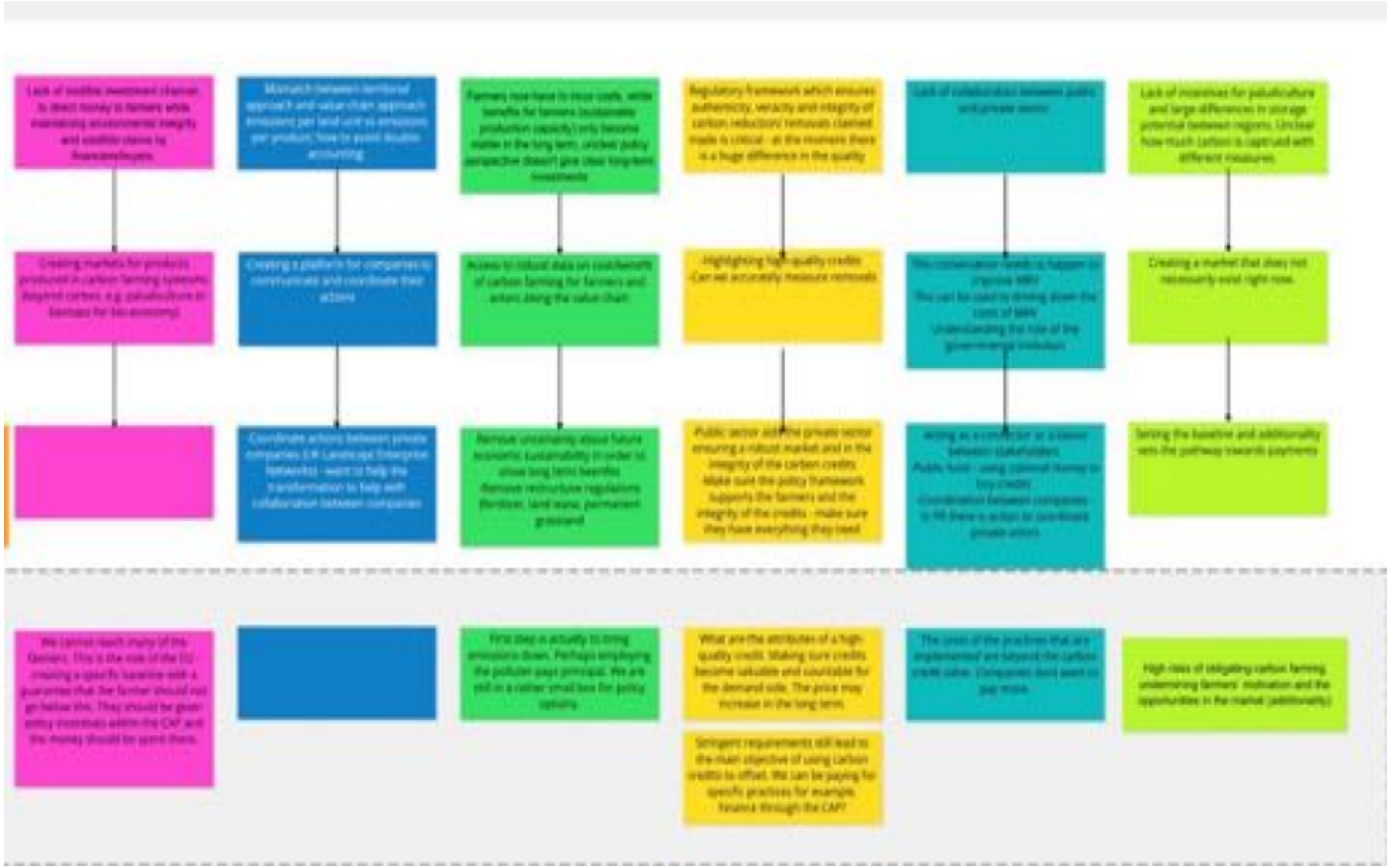
3. What tools and data could be mobilised to monitor impacts and cobenefits on biodiversity from carbon farming?

Appendix B Breakout Room 2: Monitoring Carbon Removals



Appendix C Breakout Room 3: Policy Framework





13. Workshop IV Report: Carbon Farming in the CAP Strategic Plans

13.1. Overview

The following report contains a summary of the fourth workshop that was held as part of a four workshop series under the study "Reviewing the contribution of the LULUCF sector to the Green Deal" commissioned by DG CLIMA to experts from COWI, Technopolis Group and Exergia. The workshop entitled "Carbon farming in the CAP Strategic Plans" was held on the 25th May 2021.

13.2. Workshop objectives

The objective of the workshop was to explore design options for carbon farming schemes in the CAP Strategic Plans and to facilitate the exchange of experiences and good practices among relevant stakeholders.

The workshop, that was held as open webinar, was organised by DG AGRI and DG CLIMA and was divided into two main parts:

- Carbon farming as a new business model
- Lessons learnt from existing carbon farming projects

The workshop gave an overview on the Common Agricultural Policy (CAP) and its intertwining with carbon farming and presented the role of the land sector towards climate neutrality through different experiences in the Member States and from EU funded ongoing projects related to carbon farming.

Several interactive polls were introduced during the workshop to obtain direct feedback from the participants together with a survey that was collected subsequent to the event.

13.3. Introduction

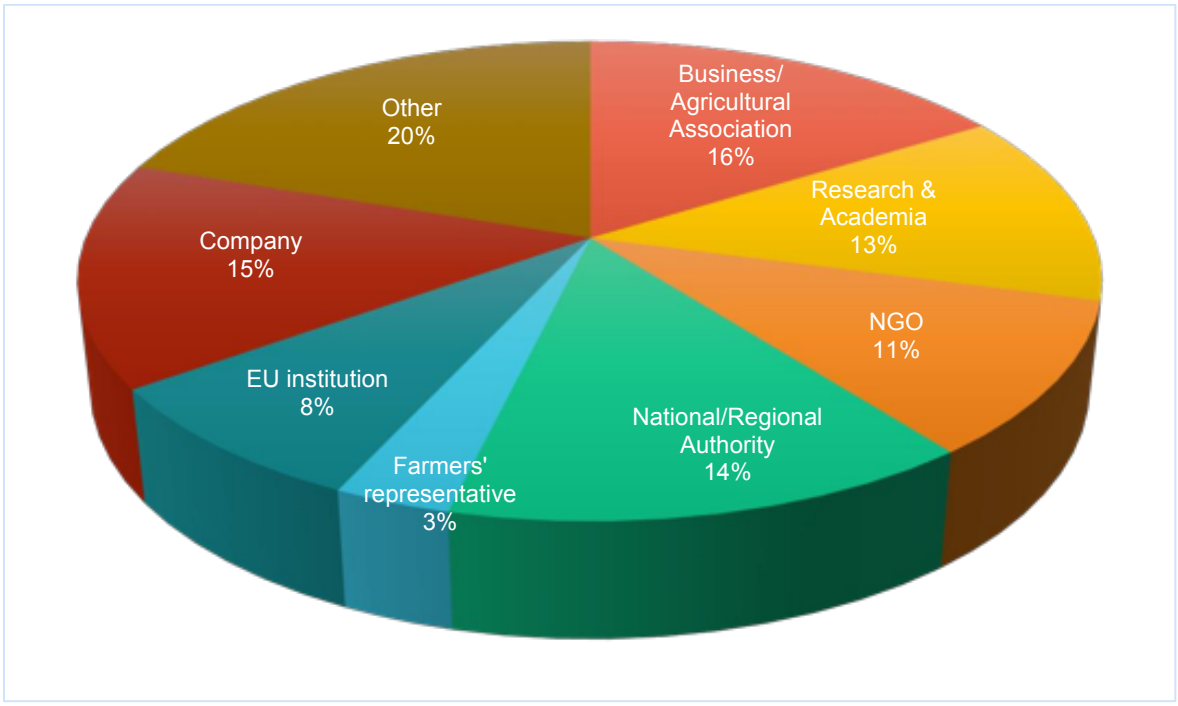
The workshop began with an introduction from the moderator, **Tomasz Kowalczewski** (COWI) who welcomed the participants and introduced the guidelines for the workshop. The agenda is presented in Figure 77 below.

10:00 – 10:05	**Introduction**	Tomasz Kowalczewski, COWI
10:00 – 10.10	**Welcome**	Pierre Bascou, DG AGRI
10.10 – 10.15	**The role of the land sector towards climate neutrality**	Yvon Slingenberg, DG CLIMA
10.15 – 10.25	**The CAP and carbon farming**	Gijs Schilthuis, DG AGRI
	Carbon farming as a new business model	
10.25 – 10.45	**Setting up and implementing result-based carbon farming mechanisms in the EU**	Asger Olesen, FSC & Clunie Keenleyside, IEEP
10.45 – 10.55	**CAP instruments for sinks**	Emmanuel Petel & Christine Falter, DG AGRI
10.55 – 11.10	**Carbon farming with agroforestry**	Patrick Worms, CIFOR-ICRAF, EU Agroforestry Federation & Gerry Lawson, UK Centre for Ecology and Hydrology, EU Agroforestry federation
11.10 – 11.20	**Carbon farming schemes from Denmark – concrete examples of possible combined support**	Thomas Skovgaard & Adam Høyer Lentz, Danish Ministry of Food, Agriculture and Fisheries
11.20 – 11.30	**Carbon farming under nordic conditions**	Perttu Virkajärvi, Luke & Pia Lehmusvuori, Finnish Ministry of Agriculture and Forestry
11.30 – 11.35	**Carbon farming in The Netherlands**	Sjoerd Miedema, De Nije Mieden
11.35 – 11.40	**Break**	
	Lessons learnt from existing carbon farming projects	
11.40 – 11.50	**LIFE Carbon Farming Scheme**	Jenni Kähkönen, SYI
11.50 – 12.00	**Interreg North Sea Carbon Scheme**	Marjon Krol, ZLTO
12.00 – 12.10	**Interreg North-West Europe Carbon connects**	Valentina Sechi, Wetsus
12.10 – 12.15	**Break**	
12.15 – 12.55	**Q&A discussion**	Christian Holzleitner, DG CLIMA
12.55 – 13.00	**Conclusions**	Christian Holzleitner, DG CLIMA

Figure 77: Agenda.

13.4. Participants

Overall, 532 individuals registered to the workshop, from a broad range of stakeholder categories. Of these 415 participated in the workshop and provided their association beforehand, which is shown in Figure 78 below.[64]



[64] While National/Regional Authority was one of the selection options for participants to identify themselves, the category is generalized as 'Public authority' within this report.

Figure 78: Makeup of stakeholder background of workshop participants

13.5. Welcome and setting the scene

Pierre Bascou from the European Commission (DG AGRI) provided an introductory presentation to set the scene for the workshop. He emphasised the overarching objective of the workshop, namely, to discuss the link between carbon farming and the Common Agricultural Policy.

Mr. Bascou pictured the vision for 2050, in which he highlighted that land and agriculture will have an important role in achieving climate neutrality. Carbon farming can represent a promising method to incentivise farmers to uptake more sustainable practices and therefore play a key role in the green transition for the EU economy, he remarked.

He then referred to the potentials of the new CAP for Member States to begin the testing of carbon farming schemes.

Mr. Bascou concluded that increasing organic matter and organic soils in land will be particularly relevant along with the protection of carbon stocks.

13.5.1. The role of the land sector towards climate neutrality

Yvon Slingenberg from the European Commission (DG CLIMA) introduced the role of the land sector towards climate neutrality.

Ms. Slingenberg stated the need to reduce greenhouse gas (GHG) emissions and pointed that in the 2050 scenario, agricultural emissions from livestock and fertilisers will make for the largest part of the EU emissions.

However, not only the land sector will contribute to the decarbonisation in other sectors through the development of a circular bioeconomy, but it will also provide large part of the removals needed to balance the hard-to-abate emissions, restoring the carbon sinks in soils and forests whilst increasing biodiversity and preserving ecosystems.

As a result, the European Commission is promoting carbon farming as a new green business model that is expected to provide new income opportunities for land managers. This model will become a pivotal example of how climate-driven action can lead to the generation of new revenues for the involved stakeholders.

Furthermore, Ms. Slingenberg emphasized the importance of establishing a credible governance system that guarantees additionality and permanence of carbon removals and pointed at the current development by the Commission of the regulatory framework for the certification of carbon removals.

Finally, Ms. Slingenberg referred to the recently published “Technical Guidance Handbook” that shall help practitioners start up and upscale carbon farming initiatives in the EU, which was presented more in detail by Mr. Asger Olesen (FSC) and Ms. Clunie Keenleyside (IEEP) later in the workshop.

13.5.2. Interactive session

An interactive software was used to gather the participants’ views through a number of poll questions.

The first poll question asked them to select their stakeholder category. 165 participants took part in the poll with the same breakdown of participant categories presented in Figure 78. Another 99 participated in various parts of the polls but did not indicate their stakeholder category. While the unspecified category is not indicated below, it is included as part of the other poll questions.

The largest groups of participants identified itself as coming from Research & Academia (21%) and public authorities (19%).

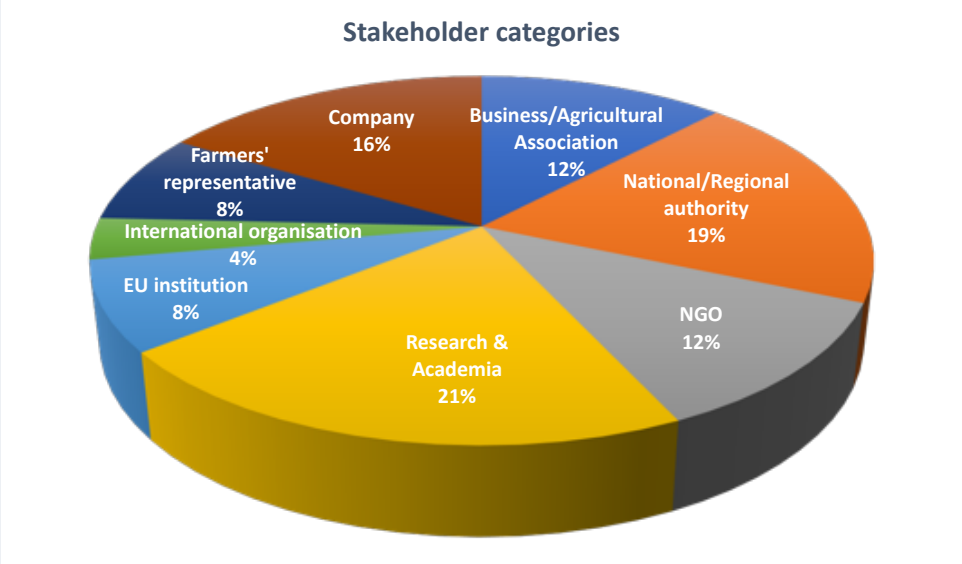


Figure 79: Responses to poll question 1.

The second poll question asked the participants what should be the scope of Carbon farming within the CAP. Multiple options were allowed, in particular:

- Increased carbon soil
- Protecting carbon in organic soils
- Carbon sequestration in biomass (e.g. afforestation)
- Carbon storage in biomass (e.g. harvested wood products)
- Reduction of emissions from livestock
- Reduction of emission from fertilizers use

203 participants took part in the **second poll question**. As shown in Figure 80 below, the most participants selected increased carbon soil as scope for Carbon farming within the CAP, followed by protecting carbon in organic soils and reduction of emissions from livestock and fertilizers use. Most categories were aligned across these options with only a few choosing other options with a higher frequency. Only participants from NGOs chose protecting carbon in organic soils over increased carbon in soil.

The least selected option was carbon storage in biomass (e.g. Harvested Wood Products) followed by carbon sequestration in biomass (e.g. afforestation), particularly from participants identified as NGOs as well as from international organisations and farmers' representatives. Still, within Research & Academia, carbon sequestration in biomass was selected with nearly the same frequency as the other options.

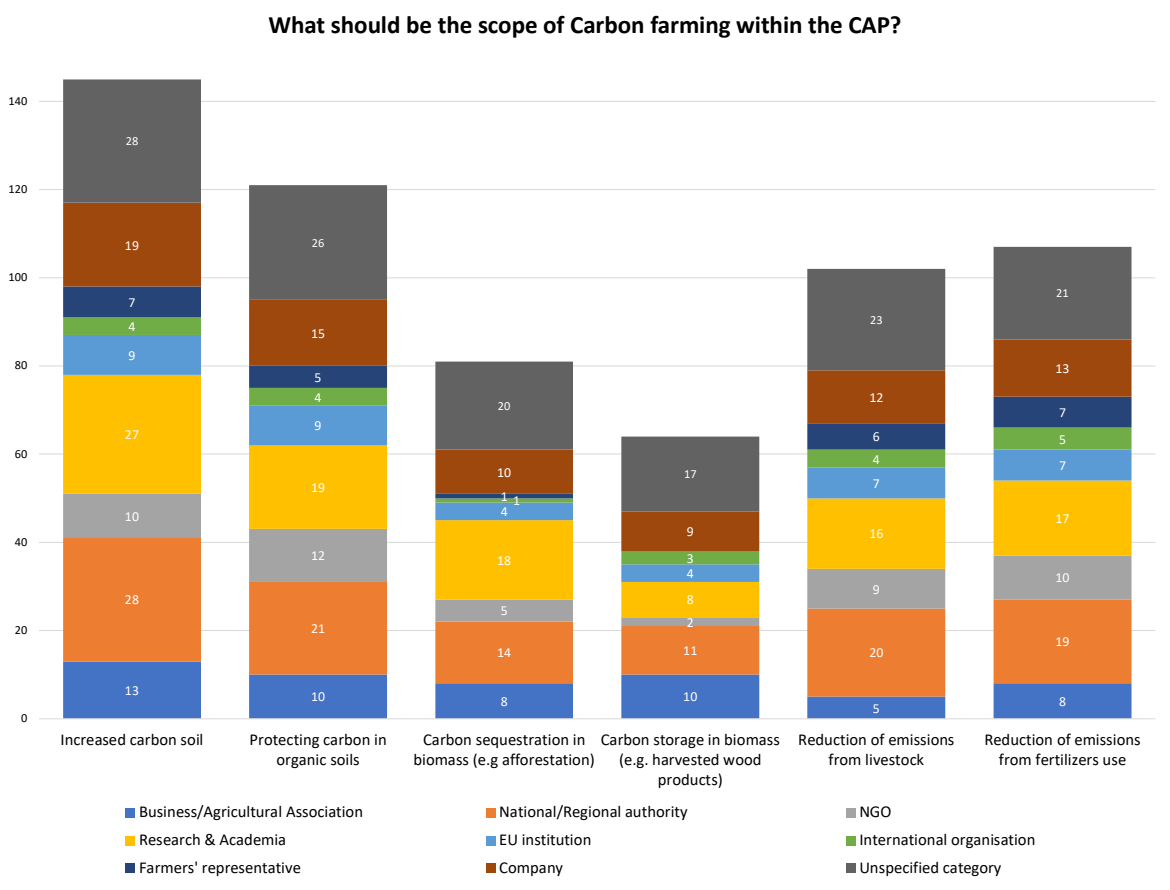


Figure 80: Respondents' answers to poll question 2.

13.5.3. The common Agricultural Policy and carbon farming

Gijs Schilthuis from the European Commission (DG AGRI) presented the main elements of the ongoing reform of the Common Agricultural Policy (CAP) in the context of Carbon Farming.

Mr. Schilthuis highlighted the importance of the CAP in contributing to the objectives of the European Green Deal, remarking that climate challenges were already embedded in the new CAP proposal. The major change comes from the shift from compliance to performance supported by a set of indicators and an upgraded set of environment and climate related instruments. He emphasized the ongoing negotiations between the European Parliament and the Council as paramount to ensure that the CAP reform will contribute to the goal of climate neutrality.

The CAP offers several policy instruments that will provide viable ways to strengthen climate change mitigation. Core actions will be undertaken by the Member States through their national CAP Strategic Plans due to be submitted to the European Commission by the end of 2021. The plans will be assessed in 2022 and subsequently implemented from 2023. Member States will develop their CAP Strategic Plans based on a SWOT analysis of their agricultural sector and rural areas, such as by examining, among the others, emissions and sinks, soil organic carbon. The SWOT will form the basis of a needs assessment, which will feed into an intervention strategy built around the necessary agricultural practices through mandatory and voluntary actions, budget allocations, and targets set at the level of result indicators such as for areas under specific agricultural practices. CAP Strategic Plans will have to take into account the findings, ambitions and targets developed in relevant national planning tools for environment and climate.

In December 2020 the Commission issued recommendations to all Member States for their CAP plans, addressing their specific problematic areas including in relation to the ambitions of the European Green Deal. It will be for Member States to decide on concrete approaches and tools appropriate in their national context. Depending on their assets and challenges, Member States can ground their agriculture's contribution to climate protection in a mix of practices. The CAP is a substantial instrument but will need to be employed in combination with other EU and national regulatory measures and sources of funding.

Furthermore, Member States have to reach out and involve stakeholders in preparing and monitoring the implementation of the forthcoming CAP instruments. All CAP plans will be made public.

13.5.4. Interactive session

The third poll question asked the participants what practices are more suitable for carbon farming via the CAP Strategic Plans. Multiple options were allowed, in particular:

- Peatland restoration and rewetting
- Grassland management
- Management of mineral soils
- Agroforestry
- Afforestation
- Decrease of livestock emissions
- Other
- Not possible to define

203 participants took part in the **third poll question**. As shown in Figure 81 below, there were three options that were selected with the highest frequency, starting with grassland management, followed by agroforestry and peatland restoration and rewetting. Whereas grassland management was the most equally chosen option across the respondent categories, those from public authorities as well as farmers' representatives were more likely to select management of mineral soils, rather than peatland rewetting.

In addition to the options of 'Other' and 'Not possible to define', afforestation was the practice that received the least amount of responses, whereas management of mineral soils and decrease in livestock emissions had almost the same amount of responses with a big share represented by the respondents falling in the unspecified category.

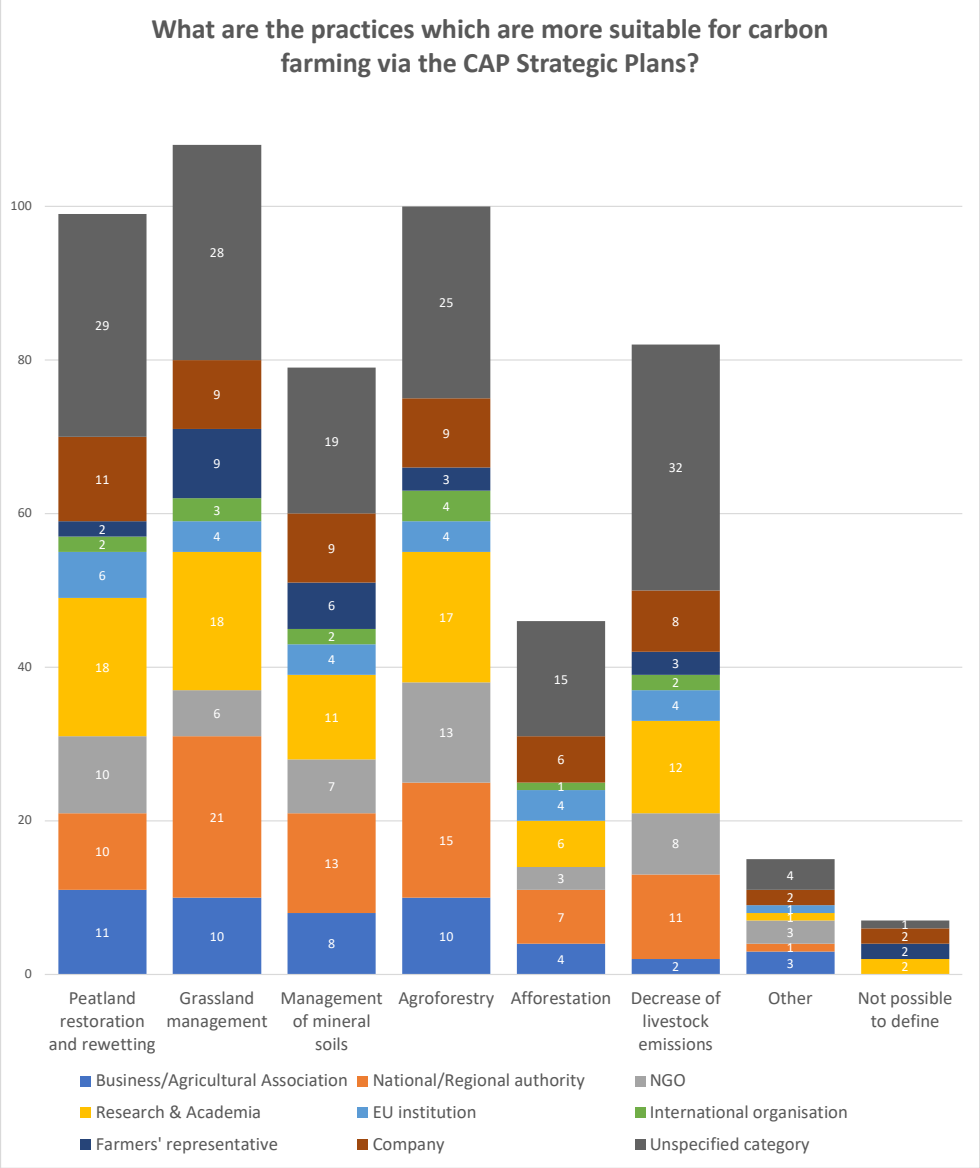


Figure 81: Respondents answers to poll question 3.

13.6. Part 1: Carbon farming as a new business model

This part of the workshop covered the various elements necessary for deployment of carbon farming as a new business model in the EU and experiences to date. Along with a presentation of the Technical Guidance Handbook on the implementation process, several examples on how to set up and implement result-based carbon farming mechanisms (e.g. peatland restoration or agroforestry), were provided and discussed in greater detail. The presentations gave concrete examples of existing carbon farming schemes in Denmark, Finland and the Netherlands.

The perspective of Member States in the development of their Strategic Plans to implement carbon farming was also provided. The speakers presented and referred to different EU and national funding mechanisms, including eco-schemes under the new CAP, noting that the potential of carbon farming implementation varies greatly among the Member States.

13.6.1. The Common Agricultural Policy and carbon farming

Asger Olesen (FSC) and **Clunie Keenleyside** (IEEP) presented the Technical Guidance Handbook commissioned by the European Commission, to provide analytical support for the Operationalisation of an EU Carbon Farming Initiative.

Mr. Olesen noted that the study had relied on previous work developed within the Kyoto Protocol, national schemes in Australia and New Zealand as well as private and local initiatives in the EU. Five case studies were developed within the field of peatland restoration and/or rewetting, agroforestry, livestock, grassland, and soil organic carbon. These case studies explored the technical readiness and implementation of carbon farming. Peatland restoration and/or rewetting is considered the most technically complete and available good practice, so the speaker focused on presenting examples of action on peatlands during their presentation, presenting the analysis carried out on initiatives in different countries from the EU such as MoorFutures (Germany), Peatland Code (UK), MaxMoor (Sweden) and Green Deal implementation procedures in the Netherlands. Such schemes rewarded ex-ante avoided emissions through ending of drainage, whereas incentives for removals revealed to be not yet developed.

Mr. Olesen concluded that:

- for pre-operational and pilot phases, all schemes have relied on a mix of funding instruments (public and private grants, expert support, etc.),
- scalable operation for revenue needs a downstream delivery model carefully designed and
- three different delivery models from existing practices were of relevance.

Ms. Keenleyside further explained the Technical Guidance Handbook.

First, she explained how result-based payments (RBP) can achieve a range of specific environmental objectives, among which reducing GHG emissions and promoting carbon sequestration. RBP are based on indicators to monitor the environmental objectives. From the land's manager point of view, the RBP is linked to verifiable indicators of either the direct environmental objective or a reliable proxy of that indicator. As such, it results in a system where the higher the quality of the indicator, the higher the payment. This system minimises the risk for the land manager while he oversees the management and choice of indicators.

Ms. Keenleyside also introduced the different costs associated to a shift to carbon farming. Up-front investments in land-use change are the main source of expenses for land managers. There are also additional opportunity costs and ongoing implementation costs. On the other side, scheme manager should bear the costs for pilots, knowledge and innovation, monitoring, reporting and verification.

Ms. Keenleyside gave examples of two RBP pilot carbon farming projects. The first example is the Swiss regional pilot Ebenrain that was funded by a Swiss bank to offset emissions locally. This provided a six-year commitment for farmers, ensuring them wider benefits to include advice, a menu of measures, and staged payments linked to soil sampling in the first, third and sixth year.

In the Portuguese project Montado a wide variety of result-based indicators was developed:

- Valorise effective management of natural regeneration system
- Preserve soil health and functionality
- Tree layer capable of regeneration

- Biodiversity of Mediterranean grassland and other elements conserved

Lastly, Ms. Keenleyside presented how the Technical Guidance Handbook should enable land managers to find the suitable and relevant type of carbon farming scheme for their proposed area of development with a decision-tree approach, including the selection of rewarding mechanisms, for example based on action-based payments, result-based payments and hybrid schemes.

13.6.2. CAP instruments for sinks

Emmanuel Petel and **Christine Falter** from the European Commission (DG AGRI) presented the instruments available in the CAP.

Mr. Petel introduced the definition and eligibility rules for agricultural land and remarked that the basic definition will not change with regard to agricultural activity and the three land use types: arable land, permanent grassland and permanent crops. Nevertheless, there will be a better recognition for paludiculture as activity as well as for agroforestry systems under the three land use types.

Enhanced conditionality is an integral part of the future CAP framework. It must cover farmers receiving CAP payments, including small farmers as they manage a significant share of the area.

Common minimum rules are necessary to safeguard the level-playing field between farmers. In this regard, enhanced conditionality includes three GAEC relevant for mitigating and adapting to climate change which are as follows:

- GAEC 1: Maintenance of permanent grassland based on a ratio of permanent grassland in relation to agricultural area;
- GAEC 2: Protection of wetland and peatland under the topic of Climate Change (mitigation and adaption);
- GAEC 10: Ban on converting or ploughing permanent grassland in Natura 2000 sites under the topic of Biodiversity and Landscape.

Other GAECS referring to soil erosion, burning of residues, landscape features are also contributing to climate objectives.

Another key part of the CAP is the eco-schemes under the funding of Pillar I. Member States will have to allocate a portion of their Pillar I funding to eco-schemes aiming to directly benefit the environment and climate (without co-financing). Participation will be voluntary for farmers. Agricultural practices that could be supported by eco-schemes will need to meet certain conditions related to their environmental objectives, ambitions and areas of action. In relation with eco-schemes, the Commission has issued in January 2021, an indicative list of practices to be supported including agroforestry and carbon farming measures.

Furthermore, Ms. Falter presented on the topic of Pilar II for the new CAP, the possibilities of rural development funding for agroforestry and peatland restoration. In terms of agroforestry, there will be continuity with the current CAP. The EAFRD support will be available for establishment, regeneration or renovation, and maintenance of agroforestry systems. However, maintenance will be situated under a different intervention than for the establishment, regeneration and renovation. Additionally, the support rate of the establishment, regeneration or renovation will go up from 80% (current CAP) to up to 100% in the new CAP.

Concerning the support for peatland under Pillar II, it will be available for:

- Restoration of drained peatland / rewetting

- Payments to conserve and restore wetland and peatland in Natura 2000 areas
- Diversification of the rural economy (e.g. recreational or touristic infrastructure etc.)

Lastly, it was concluded that good articulation between the different CAP instruments in the CAP strategic plans to address carbon farming in the future will facilitate for the advancement of the field.

13.6.3. Agro-forestry within the CAP

Patrick Worms and **Garry Lawson** (EURAF) presented the topic of agroforestry within the CAP.

Mr. Worms introduced the presentation defining the differences between the two terms “forest” according to the definition based on the UNFCCC Marrakesh Accords and the EU definition of “agroforest”. The latter definition leaves an open interpretation for Member States to define the maximum and minimum number of trees per hectare.

Mr. Lawson presented an overview of the forest areas and existing trees in the Member States. While the planting rates can be considered remarkable with high levels of reforestation and planted seedlings, there are still great differences between Member States such as Slovenia or Spain, where notable higher percentages of trees are situated outside forest areas.

Agroforestry mitigates 3 tonnes carbon/ha per year and it meets the requirements for permanence (as it produces construction timber and has deep-soil impacts), has some environmental benefits (N_2O and ammonia leakage reduction, animals can stay longer outdoors, increase farm biodiversity, increase soil organic carbon). Agroforestry needs anyway incentives to cover the establishment and maintenance costs.

Despite the presence of agroforestry within the last CAP, the figures show that the uptake by Member States and farmers has not achieved the expected results. For instance, only 2.5% of the planned expenditure by 2019 of EUR 64M was actually spent. Member States tend to underspend forestry and agroforestry budgets, directly influencing the targets and achievements set up by the CAP. As such, Member States should clarify and extend the conditions required for full basic payment eligibility in parcels containing trees (e.g. when agriculture is conducted on more than 50% of the surface area).

In the context of the new CAP, five agroforestry eco-schemes could be offered by Member States to farmers through a satisfactory completion of various stages covering: planning for trees on farms; establishment of landscape features; enrichment of landscape features; silvopasture or silvoarable establishment; regeneration of mature silvopasture or silvoarable lands.

Lastly, it was stressed that it shall be ensured that agroforestry is included in the CAP Strategic Plans of each Member State.

13.6.4. Carbon farming schemes from Denmark – concrete examples of possible combined support

Thomas Skovgaard and **Adam Høyer Lentz** (Danish Ministry of Food, Agriculture and Fisheries) presented carbon farming schemes in Denmark.

The Danish government has put forward two plans with ambitious goals, namely, to reach 70% greenhouse gas reductions by 2030 and climate neutrality by 2050. The agriculture sector in Denmark has an incentive to reach this target as the country has almost two-thirds of land under cultivation. This land accounts for 30% of all GHG-emissions in the country. In this

context, carbon rich peat soils represent one of the primary emission sources, emitting 4,8 million tonnes of CO2eq (in 2019).

Mr. Skovgaard presented the Danish objective to reduce CO_2 emissions from carbon rich (organic) soils within the area of peatland restoration and rewetting. To accomplish this goal, Denmark offers landowners a variety of payment schemes. Such schemes are financed either as lowland schemes under the Rural Development Programme (RDP), as a Climate Lowland scheme 100% nationally financed, or as a Climate Forest Fund financed with a combination of national and private funds. The scope of this project is the total area of cultivated organic soil, accounting for 7% of the total cultivated area and equal to 170,000 hectares of land.

All schemes will be based on voluntary efforts due to the uneven location of organic soils throughout the country. Landowners are compensated for their loss of income, and from 2023 they expect to pay the compensation as a one-time compensation.

Moreover, the government proposal towards 2030 is to restore, rewet or set aside at least 88.500 hectares of carbon rich peat soils, which is expected to have a climate impact of 0,9 million tonnes of CO2 emission reduction.

A varied picture of the upcoming challenges was then presented, focusing on both barriers and synergies. Barriers could include the risk of emission of phosphorus to the environment; the possibility of peatland projects to be in conflict with regulation related to the protection of nature (e.g. Natura 2000); the level of compensation and the implementation time required by peatland projects. On the other side, peatland projects have the advantage to enhance nature and biodiversity and reduce nitrogen leaching. Moreover, Denmark can count on high level of data and ongoing national research and the flexibility accorded by the fact that there is more than one scheme.

Lastly, the 'Targeted nitrogen regulation' scheme was given as an example of maintenance and enhancement of soil organic carbon with a primary objective to reduce leaching of nitrogen to the aquatic environment. This is obtained through establishing catch crops or implementing alternative nitrogen reducing measures (e.g. set-aside or sowing energy crops), for which farmers will be financially compensated. As a result, catch crops will maintain or enhance the level of organic carbon in the cultivated soils for an expected climate impact of 0,5 million tonnes of CO_2 emissions reduction in 2030.

13.6.5. Carbon farming under Nordic conditions

Perttu Virkajärvi (Luke) and **Pia Lehmusvuori** (Finnish Ministry of Agriculture and Forestry) followed up with a presentation of a case study of carbon farming under Nordic conditions, focusing on Finland.

Mr. Virkajärvi began the presentation giving insights about the Finnish agricultural conditions, remarking that the soil organic carbon content is high in most part of Finland which is a challenge for LULUCF emissions. Additionally, the cold winter and long snow cover have implications for the choice of crops and forage species, as well as a larger presence of spring types of cereals and rape seed.

Mr. Virkajärvi presented further the results of a study concerning agricultural emissions in organic soils. The data showed that annual crops have the highest emission factor in relation to other agricultural systems. Although the mitigation potential per tonne of CO_2 is lower, there is a larger application area on mineral soils that partly compensates this lower change in emission per hectare compared to the organic soils.

Ms. Lehmusvuori followed with a separate presentation on the carbon farming eco-schemes that Finland intends to include within the CAP strategic plan to achieve environmental and climate objectives. Finland has planned to offer eco-schemes for crop cover during winter and grass cultivation without plant protection products and fertilizers and with certain species.

With regard to the agro-environmental commitments under the RDP, Finland has planned to include several measures, namely catch crops; soil improving crops; grass cover on peatland fields after arable crops without plant protection products and fertilizers; application of organic matter to arable land; controlled drainage management; constructed wetlands management; grazing of semi-natural pastures; and organic production.

13.6.6. Carbon farming in the Netherlands

The presentation by Mr. **Sjoerd Miedema** (De Nije Mieden) gave the local perspective of an organic farmer implementing carbon farming in the Netherlands. He was the first Dutch carbon farmer working with peat meadows who has also achieved lower carbon emissions through peatland activities.

Mr. Miedema's main point is that soil can play a key role in increasing the sink with a direct effect on improving biodiversity. He proposed implementing measures that avoid mineral fertilisation, the use of chemicals and tillage. He stressed the importance to reward front-runners and rethink the role of farming as key to the solution.

13.6.7. Interactive session

The **fourth poll question** asked participants to identify the barriers to the uptake of carbon farming schemes. Multiple options were allowed, in particular:

- Lack of tailored advisory services
- Uncertainty about funding opportunities
- Regulatory obstacles
- Insufficient reward for co-benefits
- Lack of MRV capabilities
- Cooperation or collective actions insufficiently supported

143 participants took this poll. As shown in Figure 82 below, the most relevant barrier to the uptake of carbon farming schemes is uncertainty about funding opportunities. This choice was homogenously given across the respondent categories, except for international organisations and companies that stressed more the importance of insufficient support for cooperation or collective actions (both categories) and the lack of MRV capabilities (companies).

Beyond funding opportunities, the other two barriers that stood out within this poll question are insufficient rewards for co-benefits as well as lack of tailored advisory services.

Regulatory obstacles was the least selected option with respondents from public authorities selecting it among the less important barriers and those from NGOs considering it on the contrary the most relevant one.

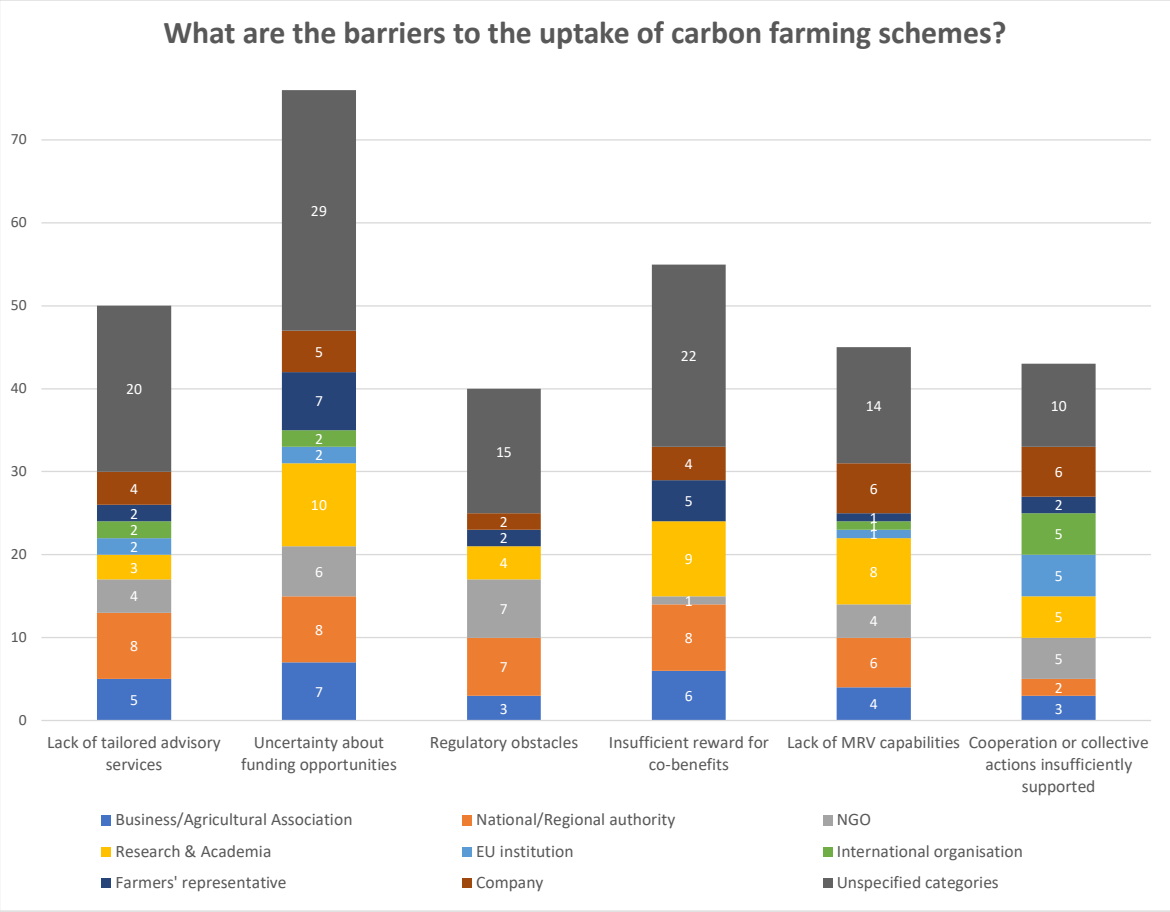


Figure 82: Respondents' answers to poll question 4.

The **fifth poll question** targeted participants from public administrations. They were asked if they were planning to include Carbon farming schemes in their CAP Strategic Plan. Respondents could choose among the following options:

- Yes
- No
- Possibly
- Not yet decided
- Already did

89 participants identifying themselves as coming from all categories took this poll. As shown in Figure 83, almost half of the respondents replied positively to the inclusion of Carbon farming schemes in the CAP Strategic Plans. 50% of the respondents identifying themselves as from public authorities signalled the plan to include carbon farming schemes in their CAP plans, whereas 25% replied, respectively, that this is a possibility or that it hasn't yet been decided.

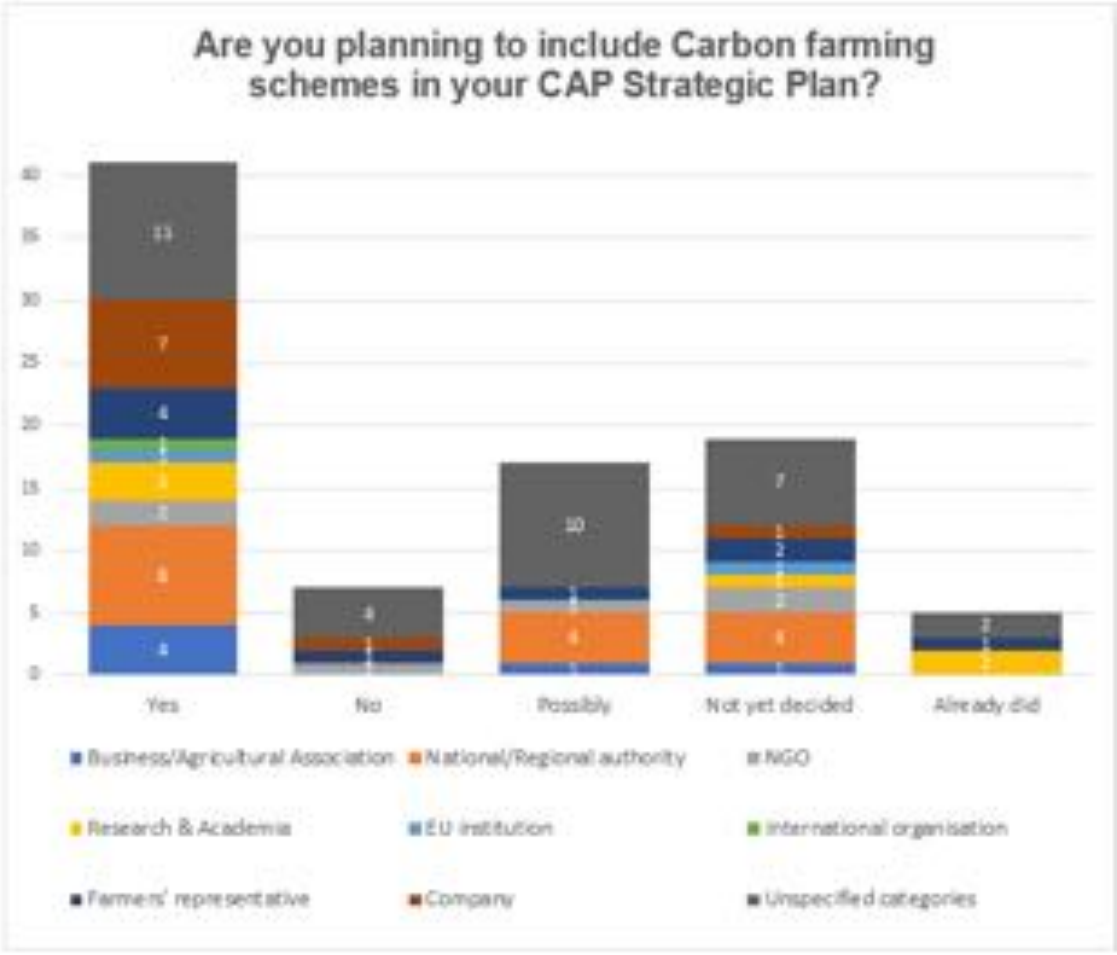


Figure 83: Respondents' answers to poll question 5.

13.7. Part 2: Lessons learned from existing carbon farming projects

The second part of the workshop focused on the lessons learned from the existing carbon farming projects. The presentations gave an overview of the implementation of carbon farming schemes facilitated through EU funding and presented existing carbon farming business models.

The lack of awareness about carbon farming in the agricultural sector and the fact that certain policies are considered by farmers restrictive rather than supportive were emphasised. However, there is a market for carbon farming as actors become increasingly attentive to aspects of sustainable farming. Nevertheless, motivation should be the guiding principle rather than obligation. A European framework should be tailored to the needs of local initiatives to encourage local and regional investment in carbon farming. A particularly promising carbon farming option is climate action on peatlands, due to its mitigation potential and lower implementation challenges. Moreover, actors would greatly benefit from more information on the advantages from restored peatland, a common certification and accreditation system, a centralised organisation for coordinating GHG monitoring standard, and a common framework of incentives and (eco-)credit systems.

13.7.1. LIFE Carbon Farming Scheme

Jenni Kähkönen (ST1) presented the outlines of their project, LIFE Carbon Farming Scheme, financed by the EU LIFE program.

The project's main objectives is to:

- Develop understanding how to incentivise carbon farming
- Identify the factors that compose an efficient market
- Demonstrate carbon sequestration in different regions in Europe

In order to address the supply and demand of carbon removals, the project has developed "The case farm pilot", where viable carbon farming methods are tested and reviewed, and the carbon sequestration potential is estimated in test farms located in different European climate zones.

Additionally, an open survey for farmers has been launched that aims at increasing the knowledge of stakeholder priorities regarding various aspects of nature-based carbon sequestration, and to better understand how to incentivise actions through policy and market mechanisms.

The project has also developed a trading pilot in Puro.earth marketplace, which quantifies the achieved carbon removal using soil amendment fibre from pulp and paper mill sludges to store stabile carbon into agricultural soils.

With regard to funding mechanisms to support carbon farming, Mrs. Kähkönen emphasised that the certification of carbon removals and measuring, reporting and verification are key pre-requisites to incentivise a favourable environment for funding. Furthermore, she put forward the key actions to improve the funding market:

- Ensuring initiation of carbon sequestration activities through public financing
- Sales of negative emissions through voluntary markets
- Regulatory markets will enable growth of carbon sequestration activities

Finally, the following next steps of the LIFE project were presented:

- Report on how to incentivise farmers and foresters to take up scalable carbon sequestration actions in EU including the study of the cost of value chain
- Summary of review of the risk assessment and policy aspects for best practices for a carbon farming scheme
- Report of the results of carbon credit trading demonstration in Puro.earth marketplace with test farmers and foresters
- Report on 5-10 best methods to bind carbon in European agricultural and forest ecosystems and prevention of the carbon loss (soil management, fires)
- Final Guidance at the end of project in spring 2022

13.7.2. Interreg North Sea Carbon Scheme

Marjon Krol (ZLTO) presented the Carbon Farming project, undertaken by seven partners including farmers associations, knowledge institutes and public institutions from four different countries. The project is 50% funded by the Interreg North Sea Region program under the European Regional Development Fund for the period of 2018-2022. The project's main

objective is to develop business models for carbon sequestration to incentivise farmers to invest in carbon farming.

Ms. Krol presented the results of a survey conducted to map the barriers farmers encounter when starting carbon farming. These show that there is a lack of knowledge about carbon farming. Additionally, economic uncertainty and contradictory and restrictive policy are considered main obstacles for farmers. Based on these results, the project developed three work packages focusing on developing techniques for carbon sequestration (W1), the study of four different business models for carbon farming (models within and outside the agri-food chain, models at the farm level and models including government institutions) (W2), and the development of 15 pilot projects to test the different business models (W3).

Ms. Krol emphasised that carbon farming serves multiple goals and has the potential to increase climate ambitions due to the motivation of companies to distinguish themselves in sustainability. The project encourages local farmers to work together in a transparent, unique and visible manner that creates additional benefits for biodiversity, landscape and water.

Ms. Krol recommended focusing on motivation instead of obligation. This can be provided by an integral framework where policy goals are connected and do not conflict with local aspirations. The focus should remain on the benefits for the farmers. Knowledge dissemination remains a powerful tool to create awareness and make transparent the added value of carbon farming for famers. A motivating reward system should stimulate the blending of public and private rewards, allowing customisation for farmers. Further actions should continue to support the market and embrace and support local initiatives and an efficient measuring, reporting verification system.

13.7.3. Interreg North-West Europe Carbon Connects

Valentina Sechi (Wetsus) presented the Carbon Connects project, which is an Interreg project funded by the European Regional Development Fund. The project is carried out by 18 partners.

The main objective of Carbon Connect is to change the traditional GHG-emitting land management practices to sustainable low carbon alternative practices in the main peatland containing regions of North-West Europe. The program provides a farmer-to-farmer learning programme that promotes the benefits of alternative land management and the adoption of sustainable low carbon farming practices. So far, a report was produced to evaluate potential business models of low carbon alternative practices, and established pilots for field-testing these practices.

When working with peatland restoration, the project identified an uncertainty in terms of a missing market for peatland related products. Additionally, there exists a technical challenge for rewetting and for alternative crop establishment. There is also a lack of societal recognition of the importance of peatlands among farmers.

Finally, the project detected a policy gap revealing that there is:

- no common matrix to estimate the benefit from restored peatland;
- no common certifications and accreditation system;
- no centralised organisation for coordination of GHG monitoring standard;
- and no common framework of incentives and (eco) credit systems.

Ms. Sechi concluded that the current carbon-credit systems and incentives do not effectively support sustainable peatland management practices and restoration. Although a few examples at national and regional level have been implemented, international standards are far too expensive for most small peatland areas. Ms. Sechi suggested that an easy and less

expensive accreditation system based on proxies to assess GHG emission reduction (e.g. GEST) can be suitable for the peatland context.

Quality can be guaranteed, and costs lowered if the accreditation is carried out to a regional standard. To ensure that the work continues in the expected progression, common guidelines are needed that measure and account for carbon credits and other ecosystem services.

13.8. Q&A and closing remarks

Following the presentations, a discussion took place, moderated by **Christian Holzleitner** from the European Commission (DG CLIMA) and based on the questions obtained from the interactive polls and the discussion in the chat. The most commonly raised ones concerned the current state of rewarding of farmers that are frontrunners in implementing carbon farming, the feasibility of combining public and private funds, and the co-benefits of carbon farming.

With regard to the possibility to reward farmers that are already practising carbon farming, Gijs Schilthuis (DG AGRI) pointed to the experiences already shared in the workshop, specifically the example from the Netherlands, showing that farmers in Member States are indeed rewarded for their implementation locally, although there might be more efforts needed to make this universal.

With regard to the possible combination of public and private funds, he remarked that the role of public authorities is not necessarily the provision of public capital but also to ensure the certainty in the planning process as this will most likely attract additional funding streams from private capital.

He encouraged the audience to have a look at the Technical Guidance Handbook, as it provides examples on how activities can have additional local environmental benefits. He concluded by underlining how the carbon farming initiative which will be launched this year by the Commission is part of the European Green Deal in combination with other initiatives and actions that aim to change the way we consume, farm and transport. All these aspects need to be coordinated and developed in the same direction, which is precisely the challenge that we are currently tackling.

Christian Holzleitner (DG CLIMA) provided the closing remarks on the workshop. He stated that the workshop has given an overview of the overall market size for carbon removals and how could look like in the future. There is a need to continue to push this discussion forward.

He stressed the importance of finding a balance between food production and carbon farming. Carbon removals should be a business integrated into EU sustainable farming that should be provided with additional funding mechanisms that ensure further progression in the field. Ongoing initiatives from the European Commission will further incentivise action for carbon farming schemes.

He concluded by noting that the transition will not be at low-cost and that therefore funds need to be mobilised from different sources, such as from the CAP budget as highlighted in the workshop, but also from major polluters.

13.9. Survey analysis

13.9.1. Background for survey

On top of the polls that were taken and commented during the workshop, a specific survey was launched after the workshop. The objective of the survey was to collect relevant input with regard to the funding mechanisms to support carbon farming initiatives, as well as to the drivers and barriers faced by stakeholders in the implementation process. The survey included the following specific questions:

- What type of stakeholder are you? (Options: Academic/research institutions, Environmental Organisation, Public authority, Business association, EU Citizen, Trade Union, Company/Business organisation, Non-EU Citizen, Training provider, Consumer organisation, Non-governmental organisation (NGO), Other with if you selected Other, please specify)
- How do you see the interaction between CAP funding and other financing opportunities such as State aid or private markets?
- What are the biggest or most common implementation challenges for the setting up and implementation of Carbon Farming schemes under the CAP?
- What kind of action could be taken at EU level that would enable a stronger uptake and upscaling of carbon farming initiatives (for examples, foster peer-to-peer knowledge, remove or simplify regulatory barriers etc.)?
- What is the scope of Carbon farming (for example, should it aim at incentivising carbon sequestration in soil or biomass or to protect or store carbon or reduce emission)?

13.9.2. Overview of respondents' categories

44 responses were collected[65]. The highest number of replies was provided by participants from public authorities making up 23% of all respondents, followed by those from academic/research institutions and NGOs as well as a few environmental organisations. The category 'other' was made up of farmers and their representatives and one non-EU citizen. Participants identified as EU citizens, trade unions, training providers or consumer organisations did not provide any contribution. The figure below presents the breakdown of the respondents' categories.

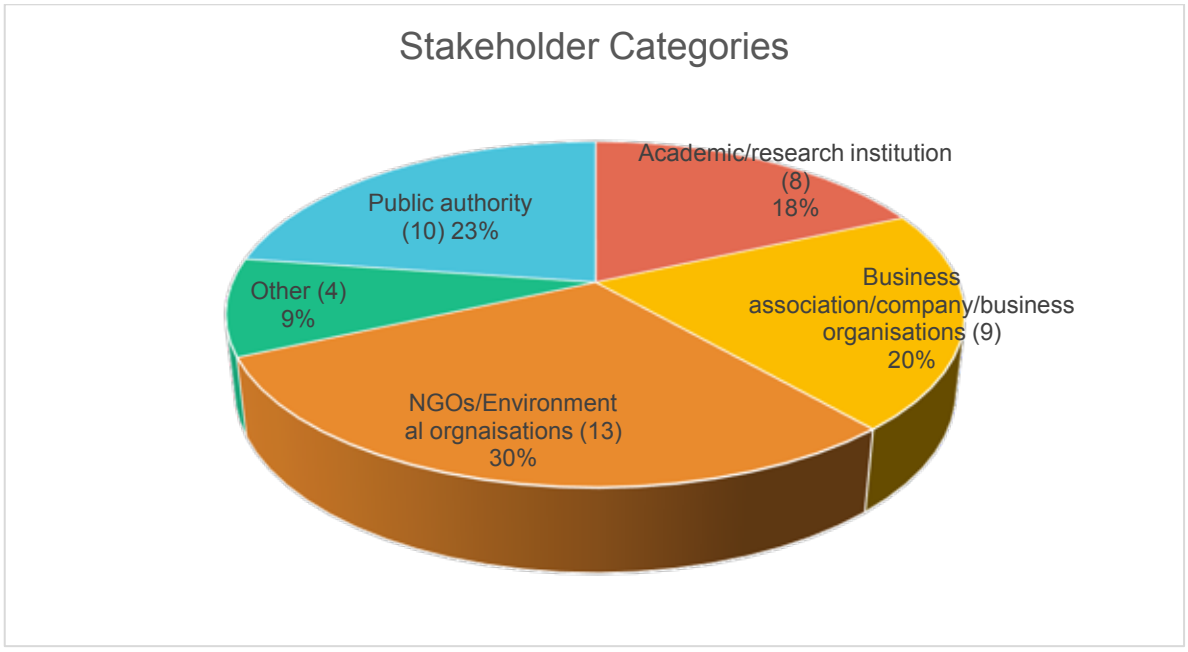


Figure 84: Breakdown of type of stakeholder that took part in the survey after the workshop.

[65] 45 responses were collected in total, but one was removed as it was a copy of another response. 44 responses were then analysed.

13.9.3. How do you see the interaction between CAP funding and other financing opportunities such as State aid or private markets?

Public authorities (9 replies). Respondents supported the interaction between different funding opportunities, remarking that private carbon markets can act as an example for the CAP to ensure that the focus from the CAP is on climate mitigation and adaption within the LULUCF sector. State aid, on the other hand, will remain the subject of further negotiations and is currently driven by different national priorities than the CAP plans. While one respondent remarked that carbon farming schemes should be fully market-based in the end, others added that the information on the interaction between funding schemes is still unclear and should be approached more coherently in the Member States. It was suggested that CAP funding, state aid and private markets should jointly contribute with broader policy measures.

Academic/research institutions (8 replies). There was a consensus among these respondents that CAP funding remains crucial and they welcome modalities between CAP, state aid and private markets as long as the framework is well designed. They agreed that farmers are the base of bioeconomy. Cost-effectiveness and a focus on environmental aspects and biodiversity was mentioned as important elements with regard to double funding (e.g. carbon farmers receiving financial benefits from both the CAP as well as from a private market). Concerns were expressed regarding the use of CAP funding to reward carbon farming, especially in terms of the risk associated with greenwashing (i.e. CAP money will be received by farmers anyway with no additional incentive to go beyond baseline practices).

Business associations/company/business organisations (9 replies). There was high support to the interaction between CAP funding and other financing opportunities. Remarks included their support for a hybrid solution that fosters a transition to regenerative agriculture and carbon farming practices. CAP funding will complement private markets that have a role to cover a share of ongoing management and profit requirements. One of the respondents suggested that farmers could access in particular both CAP funding as well as carbon credits on the market, whereas one respondent remarked that a private market carbon credit-system may not be a good option due to requirement of 'additionality' and the lack of consensus on soil carbon measurement methods and carbon sequestration-certification. Focus on certification standards was highlighted. Attention to forestry and agroforestry was also highlighted as a relevant distinction so that ecosystem services are properly compensated through a carbon market.

Environmental organisations/NGOS (13 replies). Respondents highlighted that the interaction between CAP funding and other funding opportunities should be a priority, mentioning that CAP funding contributes to lowering barriers for entry and to the costs of change of operations and behaviour. They highlighted that CAP should provide incentives to continue low carbon agriculture based on results from pilots. It was also remarked that funding for carbon farming, especially on forestry, should be supported outside the CAP including measures such as mandatory investments in carbon certificates to stimulate industry participation. Furthermore, it was suggested that the interaction should be put on public funding in combination with private non-market-based financing such as Extended Producer Responsibility mechanisms and value chain financing. Some respondents were less in favour of an interaction in funding and remarked that the current system is not climate focused enough, often steering public and private funding towards greenwashing. The concern was raised that large amounts of private funding can lead to perverse effects and disincentivise farmers from transitioning to forming systems that deliver more benefits. They also remarked that that funding should be paid directly to farmers who can show results that improve carbon storage in soil and that climate perverse subsidies need to be phased out (e.g. CAP payments that encourage the drainage of soils).

Other (3 replies). It was remarked that the CAP and other funding mechanisms should integrate carbon credit supply from agriculture into the EU ETS or to benchmark prices. It was also mentioned that there is a need for public-private partnerships and an understanding of how the farmer can measure sustainability and the impact on the environment. A further remark pointed out to the possibility of better funding forestry through well-functioning private market solutions rather than the CAP.

13.9.4. What are the biggest or most common implementation challenges for the setting up and implementation of Carbon Farming schemes under the CAP?

Public authorities (9 replies). A range of challenges were mentioned and no clear consensus about the main challenge was identified. There was the mention of lobbying activities from the big players that are not motivated by sustainability; the lack of knowledge and training to farmers in implementation of interventions and best practices; coordination across policy fields and departments; MRV and ensuring performance and liability of emission reductions; a control framework for the EU-wide carbon farming scheme; the lack of identified areas of peatland and wetland in Member States; low level of compensation and long-term stability and low profitability in the forestry sector; and the conceptual conflict between food security and the increase of non-productive land. It was additionally noted that it is not clear if it is the state or the individual that will benefit in setting up and implementing carbon farming schemes under the CAP.

Academic/research institutions (8 replies). There was agreement that one big challenge is to develop robust monitoring, reporting and verification with cost-effective tools, including environmental indicators, ensuring quality markets and removals. Some respondents highlighted the challenges linked to permanence and leakage, the payment unit and the long-term responsibility and to helpful cost-benefit models and robust result-based schemes.

Business associations/company/business organisations (9 replies). This group highlighted as big challenges to decide on the importance of additionality, how to define carbon leakage, to find scientific consensus on soil carbon measurement and to communicate agronomical advice on carbon farming techniques to EU farmers. Moreover, the economic equation (i.e. the balance between costs and compensation), the lack of economic impact calculation of co-benefits, a missing legal framework that recognises standards, the cost of MRV, the difference between annual payments in Pillar I and multi-annual payments in Pillar II, and the permanence and the remuneration of farmers for protecting carbon stocks remain crucial obstacles. According to some respondents, an effective MRV system, the timeframe with different speeds of carbon farming, competing ecosystem services, sequestration below the root zone and bordering practices, lack of a clear carbon market, costs of investments to transition to regenerative agriculture, implementation of carbon credits and carbon certification standards, and soil carbon measures are the biggest challenges.

Environmental organisations/NGOs (13 replies). The biggest challenge is to ensure a trustworthy and acceptable monitoring, reporting and verification system of carbon removal and an appropriate pricing mechanism. Other challenges mentioned are the reduction of livestock and ruminant emissions in oversaturated soil; keeping transaction costs low to maintain confidence in results and to deal with the risk of non-permanence, risk of leakage and additionality; the coherency with overall climate policy given the different priorities of the CAP and coherency with EU Climate Law; and the lack of a CAP performance framework that incentivises Member States to implement ambitious carbon farming schemes based on the impacts of GHG rather than on the assessment of uptake. Another key issue mentioned was the lack of homogeneity as regards knowledge, skills, natural conditions, and baselines of farmers across the various Member States. There are costs linked to ensuring efficiency with

consultancy, training and adoption to the specific farm context, including accuracy and accountability of carbon sequestration in arable land. There is a need to link carbon farming to EU nature restoration plans, promote biodiversity, and ensure clear guidance on the benefits to small farmers. For peatland in particular, the biggest challenge is losing the access to payments from Pillar I as well as certain protection for grassland that can hinder paludiculture. Moreover, synthetic pesticides remain an issue along with the lack of a systematic approach that focuses on increasing sequestration. Finally, there should be a strict separation from the EU ETS to limit the disincentives for other sectors in need of decarbonisation.

Other (4 replies). Bringing many actors together and ensuring that they understand what carbon sequestration is and how to measure and reward these practices constitutes a big challenge. Additionally, proving additionality and avoiding double payments for the same services, as well permanence were mentioned as further challenges. It was suggested to develop the carbon credits market and provide blended finance. Finally, the lack of general funding, the administrative burden and the need to acknowledge the carbon already sequestered by farmers were also addressed.

13.9.5. What kind of action could be taken at EU level that would enable a stronger uptake and upscaling of carbon farming initiatives (for example, foster peer-to-peer knowledge, remove or simplify regulatory barriers etc.)?

Public authorities (9 replies). Lobbying should be regulated and there should be educational programmes for communities, farmers, public authorities on the importance of rewarding carbon farming. Additionally, the respondents expressed the opinion that the best regulatory practices are through information sharing through advisers and EU innovation partnerships and through removing and simplifying regulatory barriers such as the administrative burden of MRV or investments in new technology on the landowner side. The remote sensing technologies were supported as a desirable tool to improve farm and forest level monitoring. Clear and affordable carbon farming schemes with a certification system for different types and sectors of agriculture should be in place.

Academic/research institutions (8 replies). There was not a common consensus on this question. Some respondents indicated that the payment for carbon should go directly to farmers/ foresters/land managers to pay for their contribution to carbon sequestration. Also, there was a call for large scale experimentation alongside research and practice to propose schemes that are well researched scientifically and can be adapted to different MS and bioclimatic conditions. There was broad agreement that more technical assistance and the building up of knowledge should be supported by the EU. In addition, eco labelling, networks for competitive business approaches and good advisory boards for farmers might be desirable. There was one indication that action to be taken at EU level should integrate the agricultural sector into a carbon pricing scheme and put a stronger emphasis on climate mitigation in the CAP Strategic Plans by also removing barriers related to CAP funding schemes. One point was made to focus on promoting biochar in soil.

Business associations/company/business organisations (9 replies). The EU should create a community of practice, develop independent advice and provide a legal framework for recognition of carbon farming standards. Further, the respondents indicated that there is a need to identify national and regional task forces to work on the topic of soil fertility, soil carbon, and climate mitigation and adaption. The respondents also called for the avoidance of administrative burden on farmers and foresters in order to secure efficiency for compensation for ecosystem services. It was mentioned that regional approaches with knowledge building help farmers to better understand and appreciate their own efforts in the long-term. Public private partnerships with incentives from CAP funding and encouraging enrolment in high quality carbon farming to issue verified soil carbon credits were presented as the best solution.

Important input was focused on MRV requirements as well as on the introduction of new technologies and a clear certification standard governance. Other solutions proposed the use of CAP as a platform to increase knowledge and human barriers currently faced by carbon farming schemes; use the Farm Advisory Services as a platform for farmer-to-farmer exchanges and events to disseminate information and expertise on the uptake of new practices; make use of the possibilities for allowing testing of new types of market-based carbon farming schemes by using the EIP-AGRI Operational Groups; and facilitate carbon farming practices (conservation agriculture, soil cover with cover crops, afforestation, grassland management) by enabling a result-based system for CO_2 equivalents removed or emissions avoided. The need for actions that should be focused on information, advice and training to raise carbon literacy amongst farmers was highlighted. Public and private reward schemes can support mutual compatibility.

Environmental organisations/NGOs (11 replies). According to the respondents, the focus should be on the rewilding of marginal landscapes as well as the rewetting of peatlands without allowing for continued emissions in other sectors. In that regard, separate accounting frameworks should be implemented. It was also stated that the CAP's policy instrument already addresses some challenges and takes action at the EU level to enable stronger uptake. Investment support, cooperation measures, advisory services, agri-environment climate measures, and eco-schemes are measures that make carbon farming more attractive to farmers. Solutions included enhancing evidence through climate tracking methodology; monitoring innovation in the CAP administrative system more focus on knowledge co-creation and exchange (e.g. through living labs and demonstration farms); attention to the demand-side levers; support for a shift to the management of grasslands; and a new framework to underpin carbon farming with mandatory baselines and ambitious targets. Some respondents believe that emitting industries should be held responsible to reduce their carbon balance and implement sustainable practices through a carbon market not within the CAP. Others called for the eligibility of paludiculture in the upcoming CAP whereas peatlands should be taken into account in the Green Deal and LULUCF regulation. The need for independent MRV as well as for training to farmers for accuracy of measurements were highlighted. It was mentioned that there should be a consideration of co-funding of inputs and tools required for successful soil management towards increase of carbon removals.

Other (4 replies). Good practices can be spread through communication and knowledge transfer. In addition, there should be a condition of increasing soil organic carbon to receive CAP payments. One respondent mentioned that carbon farming should be a green business model based on carbon markets. Finally, industries should reduce their carbon-balance through, e.g. carbon farming certificates, and the contribution to carbon farming through the use of wood from sustainable forestry should also be acknowledged.

13.9.6. What is the scope of Carbon farming (for example, should it aim at incentivizing carbon sequestration in soil or biomass or to protect or store carbon or reduce emissions)?

Public authorities (8 replies). The respondents remarked that incentivizing a change in agricultural management would inherently result in more removals and that carbon sequestration is part of some interventions planned in the CAP strategic plans, e.g. agroforestry, which has the potential for sequestration in soil and biomass.

Academic/research institutions (8 replies). It was noted that the biggest challenge would be to combine four scopes: reduce emissions, protect existing carbon, improve sequestration in biomass with respect to permanence, and improve carbon sequestration in soils. Other respondents flagged the need to optimize carbon management on-farm to incentivize carbon sequestration in soil and to protect or store carbon and reduce emissions. The scope has to

give priority to the climate mitigation goals and take into consideration all options with appropriate measures that can more easily tackle barriers such as MRV or long-term planning. Also, it was mentioned that the scope should be wide and country specific. Further it was indicated that the proposed approach should be effective and profitable at the same time. One respondent stressed that biochar is the best option for soil carbon in climate mitigation and for direct negative emissions.

Business associations/company/business organisations (9 replies). It was highlighted that the scope should be as wide as possible, but under the condition that each farmer should be able to implement their own tailor-made mitigation strategy. There was agreement that it is important to take into account both the external climate factors that influence ecosystems as well as the natural biogeophysical aspects of carbon when establishing this approach to take into account the multifunctionality of forests. It was also underlined that the objectives vary depending of the different types of land. For example, peatlands need protection while in agricultural land, increasing sequestration is more important. The need for large scale implementation of farm practices to reduce the agricultural carbon footprint, via carbon sequestration or reducing emissions was highlighted. Existing stocks should be protected through regulatory requirements for the maintenance of existing stocks rather than ongoing payments and grant-aid to help with upfront capital investments (e.g. for peatland restoration). It was also noted that the scope of carbon farming should include a step-wise approach supported by a regulatory framework which starts with soil carbon and carbon stored in trees, leading to the development of carbon schemes that can be adapted and improved.

Environmental organisations/NGOs (13 replies). The focus was given to the fact that carbon farming should help the food systems to adapt to planetary boundaries, restore biodiversity and implement animal welfare. Further it was mentioned that the scope has to be global, focusing first on storing carbon in soil and biomass and second on decarbonization. The improvement of soil fertility through carbon farming practices was mentioned. Carbon farming should ensure the increase of nature-based carbon removals without affecting emission reductions and to include other metrics beyond carbon removal to avoid trade-offs with biodiversity. It was also highlighted that carbon farming should cover land management practices and not be limited to carbon dioxide or costly result-based schemes that require high precise results measurement. Avoided emissions should only be included if they are a result of an active change in management. Objectives such as biodiversity restoration/protection, climate adaptation, water quality, and soil health should all be fully integrated in a carbon farming scheme. In addition, there should be more stringent penalties for activities that remove forest materials unsustainably. It was said that peatland rewetting is the most effective measure for storing carbon in the ground. Existing carbon stocks must be protected, and only additional carbon removals must be counted.

Other (4 replies). The replies were not homogeneous. Whereas on one side it was remarked that carbon farming is beyond the scopes listed and should promote good practices, on the other side it was noted that it should include incentives for additional carbon sequestration in the soil as well as in products with a compensation for keeping soils with high carbon stocks in good shape. A broad scope should focus on innovative practices as part of regenerative farming.

13.9.7. Summary

The survey shows that the respondents are overall positive with regard to the **interaction between CAP funding and other funding opportunities**. Respondents emphasise the importance of keeping the focus on raising awareness and on support for farmers who implement local initiatives. Some stakeholders agree that CAP direct payments to farmers is a better method for incentivising them to improve carbon storage in soil rather than relying on carbon market schemes as main solution, as large amounts of private funding can lead to perverse effects and ultimately disincentivise farmers. However, some respondents also

remarked that private carbon markets can act as a good example for the CAP in ensuring that the focus remains on climate mitigation and adaption in the LULUCF sector. Some scepticism is shown with regard to the use of CAP funding for carbon farming, especially in relation to additionality and the lack of consensus on soil carbon measurement methods and carbon removal certification. The interaction between funding schemes is still unclear and should be approached more coherently in the Member States. However, respondents mostly support a hybrid solution of funding mechanisms, indicating a need for a careful overview and monitoring of private markets.

A **wide range of implementation challenges** was pointed out. The most common challenge is the lack of robust monitoring, reporting and verification systems and knowledge about the relevant costs. Furthermore, the importance of additionality and how to define carbon leakage on one side, as well as the relevance of knowledge awareness and agronomic advice on carbon farming techniques for farmers on the other side could be identified as second and third most mentioned challenges.

In addition, the following challenges were mentioned as relevant:

- lack of a clear carbon market
- lack of homogeneity in knowledge, skills, natural conditions and baselines of farmers across the various Member States
- balance between costs and compensation for the transition to regenerative agriculture
- lack of economic impact calculation of co-benefits
- missing legal framework that recognises standards
- difference between annual payments in Pillar I and multi-annual payments in pillar II
- ensuring coherency between the EU Climate Law and the overall climate policy and the different priorities of the CAP
- lack of a CAP performance framework that incentivises the Member states to implement carbon farming based on the assessment of uptake rather than on the GHG impacts
- lack of identified areas of peatland and wetland in Member States
- as regards peatland, losing the access to payments from Pillar I as well as certain protections for permanent grassland that can hinder paludiculture
- conflict between food security and the increase of non-productive land
- low level of compensation and long-term stability and low profitability in the forestry sector
- reduction of livestock and ruminant emissions
- low transaction costs to maintain confidence in results
- administrative burden in the implementation process

When respondents were asked the same question during the workshop, the lack of MRV capabilities was the third most common answer. There is therefore a certain divergence of views in the two stakeholder feedbacks. However, the lack of knowledge about the MRV costs and the relevance of knowledge for farmers that are frequently mentioned in the survey as big challenges connect to the uncertainty about funding and the lack of tailored advisory services which are, respectively, the first and third most common barrier to uptake of carbon farming in

the poll question. Moreover, several challenges highlighted in the survey relate directly or indirectly to funding as well as to the need to reward co-benefits in a more robust manner, which was the second most common option chosen in the poll.

With regard to the **type of actions that would encourage uptake**, there was agreement that larger information for landowners on the benefits of carbon farming would promote uptake. Advisory services at EU level was one of the main suggestions across all categories of respondents. Better MRV through, e.g. better training of farmers on improved accuracy in measurement, was also cited as a key action for setting up a highly effective carbon farming initiative. In addition, forms of cooperation for the implementation of good practices for climate and environment should be promoted whereas lower administrative burden for farmers and landowners would be key to encourage uptake within carbon farming and this goes hand in hand with a strong regulatory backbone.

As regards the last question on the possible **scope of carbon farming** it was repeatedly stated that incentivizing carbon sequestration and storage in soil or biomass and emission reduction goes hand in hand. The scope should be broad in order to maximize uptake. Many respondents referred to the country-specifics and how it is important to take into consideration the different biogeoclimatic conditions of the Member States when evaluating the scope of carbon farming.

The results from the survey are partially in line with the replies given by the respondents during the workshop. There is convergence in the respondents' feedback to the poll and the survey with regard to increased carbon in soil as key scope of carbon farming. Still, many survey respondents mentioned that while increased carbon in soil is highly important, the scope should also include increased carbon storage in biomass, whereas this - together with sequestration in biomass - were the two answers in the workshop that had the lowest response frequency. When comparing the response levels given to the poll and the survey, it can be concluded that they are similar (with some small deviations) indicating that on a general level there is an overall agreement on a broad scope for carbon farming.

Also the poll question regarding the practices that are more suitable for carbon farming via the CAP Strategic Plans had some cross-over with the survey answers. The answers to the poll question highlight key areas of land management that could help shape the scope of carbon farming due to their potential for uptake. The survey answers frequently mention the need for attention to agroforestry and peatland, which are, respectively, the second and third most common answers to the poll. Another point of convergence is with regard to grassland management as this practice is mentioned several times across the survey answers as falling within the scope of carbon farming, while constituting the most common answer to the poll.

14. Inception Impact Assessment Analysis

14.1. Introduction

This report presents and analyses stakeholder feedback on the Inception Impact Assessment (IIA) on the review of the EU rules on land use, land use change and forestry (LULUCF).

The IIA on the review of the EU rules on LULUCF received a total of 93 responses from different stakeholders/user groups as shown in the figures below. The private sector with a combined share of responses of 39% represents the largest share of responses. This includes business associations with a total of 22% (20 responses) and companies/business organisations with a total share of 17% (16 responses) of all submitted responses. Non-governmental organisations contributed 28% of responses (25 responses), followed by environmental organisations with 10% (9) of responses. There are also a number of responses from EU citizens (9%, 8 responses), academic/research institutions (8%, 7 responses), from a stakeholder group which was not predefined (6%, 6 responses) and from public authorities (2%, 2 responses).

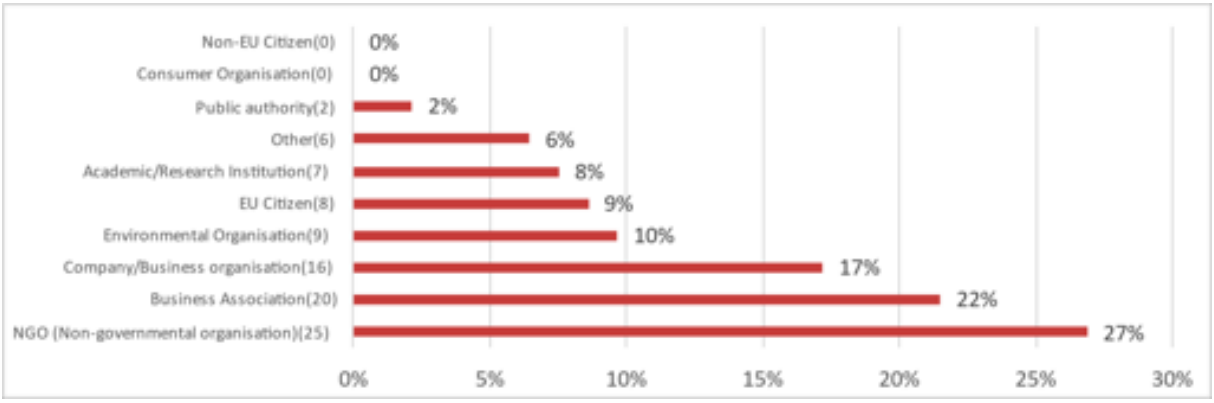


Figure 85: Respondent profile: type of organisation, Source: Technopolis Group (n=93)

The largest share of respondents from the private sector was represented by the bio-based sector (25% of the total of respondents), including the Harvested Wood Products (HWPs) value chain and biofuels, as well as the agricultural sector (8%) and energy sector (6%).

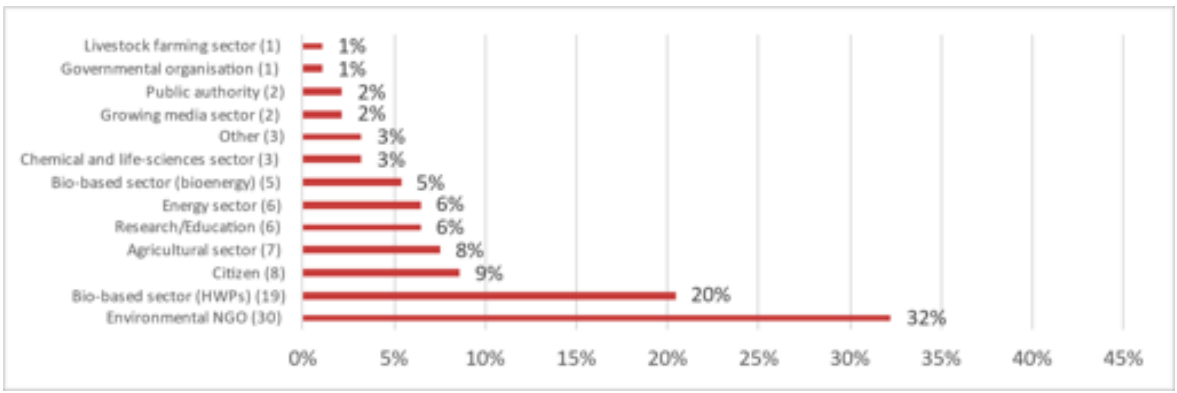


Figure 86: Respondent profile: sector. Source: Technopolis Group (n=93)

Responses were collected from across 21 EU members states. The largest number of replies came from Belgium (23%, 21 respondents), which includes responses from European

representative bodies based in Brussels. A further 12% of respondents were from Finland (11 respondents). A larger number of responses came also from Germany (11%, 10 responses), and non-EU countries which included the United States and the United Kingdom (8.6%, 8 responses), Sweden (6.5%, 6 responses).

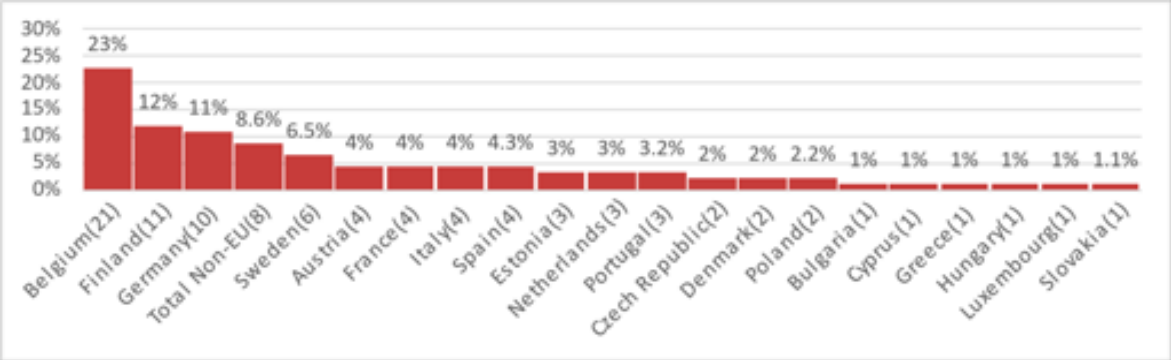


Figure 87: Respondent profile: country. Source: Technopolis Group (n=93)

14.2. Results of IIA feedback consultation

14.2.1. A. Context, Problem definition and Subsidiarity Check

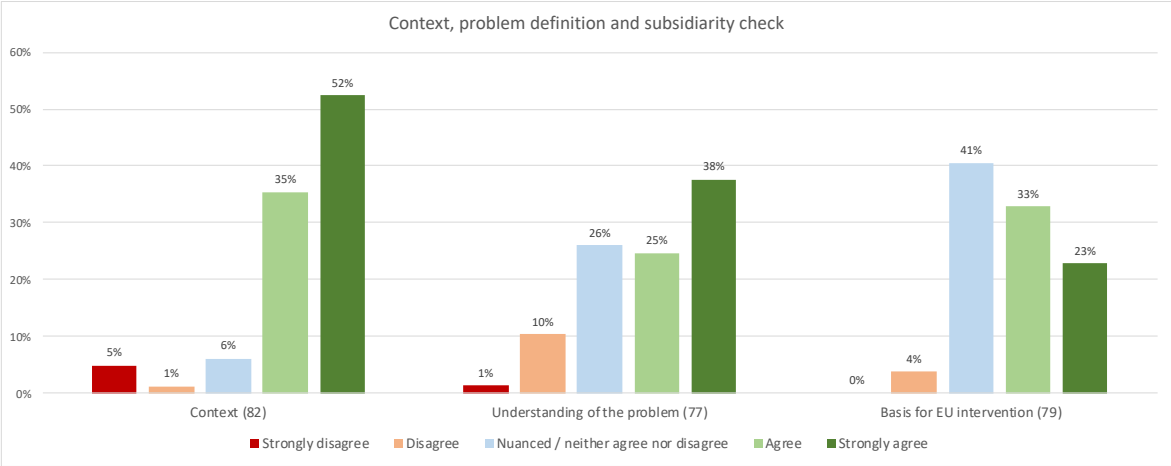


Figure 88: Feedback on context definition, understanding of the problem and basis for EU intervention in the revision of the LULUCF Regulation. Source: Technopolis Group.

82 respondents provided feedback on the context of the revision of the LULUCF regulation as presented in the Inception Impact Assessment. A majority of them (87%, 72 respondents) explicitly agreed with the context, meaning that they support the need to amend the LULUCF regulation to align with the higher climate target set in the European Green Deal. A further 6% (5) explicitly disagreed with the context, and another 6% (5) neither agreed nor disagreed, providing a more nuanced answer.

Among the 72 respondents who agreed with the context, the most common reasons given for support were the more ambitious targets, the need for the LULUCF sector to contribute through carbon removals, including by replacing fossil-based materials and energy with bio-based ones. While most stakeholders agreed with the context, some also pointed out that the targets were not ambitious enough, and a concern with increasing the flexibility between sectors. Many respondents also expressed a strong disagreement with the replacement of fossil-based materials and energy with bio-based ones. These concerns were often linked to the objectives and policy options, the most prominent points raised are outlined in the chapters B and C of

this report. The 5 respondents who explicitly disagreed with the context raised the following points: a disagreement with increasing removals in the LULUCF sector; a concern with the targets not being ambitious enough; and a concern with increasing the flexibility between sectors. The 5 respondents who neither agreed nor disagreed with the context expressed that although they agree with an increase in carbon sequestration in the LULUCF sector, they believe the focus should be on emissions reductions within the Emissions Trading Scheme (ETS) and Effort Sharing Regulation (ESR).

77 respondents provided specific feedback on the section of the IIA presenting the problem the initiative aims to tackle. Most of them (63%, 48 respondents) agreed with the understanding of the problem presented. Fewer respondents (11%, 9 respondents) from a variety of sectors explicitly disagreed with the understanding, while a larger number of respondents from the bio-based sector, agricultural sector and environmental NGOs (26%, 20 respondents) provided a more nuanced answer or neither agreed nor disagreed. This means that whereas some respondents explicitly expressed their agreement/disagreement, other used different formulations e.g., highlighting aspects that in their view were not properly presented or addressed in the IIA, and that they were suggesting factoring in.

79 respondents provided some comments on the IIA section describing the basis for EU intervention through coordinated EU policies. Of those who provided feedback related to this, 56% (44) agreed with intervention at the EU level, 41% (32) neither agreed nor disagreed and 4% (3) disagreed. The respondents who provided a more nuanced answer, as for the presentation of the problem, highlighted aspects that in their view were not properly presented or addressed in the IIA. Some expressed the following specific points: the importance of a place-based approach in landscape management which involves all relevant local stakeholders; the importance of coherent action through the various climate policies; the need for regulatory stability for industrial R&D; the need to take into account the local economy and not penalising some Member States.

14.2.2. B. Objectives and Policy options

81 respondents provided feedback on the specific objectives of the revision of the LULUCF regulation to align to new Green Deal targets. 55% of respondents (45 respondents) expressed overall agreement with the objectives of the review of the LULUCF regulation, 31% (25) expressed a nuanced opinion which could not be classified as agreement/disagreement and 13% (11) disagreed.

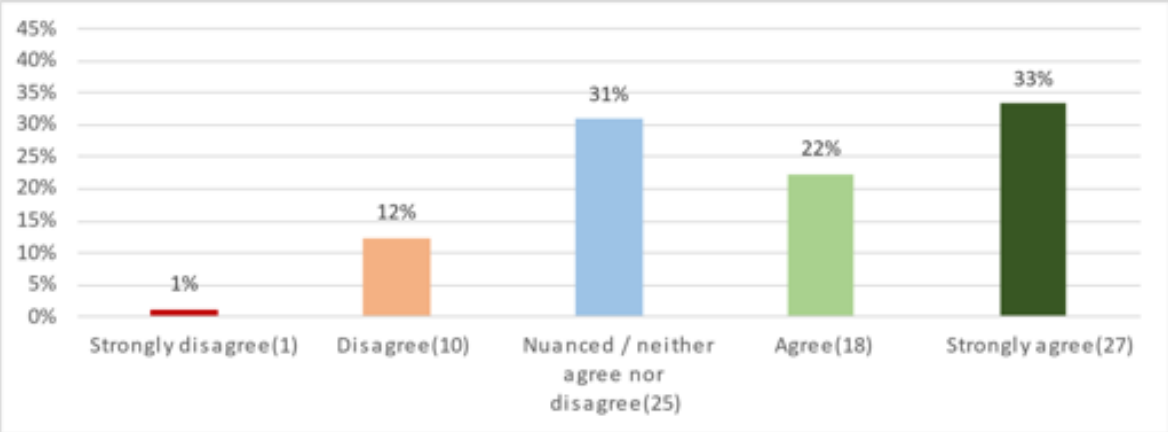


Figure 89: Feedback on the objectives of the initiative revising the LULUCF Regulation
Source: Technopolis Group n=81

Specific comments regarding each objective are reported below:

- A large majority of respondents strongly agreed with the objective of enhancing land-based sinks in the land use sector. However, respondents differed in their view of how to enhance the carbon sink: respondents from the bio-based sector favour an approach that rewards active forest management and views Harvested Wood Products (HWPs) as part of the sink, while environmental NGOs strongly disagree with this approach and would rather see a preservation of the existing land carbon sink. The minority that disagreed with this objective, views it as a risk to the bio-based sector if further obligations are implemented that constrain the use of forests or soils or that require the land-based sector to offset emissions from other sectors.
- Very strong views were expressed regarding incentives for substituting fossil-based materials with bio-based ones. The bio-based sector is in strong and uniform agreement to enhance incentives for utilising the positive carbon effects of carbon storage in HWPs and for the substitution of fossil-based materials with bio-based ones. Some representatives from the agricultural, chemical and life sciences and energy sectors also support this view. On the other hand, environmental NGOs expressed a strong opposition to the idea of further incentives for the use of bio-based materials since this objective is in potential conflict with the enhancement of the forest carbon sink.
- 11 respondents provided specific feedback on market-based approaches to accelerate the transition towards a resilient and climate-neutral bio-economy. Of these, 8 respondents provided comments on carbon farming, with stakeholders from the agricultural sector and the bio-based sector agreeing with the mobilisation of private funding through incentives for carbon removals and for sustainable land management practices, including afforestation. Disagreement was expressed by one environmental NGO, on the basis that MRV and accounting for such a scheme are likely to be complex and controversial, and by one company from the chemical and life sciences sector, which is concerned that such a scheme would reward a passive management approach to forestry.
- While respondents discussed extensively the reduction of emissions in other sectors, a reduction of land emissions was approached mainly in the context of limiting emissions from the burning of forests caused by forest fires. Extensive ploughing of soil for agriculture was also mentioned as a cause for land emissions. There were no particularly strong views on this objective.

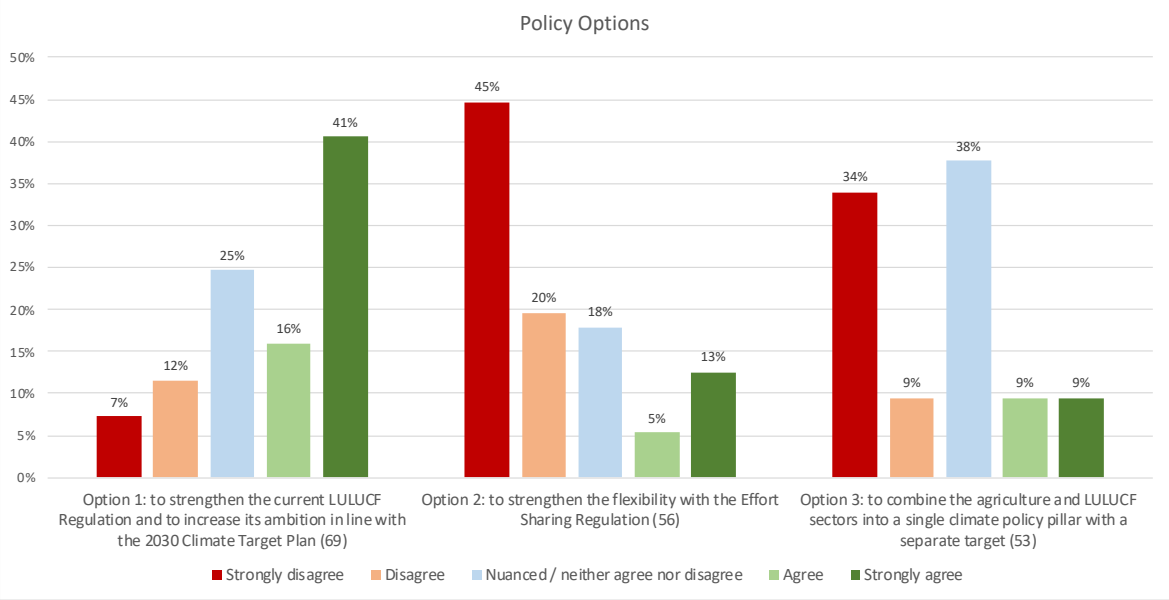


Figure 90: Feedback on proposed policy options to amend the LULUCF Regulation
Source: Technopolis Group

14.2.2.1. Policy option 1

Of all responses 69 provided feedback on the Policy Option 1 seeking to strengthen the LULUCF regulation in line with the new climate targets. Of these, 57% (39) agreed with a strengthening of the current regulation to increase its ambition, 25% (17) neither agreed nor disagreed with the policy option presented, while 19% (13) disagreed.

The most frequent reasons for agreement were the ambition to align the LULUCF sector with the 55% 2030 targets by increasing sinks and lowering emissions, as well as the need to increase ambition in protecting and increasing the current carbon sink.

All of those disagreeing with this policy option expressed a concern that a strengthened regulation would lead to further obligations on the part of the bio-based sector.

A number of respondents who provided a more nuanced response, which could not be classed as agreement or disagreement, expressed that they would welcome further detail on the policy option outlined, and that they would like the LULUCF regulation to include incentives for the substitution effect of wood.

14.2.2.2. Policy option 2

56 respondents provided feedback on Policy Option 2. A majority of those respondents (65%, 36 respondents) disagreed with increasing the flexibility with the Effort Sharing Regulation. The stakeholder types who expressed this view most frequently were environmental NGOs and respondents from the bio-based industry (forestry sector, growing media sector). Their disagreement was motivated by a concern that a increase in flexibility with LULUCF could lead to a decrease in the ambition to reduce emissions in other. A second concern was that the LULUCF sector would have to share a relatively higher economic burden if the carbon sink is increasing in the LULUCF sector to compensate other sectors.

18% (10) of respondents agreed with this policy option and a further 18% (10) neither agreed nor disagreed. Those who agreed with this option see it as the best option to moderate the compliance costs of achieving the 55% target through carbon removal credits and as a solution to mitigate hard-to-abate emissions.

14.2.2.3. Policy option 3

53 responses were provided for Policy Option 3. 43% (23) of respondents disagreed with combining the agriculture and LULUCF sectors into a single climate policy pillar with a separate target, expressing concerns such as an expectation for the forestry sector to offset emissions from the agricultural sector or to reduce wood harvest rates.

38% (20) of respondents neither agreed nor disagreed with this policy option. The most frequent comments made were a request for additional evidence of the impact of this option on forest-based industries and a suggestion to consider incentives for the substitution of fossil-based materials.

18% (10) agreed with combining agriculture and LULUCF and creating a separate target. Of those who agreed with it, about half (4) would like to keep non-CO2 emissions within the scope of the ESR, while others did not discuss this point specifically.

14.2.2.4. Additional information on policy options and MRV/coherence

Respondents also raised other points which were not directly related to the policy options presented in the IIA:

- The need to set new more ambitious Forest Reference Levels based on a projection of a desired target for 2050.
- The need to ensure coherence of the LULUCF regulation with the EU's biodiversity goals, in support of the implementation of the new Biodiversity Strategy for 2030. Planning for afforestation and reforestation needs to include ecological expertise.
- The issue of coherence between LULUCF rules and incentives for the burning of biomass as part of the Renewable Energy Directive (RED II). The promotion of the bio-based economy and any use of bio-based products for climate reasons should be accompanied by extensive life-cycle assessments to ensure that adverse impacts (for example deforestation in and outside the EU) and perverse incentives are limited.
- Setting direct incentives for farmers and foresters who implement sustainable practices. There were mixed views on setting incentives through the Carbon Farming initiative and the Carbon Removal Certification Mechanism: while some respondents expressed strong agreement with the initiatives, others were in disagreement due to the current complex nature of MRV and accounting systems.
- The need to revise Monitoring, Reporting and Verification (MRV) of data. There are mixed views on the use of satellite imagery to strengthen MRV requirements: while remote sensing tools could be used by Member States for identifying landscape features, these tools are not yet developed enough to be used as the only method and the data must be verified by land-based methods. It was also raised that the data used as a basis for decision making must be accepted and validated by all parties involved.
- The need to revise accounting rules for the regulation, particularly where LULUCF removals are to be used flexibly with other sectors, according to principles of Transparency, Accuracy, Completeness, Consistency and Comparability (TACCC) of data. This would improve the quality and harmonisation of data coming from Member States.
- Ensuring synergies with other climate legislation in the EU, such as the Common Agricultural Policy, ESR, ETS, Farm to Fork Strategy, Circular Economy Action Plan.

- The need to balance between the LULUCF objectives and progress in the bioeconomy by taking into account substitution of fossil-based materials.

14.2.3. C. Preliminary Assessment of Expected Impacts

A majority of respondents (81) expressed their views on the expected impacts of a revision of the LULUCF regulation through the policy options outlined.

The economic impact mentioned most frequently by respondents was the growth of the bio-based sector through increased use of HWPs in substitution to fossil-based materials. Another expected impact which was mentioned by a large number of respondents was a just and inclusive transition to climate neutrality which does not leave any sector behind, particularly within the context of the recovery from the impacts of COVID-19. This concern was expressed by respondents from the bio-based sector (including the wood products value chain) and the livestock farming sector.

The likely social impacts of a review of the regulation include: the creation of new business opportunities and the generation of income for rural communities and for small businesses; the promotion of territorial cohesion where there are significant structural and economic differences between Member States and regions; repopulation in rural areas which have been abandoned due to lack of economic opportunities.

The following expected environmental impacts were mentioned most frequently: increased carbon sequestration; preservation of landscapes and ecosystems, including water systems and peatlands; preservation of forests as carbon sinks and biodiverse systems; afforestation and reforestation where there has been intense logging; improved soil fertility and carbon content; reduction of emissions and substitution of fossil-based materials.

Some respondents also mentioned some expected impacts in terms of simplification of the administrative burden, such as a simplified MRV system with more coherent and comparable data across Member States and a simplification of LULUCF accounting rules.

15. Synopsis Report for the Analysis of the LULUCF Open Public Consultation

15.1. Introduction

This report presents and analyses the results of the responses collected through the Open Public Consultation (OPC) on the review of the EU rules on land use, land use change and forestry (LULUCF). A detailed overview of the respondents, showing the distribution by user type, and country is followed by analysis of the quantitative and qualitative responses per question.

15.2. Status of consultation and profile of respondents

The OPC on the review of the EU rules on LULUCF received a total of 235 replies from different stakeholders/user groups. The private sector was well represented, private sector organisations had a combined share of the responses of 28%. This includes business associations with a total of 18% (43 responses) and companies/business organisations with a total share of 10% (24 responses) of all submitted responses. There was also a large contribution from EU-Citizens, 26% (60 responses) of all responses came from EU-Citizens. 17% of respondents represent a non-governmental organisation (NGO) (41 responses) and 12% came from academia (29 responses). There are also a number of responses from public authorities (8% /18 responses), trade unions (2% /4 responses), environmental organisations (1% / 3 responses), and a non-EU citizen (1 response). 5% (12 responses) were from a stakeholder group which was not predefined.

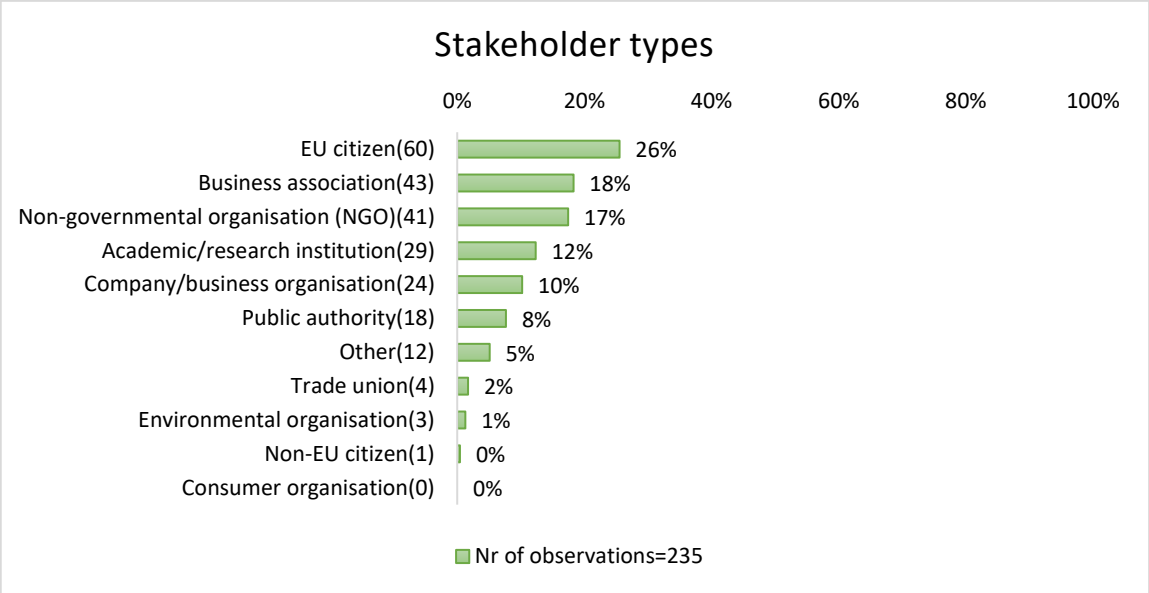


Figure 91: Respondent type

Responses were collected from across 22 EU Members States (MS), with no respondents from Croatia, Republic of Cyprus, Lithuania, Luxembourg, and Malta. As shown in the figure below, the largest number of replies came from Belgium (17% / 39 respondents), which includes responses from European representative bodies based in Brussels. A further 16% of respondents were from Germany (38 respondents). A larger number of responses came also from Italy (9% / 20 responses), Hungary (8% / 19 responses), Sweden (8% /18 responses), France (7% / 16 responses), Finland (5% / 12 responses), and Spain (5% /12 responses). 14 respondents were from outside the EU, these include stakeholders from Australia (2), Brazil (1), Ethiopia (1), Norway (1), Switzerland (5), United Kingdom (1), and the United States (3).

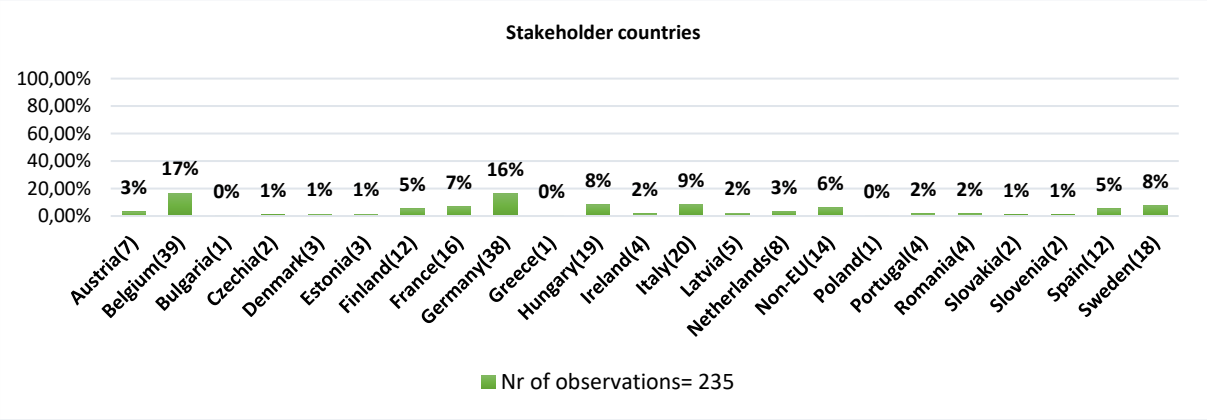


Figure 92: Respondent country

15.3. Part I: Mobilising the mitigation and business potential of the land sector and the bioeconomy

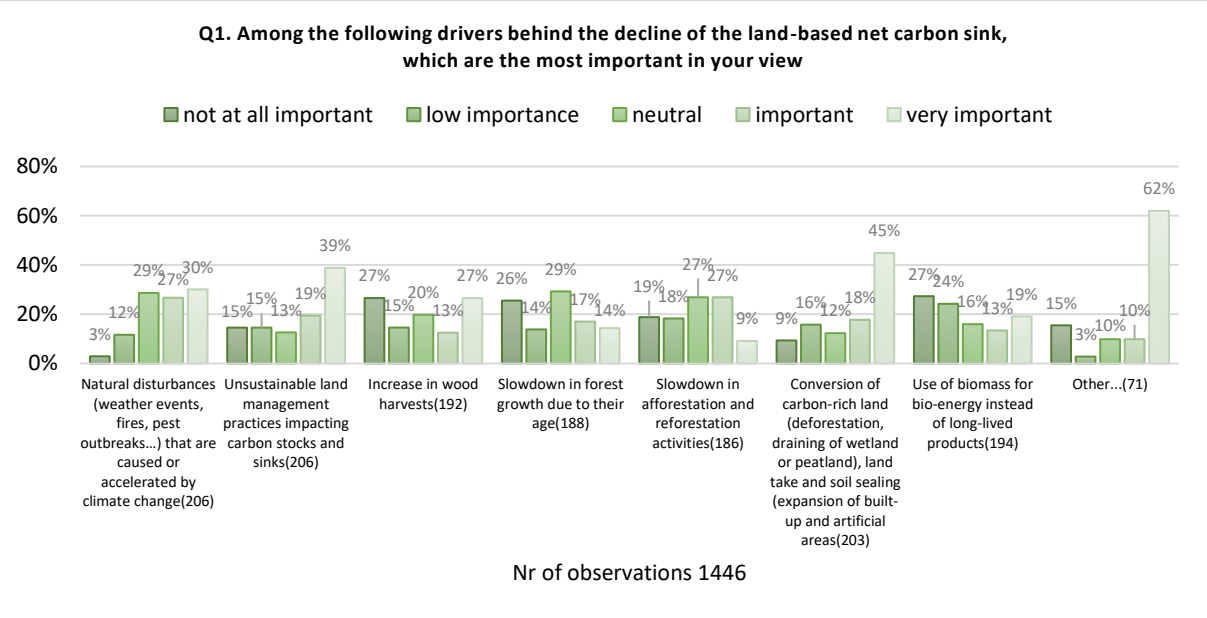


Figure 93: Q1. Among the following drivers behind the decline of the land-based net carbon sink, which are the most important in your view

Stakeholders were asked which drivers behind the decline of the land-based net carbon sink they view as the most important. The **driver which was seen by the most stakeholders as important** was the **Conversion of carbon-rich land (deforestation, draining of wetland or peatland), land take and soil sealing (expansion of built-up and artificial areas (63% / 127 respondents** see it as important or very important) this was also the driver which was also most frequently selected as very important. The driver which was seen as the second most important was **Unsustainable land management practices impacting carbon stocks and sinks** (**58% / 120 respondents** see it as important or very important), followed by **Natural disturbances (weather events, fires, pest outbreaks…) that are caused or accelerated by climate change** (**56% / 117 respondents**), **Increase in wood harvests** (**39% / 75 respondents** see it as important or very important), **Slowdown in afforestation and reforestation activities** (**36% / 67 respondents** see it as important or very important), **Use**

of biomass for bio-energy instead of long-lived products (**32% / 63 respondents** see it as important or very important), and at the bottom **the Slowdown in forest growth due to their age** (**31% / 59 respondents** see it as important or very important).

The 3 drivers which were **most often selected as not being important** were the **use of biomass (52%), increase in wood harvests (41%), slowdown in forest growth due to their age (39%), and Slowdown in afforestation and reforestation activities (37%).** As seen in the figure above, some drivers such as the increase in wood harvests had very polarized opinions.

71 stakeholders provided additional drivers or additional comments to this question within the open text response. A number of stakeholders including MS' public authorities highlighted that this question should not be opinion based but additional scientific empirical analysis would need to be conducted, ideally the Commission should provide in-depth analysis of the causes of the decline, preferably at MS level. It was also mentioned that the main loss of the sink is happening outside of Europe in particular by deforestation in tropical forests and it will be difficult to adress this only at EU level, especially given that the current LULUCF regulation already prevents decrease with the no-debit rule and the EU is a net-importer of Harvested Wood Products (HWPs). In this context also the lack of strong sustainability verification at the global level was highlighted. Also it was stated that drivers vary in Europe from permafrost emissions in the north to logging in the South-East. It was also raised that the decrease in the sink since 2008 could be temporary due to, for example, bark beetle infestation. Another often mentioned driver was artificialisation of the sink from construction i.e. buildings and roads. Weak sink accounting methods were also mentioned by a number of stakeholders but it was not made clear whether these overstate a decrease of the sink. One stakeholder also disagreed that the sink is decreasing at all.

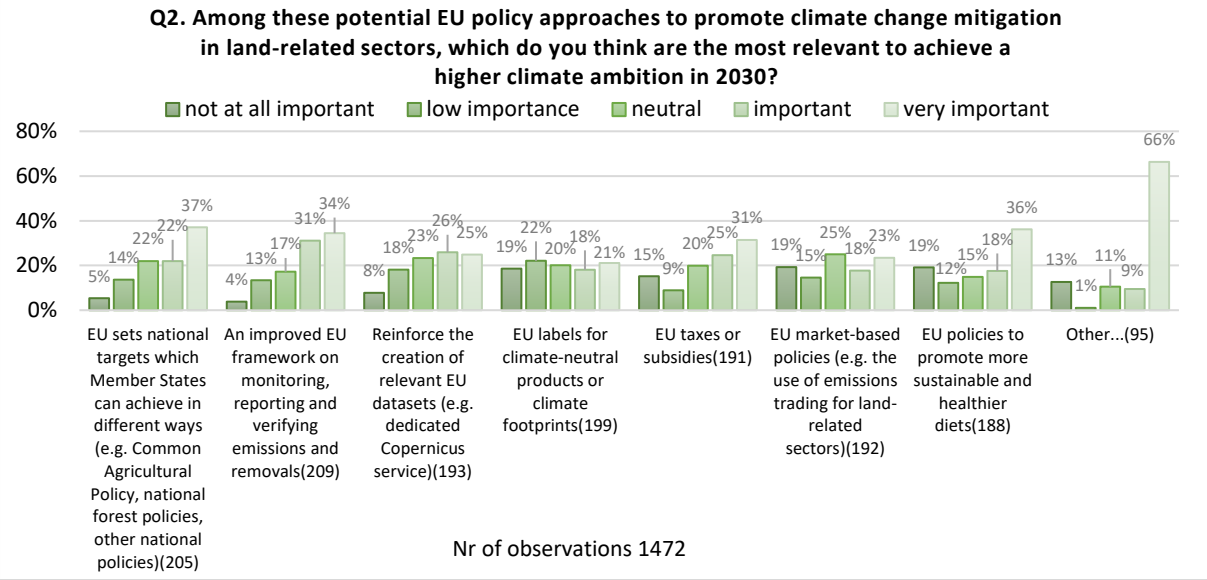


Figure 94: Q2. Among these potential EU policy approaches to promote climate change mitigation in land-related sectors, which do you think are the most relevant to achieve a higher climate ambition in 2030?

Stakeholders were asked which potential EU policy approaches to promote climate change mitigation in land-related sectors they regard as the most relevant to achieve a higher climate ambition in 2030. **The policy approach which was most frequently selected as important or very important was to create an improved EU framework on monitoring, reporting and verifying emissions and removals (MRV). This was selected by 66% (137) of respondents as important or very important. This was followed by national targets (59% / 121 important or very important), EU taxes or subsidies (56% /107 important or very important), EU policies to promote more sustainable and healthier diets (54% / 101 important or very important), and EU market-based policies (41% / 79 important or very**

important). The only option which was more often selected as being not important was having EU labels for climate-neutral products or climate footprints, 41% chose this to be not at all important or having a low importance compared to only 39% which found this important or very important.

95 stakeholders selected the "other" option, and many of them only used it to further comment on their choice rather than suggesting alternative policy approaches. However, a large number of stakeholders also provided additional options to achieve a higher climate ambition in 2030. These include the promotion of a circular economy, as well as recycling of resources; the use of carbon farming; adaptation measures against natural disturbances such as forest fires; the obligation to compensate for any artificialised land, especially in the construction sector; implementing the new EU targets for collection and recycling of organic waste and more composting; increasing R&D, for example for precision forestry and improving silviculture; financial incentives to use sustainable fertilisation and sustainable forest management; making forest management funding programmes more accessible; mainstreaming biodiversity; and using forest-based products to replace hydrocarbons. It was also raised that binding targets on biodiversity are needed. Some stakeholders also raised that the incentives for using forest biomass for bioenergy should be reduced, together with a reduction of biomass imports or the implementation of policies which prevent carbon leakage.

Comments which were aimed at how targets could be implemented include strict deforestation measures in the Common Agricultural Policy (CAP); policies which produce solutions with synergies e.g., combining renewable energy (RE) with food/feed/material production or biodiversity/peatland restoration; an EU common forestry policy; higher aid for forests; and the implementation of a carbon tax.

Regarding future monitoring approaches it was emphasised by a number of stakeholders to use existing MS expertise for monitoring as well as for example the European National Forest Inventory Network (ENFIN) and the national forest inventories as well as developing an EU forest information system. It was also raised that the EU needs to conduct more full life-cycle analyses for LULUCF sector products and focus more on material neutrality.

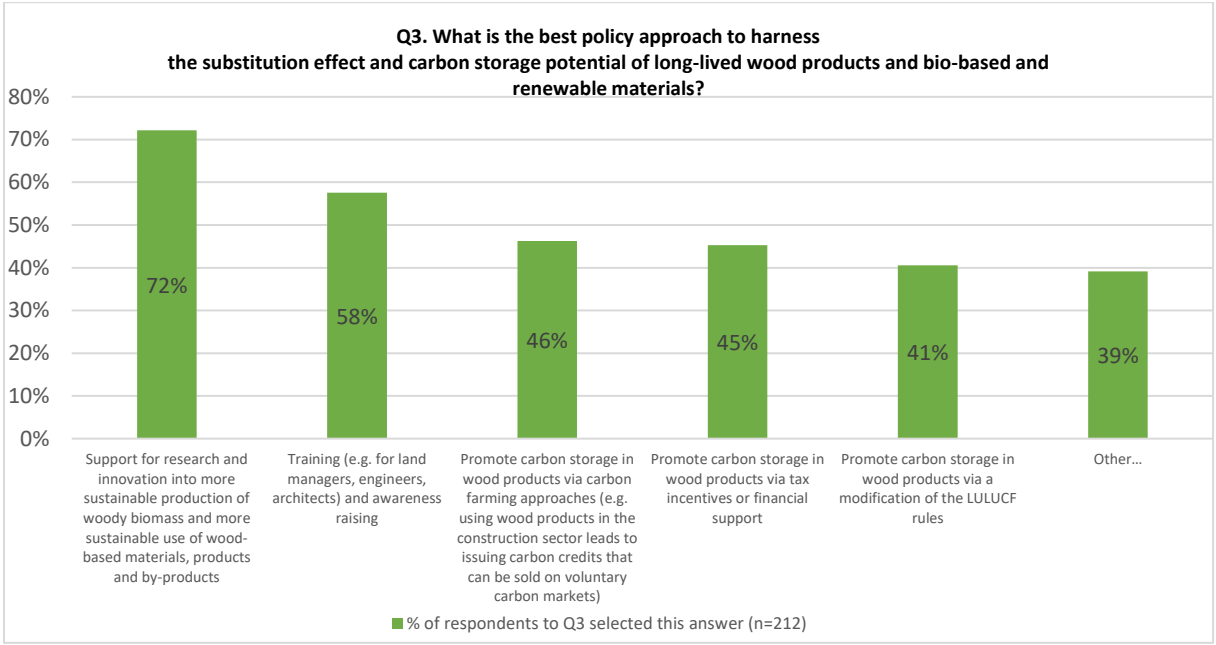


Figure 95: Q3. What is the best policy approach to harness the substitution effect and carbon storage potential of long-lived wood products and bio-based and renewable materials?

Stakeholders were asked about what they see as the best policy approach to harness the substitution effect of bio-based and renewable materials, and the carbon storage potential of long-lived wood products. 72% of respondents (153) believe that the EU should follow a policy approach that supports research and innovation into more sustainable production of woody biomass and more sustainable use of wood-based materials, products and by-products. 58% of respondents (122) support a policy approach focusing on training (e.g. for land managers, engineers, architects) and awareness raising. 46% of respondents (98) believe that a carbon farming approach would be an effective policy option to incentivise use of wood products in sectors such as construction. 45% respondents (96) selected the policy option seeking to promote carbon storage in wood products via tax incentives or financial support. 41% respondents (86) believe a modification of LULUCF rules would promote carbon storage in wood products. Finally, 39% respondents (83) expressed they would like to see other or additional policy approaches being pursued.

82 stakeholders provided other policy suggestions or comments on the incentivisation of bio-based materials and long-lived wood products. A large number of those respondents disagreed with the assumption made in the OPC questionnaire that the use of bio-based materials and use of long-lived wood products delivers climate benefits and believe these should not be incentivised further. Instead they called for a detailed life cycle analysis of the carbon storage and emissions of HWP. Taxes and fees on the use of fossil-based materials were also mentioned as a policy approach.

A variety of opinions were expressed by those respondents who agreed with incentivising long-lived wood products. The most frequently mentioned points was that a better way of incentivising the use of long-lived products would be to remove incentives to use wood as a short-lived product, such as for bioenergy. Respondents had different opinions on how to account for the substitution and storage effects of such products: some believe it should be counted towards the wood and forestry sector, others that carbon credits for the use of biomass or long-lived wood products should be allowed to be used in the Emissions Trading Scheme (ETS) and Effort Sharing Regulation (ESR) sectors. A number of stakeholders believe that fibre-based textiles should also be recognised in carbon accounting. Finally, some respondents believe that policies should incentivise a reduction of the overall use of raw materials and recycling of wood.

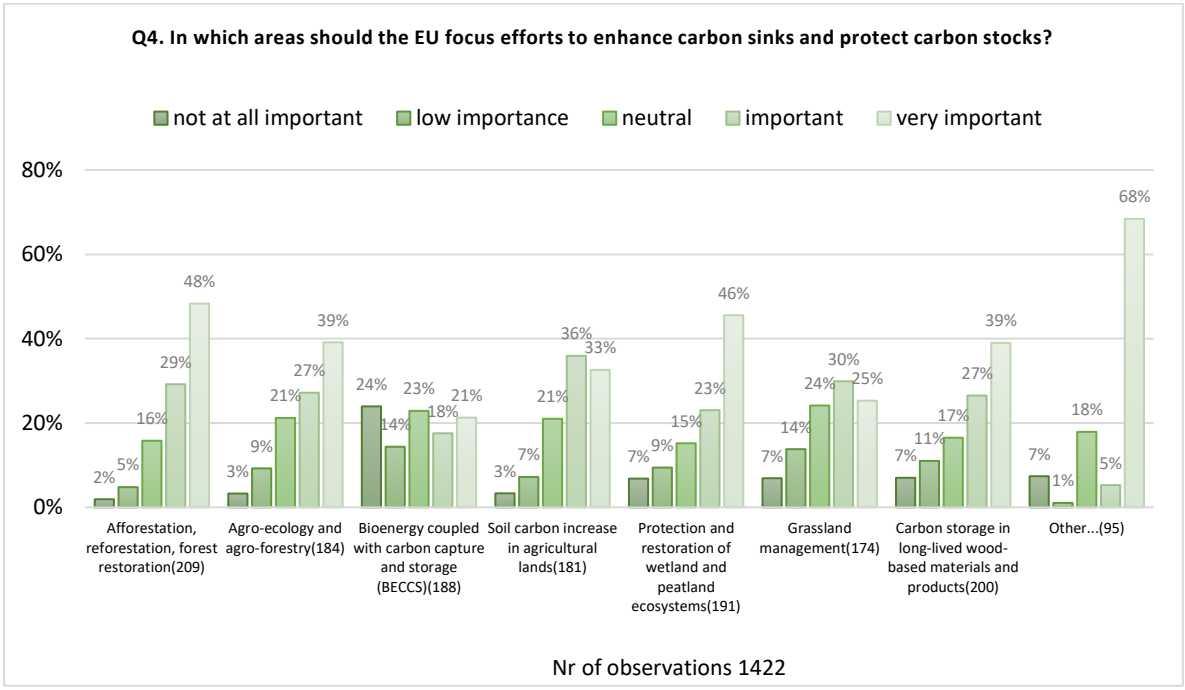


Figure 96: Q4. In which areas should the EU focus efforts to enhance carbon sinks and protect carbon stocks?

Stakeholders were asked to rate the most and least important measures to enhance carbon sinks and protect carbon stocks. The measure which most stakeholders see as important is Afforestation, reforestation and forest restoration (77% / 162 respondents see this as important or very important). The measures which were seen as the second most important are Soil carbon increase in agricultural land and Protection and restoration of wetland and peatland ecosystems which were both scored as important or very important by 69% / 124 respondents. Agro-ecology and agro-forestry and Carbon storage in long-lived wood-based materials and products were also both scored as important or very important by 66% / 122 respondents, followed by grassland management (55% / 96 respondents) and Bioenergy coupled with carbon capture and storage (BECCS) (39% / 73 respondents).

The area which was selected most often as not at all important or of low importance was Bioenergy coupled with carbon capture and storage (BECCS) (38% / 72 respondents).

93 stakeholders provided additional comments on where they believe the EU should focus efforts to enhance carbon sinks and protect carbon stocks. Comments regarding forests included a wish to see measures for the protection of forests with high carbon stocks (old-growth, primary, naturally structured) and implementing preventive forest management to protect forests against disturbances such as fires. Livestock grazing in forests was seen to reduce the risk of forest fires by some respondents from the Mediterranean area.

Healthy and biodiverse soils are seen as central to climate solutions as they control the long-term fluxes and flows of carbon in and out of soils. Respondents discussed ways to promote soil carbon increase in agricultural land, such as application of compost to soils to restore humus, as well as use of biodegradable products in agriculture. It was also said that any farming model could contribute to restoring soil carbon with the right practices and tools (cover crops, crop protection and breeding, no-till farming, fertilizer management, integration crop management, and precision agriculture), which could be incentivised also through the CAP. There were a number of comments disagreeing with organic farming as it requires larger areas of land to be dedicated to agriculture and is therefore not consistent with climate objectives.

Comments regarding carbon storage in long-lived wood products were polarised on two main positions, namely a disagreement with an increase of logging, and a strong support for incentives to active forest management and storing carbon in such products. Protection and restoration of peatlands was mentioned as a space efficient carbon sink and stock, together with paludiculture.

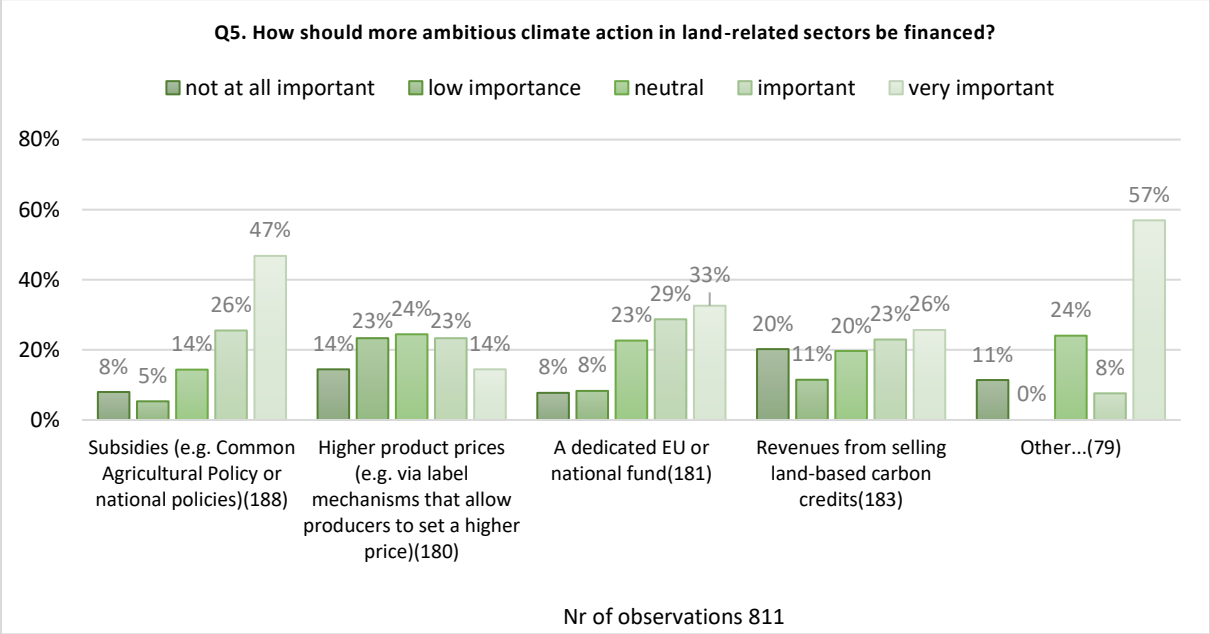


Figure 97: Q5. How should more ambitious climate action in land-related sectors be financed?

Stakeholders were asked to rank the importance of approaches to finance more ambitious climate action in land-related sectors. Financing climate action through subsidies and via a dedicated fund received strong support from stakeholders. 72% (136) of respondents selected subsidies to be an important or very important option, only 13% (25) disagreed that subsidies are of high or very high importance. A dedicated fund was seen by 61% (111) of stakeholders as important or very important, only 16% (29) of stakeholders did see this as not at all important or of low importance. The picture was less clear for using revenues from selling land-based carbon credits where 49% (89) found this important or very important but also 20% (37) found it not at all important and 11% (21) of low importance. The most opposing views were given on raising product prices to finance climate action in land-related sectors, 37% saw it as important or very important while also 38% (68) saw this option a not at all important or of low importance. This option also had the largest number of stakeholders remaining neutral (24%/44 respondents). The main comment stakeholders had on this option which also partially explains that there is no clear opinion is that low-income consumers would need to be protected from high prices instead of using a flat-tax style approach.

79 respondents selected the option “Other”, beside a more detailed explanations of their chosen options, stakeholders also provided a number of alternative financing solutions:

- Alternative modes of financing suggested included: Cross-financing from other sectors that are not taxed enough, a carbon tax on imports, financing by taxing financial markets (Robinhood tax), a European harmonized forest management taxation, building on existing CAP instruments, or the creation of a specific land-change tax which is levied when soil is artificialised.
- There were some opposing opinions regarding bioenergy. Some stakeholders suggested tax benefits for HWP/bioenergy, while others suggested to redirect existing subsidies currently going to increased bioenergy use (Renewable Energy Directive) and to intensive industrial agriculture (CAP) to allow a funding of ambitious climate action in the land sector.
- A point which was raised often was that any product price or consumer cost increase must avoid penalising citizens on low incomes and that the polluter should pay higher fees, alternatively also preferential taxation for sustainable land use products could be used. It was also raised that labelling sustainable products will make them more

expensive to meet labelling standards; this would make them less price competitive, which could lead to overall less sales than currently compared to unsustainable products.

- Many stakeholders strongly expressed their views against offsetting emissions via carbon credits to not lead to lower emission reductions in other sectors. This point is addressed in more detail in comments to other questions in this report. In the context of financing the LULUCF sector it was highlighted by a stakeholder that gaining revenues from selling carbon credits can disturb the wood markets and long-term positive development of forest resources and the bioeconomy.

15.4. Part II: Overall policy approach

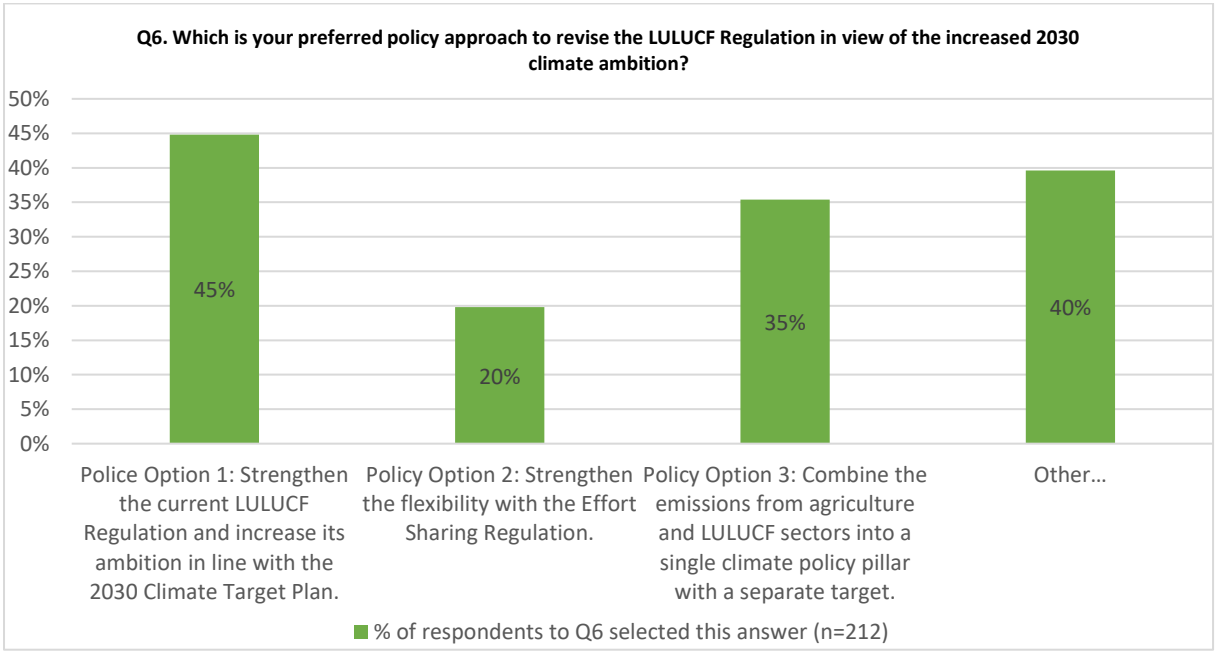


Figure 98: Q6. Which is your preferred policy approach to revise the LULUCF Regulation in view of the increased 2030 climate ambition?

212 stakeholders responded to the question on the preferred overall policy approach to revise the LULUCF regulation in view of the increased 2030 climate ambition. Stakeholders could select more than one option. **The most frequently selected** option was *Policy Option 1: **Strengthen the current LULUCF Regulation and increase its ambition in line with the 2030 Climate Target Plan,*** **45% (95)** of all respondents selected this option. **The second most frequently selected** option was *Policy Option 3: **Combine the emissions from agriculture and LULUCF sectors into a single climate policy pillar with a separate target,*** it was selected by **35% (75)** of stakeholders. **The least frequently selected** policy option was *Policy Option 2: **Strengthen the flexibility with the Effort Sharing Regulation*** which was only selected by **20% (42) of stakeholders.** 40% (84) of stakeholders provided another option or further explained their choices.

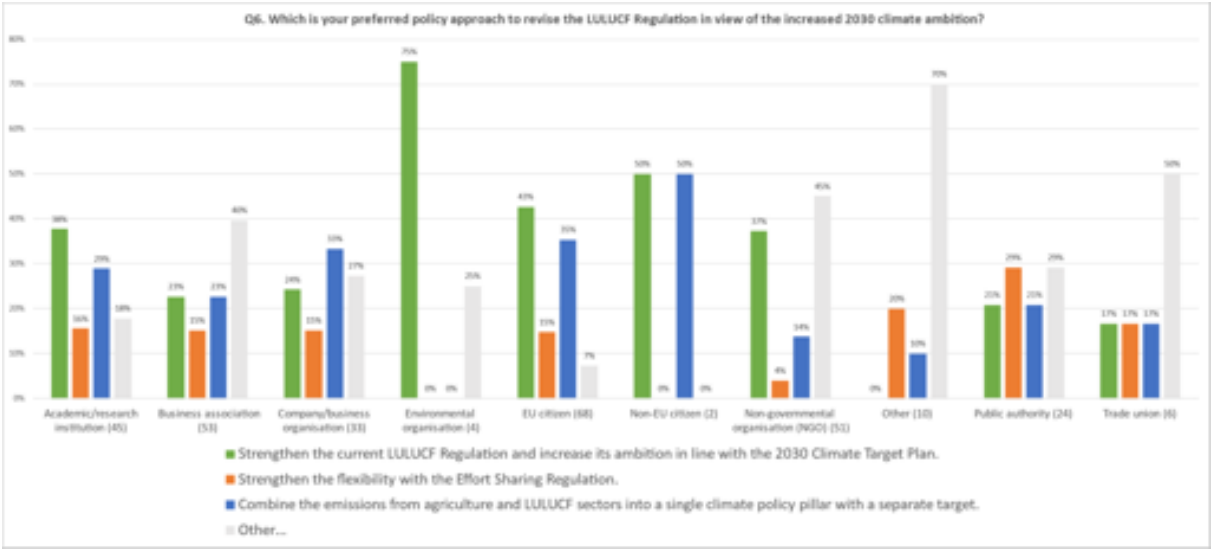


Figure 99: Q6. Which is your preferred policy approach to revise the LULUCF Regulation in view of the increased 2030 climate ambition? Breakdown by stakeholder

Policy Option 1: Strengthen the current LULUCF Regulation and increase its ambition in line with the 2030 Climate Target Plan was the most frequently selected policy option among Academic/research institutions, Environmental organisations, EU citizens, and NGOs. The two Non-EU citizens, Trade unions also had it as their most frequently selected option, shared with other options. This policy option was also the second most selected option for the private sector and shares the second most frequent selection with Policy Option 3 for Public authorities. No stakeholder group beside the Other stakeholder group had Policy Option 1 as their third most frequent choice.

Comments on this policy option overlapped strongly with the comments on other questions in this OPC. Most comments focussed on whether or not a target should be introduced for the LULUCF sector and some stakeholders were concerned that a LULUCF sector wide target would put an unequal burden on its subsectors. One stakeholder raised that the LULUCF sector should have a climate target separate from the EU's economy wide GHG reduction target which is not merged into a net-reduction target. Another raised that the inclusion of waste management and waste-to-energy plants into the LULUCF sector should be considered when the ESR comes to an end. It was also mentioned that Policy option 1 needs more clarity in the upcoming impact assessment. Respondents also mentioned that changes to the LULUCF regulations must align with the upcoming EU nature restoration target, the Biodiversity strategy 2030, and the implementation of having 30% protected land by 2030. A number of stakeholders also emphasised to separate the sectors more carefully due to the different carbon sequestration potential of the different LULUCF sub-sectors. Overall, also in comments to other questions, there was little consensus whether this problem should be addressed at the MS or EU level, but it was said it is important to use the expertise both at MS level (national monitoring data) and tools at EU level (e.g., Copernicus). A stakeholder further stated that policy changes related to LULUCF should be coordinated even higher at a global level in the UNFCCC and not through standalone action by the EU.

Policy Option 2: Strengthen the flexibility with the Effort Sharing Regulation was the most frequently selected option by Public authorities, the Other group, as well as for the small sample of trade unions in which all policy options were selected once. Policy option 2 was not the second most frequent choice for any stakeholder group. Out of all three policy options, option 2 was the least frequently selected option for the majority of stakeholders, which includes Academic/research institutions, the Private sector, Environmental organisations, EU citizens, Non-EU citizens, and NGOs.

The policy option to strengthen the flexibility with the ESR received the strongest opposition in the open text response out of all policy options. While some stakeholders wrote supportive statements, a majority of the text-based responses were critical. Many stakeholders wanted to fully remove any flexibility with the ESR and have a separate LULUCF target. One stakeholder mentioned that non-CO2 agricultural emissions should remain in the ESR. The most often named reason why stakeholders opposed this option was that it would lead to inaction in the ESR sectors by enabling offsetting. Other reasons included that the emitting sectors still need to lower emissions; the effect of agricultural emissions decrease on the enhancement of natural sinks; the risk that the flexibility would cause a zero-sum game; the permanence risk of sinks; and the uncertainty in current sink MRV.

It was also mentioned that instead, or in addition to flexibility with the ESR, LULUCF could be merged with the ETS to sell CO2 credits stored in wood products on the ETS market. However, other stakeholders completely opposed this in their feedback since it would further delay a circular bioeconomy and because it would overall enable replacing reductions in fossil fuel-based emissions with sinks which would harm the integrity of the ETS.

Policy Option 3: Combine the emissions from agriculture and LULUCF sectors into a single climate policy pillar with a separate target was the most frequently selected option by the private sector as well as for the small sample of trade unions in which all policy options were selected once. It was the second most frequently selected option by Academic/research institutions, EU citizens, NGOs, Others, and Public authorities. Only environmental organisation had this option as their least frequently selected option, none out of the four environmental organisations which responded selected this option.

Stakeholders provided further comments on Policy Option 3 i.e., a potential Agriculture, Forestry and Other Land Use (AFOLU) sector. Comments included the need for separate targets for the LULUCF and agricultural sector and that the combination should not lead to a reduction of ambition in the agricultural sector. One stakeholder also made the point that if an AFOLU sector is created, this should happen at a much later stage, once sufficient efforts have been made to reduce agricultural emissions, with the presence of a 'negative cap' to maintain ambition, as opposed to simply financing removals by land sinks. Respondents also asked for a thorough impact assessment on this option. A stakeholder also suggested that the non-energy-related emissions from agriculture with the LULUCF sector should be complemented with the non-energy-related emissions of the waste treatment sector – in particular with respect to biogas production from biowaste and wastewater treatment.

Stakeholders which were critical about combining the sectors raised a number of critical points including that a new AFOLU sector risks undermining emission reductions in the agricultural sector and that for example forests cannot be equated with agricultural commodities.

15.5. Part III: Setting more ambitious rules for the Land Use, Land Use Change and Forestry sector

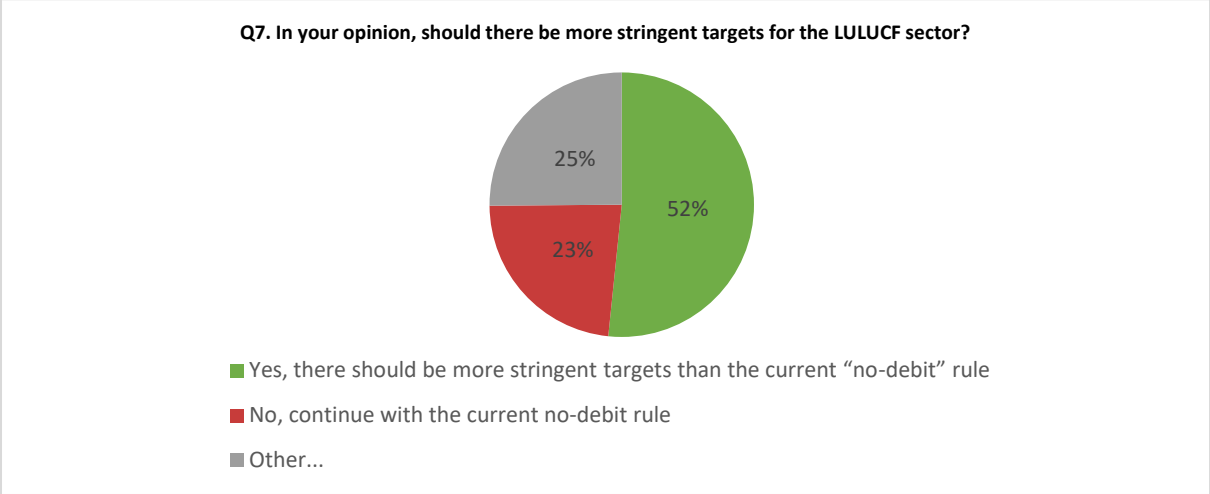


Figure 100: Q7. In your opinion, should there be more stringent targets for the LULUCF sector?

215 stakeholders provided an answer to whether there should be more stringent targets with a large majority (52%) preferring more stringent targets than the current “no-debit” rule. 23% of stakeholders oppose more stringent targets and would like to continue with the current no-debit rule. 25% would prefer a totally different option.

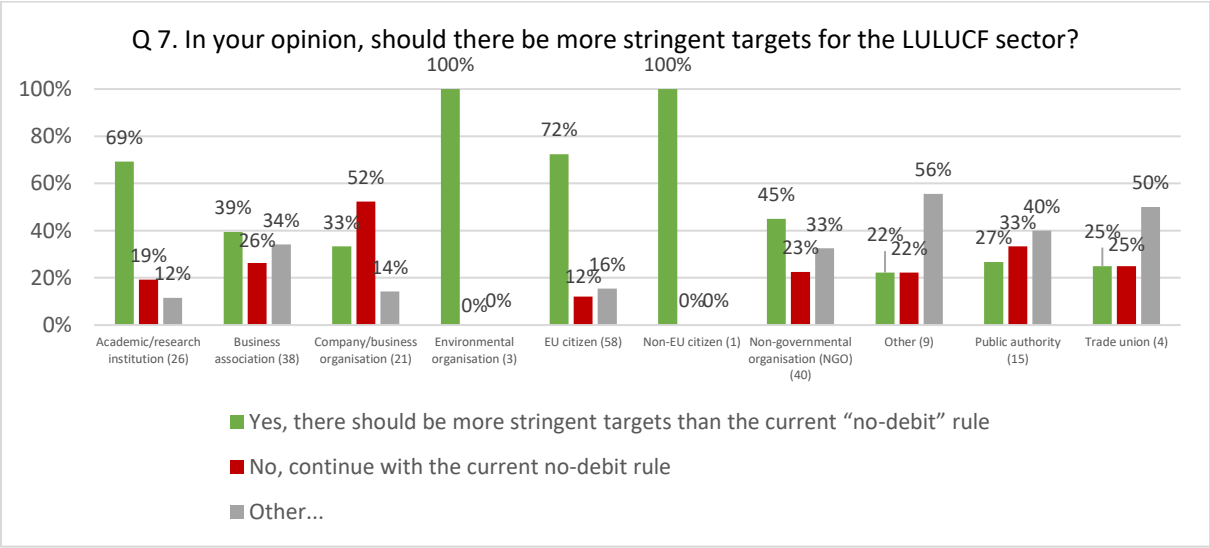


Figure 101: Q 7. In your opinion, should there be more stringent targets for the LULUCF sector? - per stakeholder

More stringent targets are strongly supported by Academic/research institutions (69%), Environmental organisations (100%/out of only 3 respondents), EU citizens (72%), and NGOs (45%). The private sector (Business associations and Company/business organisations) is split with 33% (22) supporting more stringent targets and 31% (21) opposing more stringent targets. Company/business organisations respondents disagree more frequently with more stringent targets compared to Business associations. Out of the 15 public authorities most (40%) support another option while 33% want to continue with the current no-debit rule and 27% want more stringent targets than the current no-debit rule.

A quarter of respondents chose to not select the options of either having more stringent targets or continuing with the no-debit rule. Those 25% who selected the “other” option mainly used it to comment on the question but most of these still either agreed or disagred with the question. In addition, there were general comments on the question. Comments primarily focussed on how the targets should be set and that whether or not a more stringent target should be used

will also depend on what accounting rules will be used to measure progress against a new target target.

Those who agree with more stringent targets also raised the following points: that more stringent targets need to include safeguarding of ecosystems functions and biodiversity; that more stringent targets would need to be part of an EU-wide approach and include climate adaptation and environmental objectives; that carbon certificates for sequestrated carbon in long-lived wood products should count against targets; that targets should be consistent with the Paris Agreement.

Those who disagree with more stringent targets raised a number of points including: that the no-debit rule can in reality make the sink decline; that there is a need to focus on incentives for farmers and foresters instead of disincentives, since more stringent targets would disincentivize using forestry for substitution of fossil materials and fossil fuels; and that the EU's approach should be to work towards 2050 goals instead of 2030 and not sacrifice long-term goals for short-term gains in the LULUCF sector. Some stakeholders also criticised that targets are based on the Forest Reference Levels (FRL) and that they are set at national levels with methodological baselines which differ among MS.

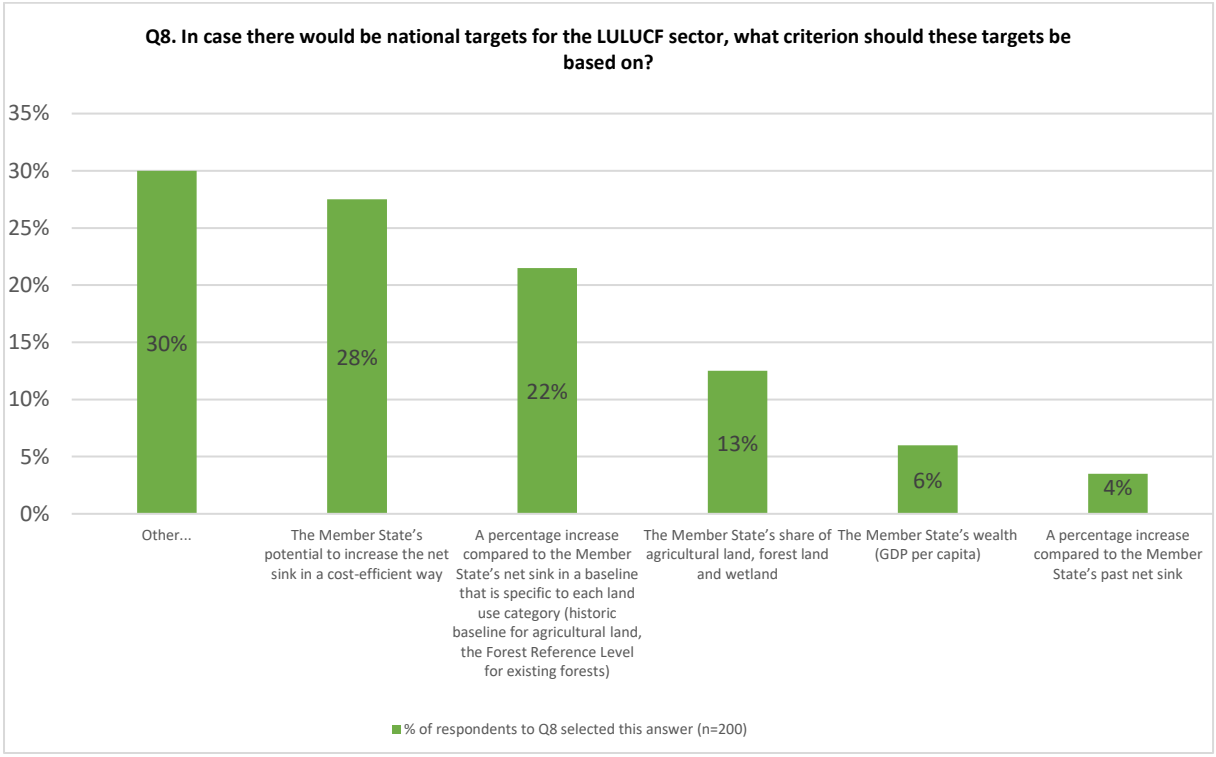


Figure 102: Q8. In case there would be national targets for the LULUCF sector, what criterion should these targets be based on?

**2 stakeholder who submitted by email provided more than one response for this question*

When asked about what criterion should national LULUCF targets be based on, about a third of respondents (30% / 60) selected the option "other" and provided a different view or agreed with the criteria outlined but added comments, as explained below. Another large proportion of respondents (28% / 55 respondents) indicated that national targets for the LULUCF sector should be based on the MS' potential to increase the net sink in a cost-efficient way. The second preferred criterion for setting national targets (of those presented in the OPC) was a percentage increase compared to the MS' net sink in a baseline that is specific to each land use category (22% / 43 respondents). This was followed by a criterion based on the MS' share of agricultural land, forest land and wetland (13% / 25 respondents), the MS' wealth, based on

GDP per capita (6% / 12 respondents), and a percentage increase compared to the MS' past net sink (4% / 7 respondents).

58 stakeholders provided additional feedback on the preferred criteria for setting national LULUCF targets. A large number of respondents from a variety of sectors expressed that LULUCF targets should be based on the MS' share of overall EU GHG emissions, for example through a requirement to create a net carbon sink amounting to a percentage of their emissions by 2030. Another significant number of respondents said that they would like to see a combination of the criteria described.

There were some comments on the need to decide targets collaboratively with the MS and one comment expressing that a percentage increase based on a baseline is unfair, because it penalises countries which have already taken measures to increase their sink in the past. Another respondent disagreed with using historical baselines as they are not representative of the potential of a MS to increase the sink, but only of actions carried out so far.

The state of biodiversity loss and the ecological potential to increase the sink were also mentioned as criteria which should be considered for setting LULUCF targets, including metrics for ecosystem restoration, for ex. soil health, water quality and retention, reduction in pollutants, biodiversity restoration and climate resilience.

Finally, there was a comment offering an alternative option where the EU would additionally allow for country pledges that go beyond a minimum EU average benchmark, based on the historic sink.

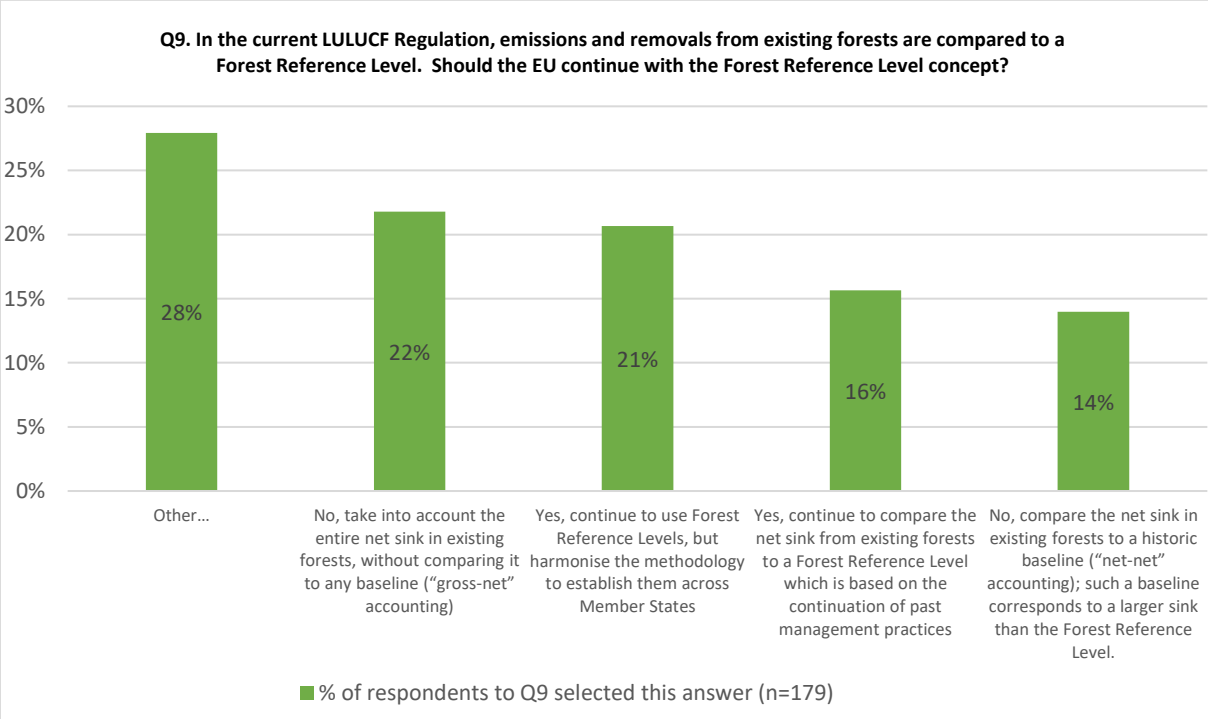


Figure 103: Q9. In the current LULUCF Regulation, emissions and removals from existing forests are compared to a Forest Reference Level. Should the EU continue with the Forest Reference Level concept?

For the question of whether the EU should continue with the Forest Refence Level (FRL) concept, about a third of respondents (28% / 50) selected the option "other" and provided a different view or agreed with the options outlined but added comments, as explained below. Another **22% / 39 respondents** believe that the EU should **discontinue the FRL approach and instead take into account the entire net sink in existing forests, without comparing it to any baseline (gross-net accounting)**. Another **21% / 37 respondents** believe that the EU should **continue to use the FRL concept, but harmonise the methodology across MS**.

16% / 28 respondents also believe the EU should **continue to compare the net sink from existing forests to an FRL which is based on the continuation of past management practices**. Finally, **14% / 25 respondents** believe **the FRL approach should be discontinued in favour of comparing the net sink in existing forests to a historic baseline (net-net accounting).**

49 comments were provided by those respondents who selected the option "other". Of these, a large number expressed agreement with a net accounting of sinks compared to a historic baseline as this approach would be the most coherent with actions in other sectors and the 2050 carbon neutrality target. Two specific suggestions were made as to what the baseline should be: a baseline when the country's ecological footprint was in equilibrium with its biocapacity; and the year 2005.

Some respondents would favour a gross-net accounting method combined with a national no-debit target. A smaller proportion of respondents suggested that accounting should include the substitution effect and be based on future sustainable forest yields rather than on historical harvesting intensity. One stakeholder suggested following the example of the Swedish SKA15 methodology; such calculation does not include protected areas where harvest is not allowed.

It was also suggested that the EU should consider the concept of "reference level with band", where only emissions or removals exceeding the band are accounted for.

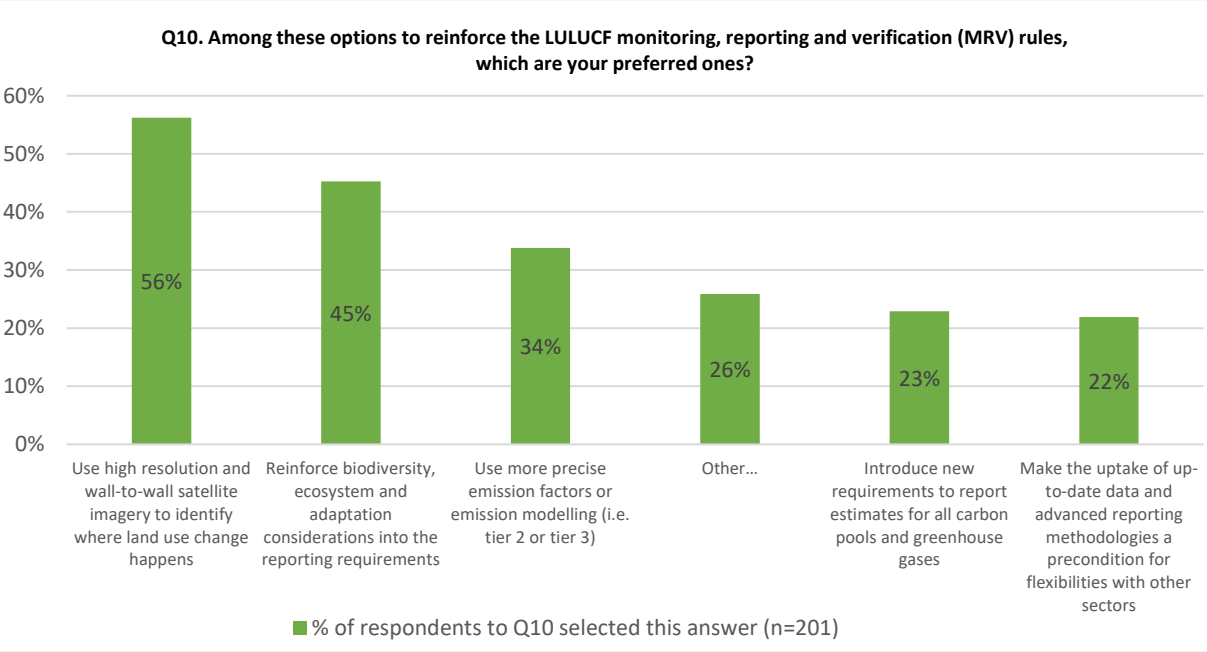


Figure 104: Q10. Among these options to reinforce the LULUCF monitoring, reporting and verification (MRV) rules, which are your preferred ones?

Stakeholders were asked about their preferred options to reinforce the LULUCF monitoring, reporting and verification (MRV) rules. A majority of respondents (**56% / 113 respondents**) supports the use of **high resolution and wall-to-wall satellite imagery** to identify where land use change happens. The second preferred option is to **reinforce biodiversity, ecosystem and adaptation considerations into the reporting requirements** (**45% / 91 respondents**), followed by the **use of more precise emission factors or emission modelling** (**34% / 68 respondents**), the introduction of **new requirements to report estimates for all carbon pools and greenhouse gases** (**23% / 46 respondents**) and finally, to make the **uptake of up-to-date data and advanced reporting** methodologies **a precondition for flexibilities** with other sectors (**22% / 44 respondents**).

50 stakeholders provided comments, or a different view on options to strengthen the MRV rules. Many comments were provided on the use of remote sensing satellite imagery, which generally is supported as an MRV methodology but only in combination with verification by land-based methods, since remote sensing is not seen as precise or developed enough to be used on its own. One stakeholder from an academic/research institution expressed that a combination of ground truthing with remote sensing by model assisted approaches would be an optimal approach and, by collapsing data into one land use category, the uncertainty would be less than 2% (change in living biomass), if based on permanent sample plots from a National Forest Inventory.

Verification uniquely by land-based methods was also expressed as a preferred option to monitor changes in forests and soils. This should be carried out by national experts for National Forest Inventories and through established sampling procedures, for example by measuring forest biomass in situ to determine the quantity of carbon stored.

Other stakeholders expressed the following points of feedback regarding the options suggested in the OPC: that Horizon Europe needs to support research on the IPCCC methodology development to ensure better data quality in the national inventory reports; that more precise emission factors and emission modelling would provide clear standards across MS; that accounting of all six land use categories[66] should be mandatory, and include also marine coastal ecosystems like saltmarshes and seagrass meadows.

One respondent suggested that the default half-life values in Annex V in the LULUCF regulation should be revised as they do not reflect realistic half-life values. It was also said that the EU should seek to spread best practices from existing MRV systems in MS.

Finally, one stakeholder expressed the concern that in the arable land sector the cost of data collection is high and there is not enough available data on carbon sequestration triggered by any new agricultural practice.

15.6. Part IV: Links between land use and agriculture

[66] A: Forest Land, B: Cropland, C: Grassland, D: Wetlands, E: Settlements and F: Other (IPCC, 2006: Guidelines for National Greenhouse Gas Inventories).

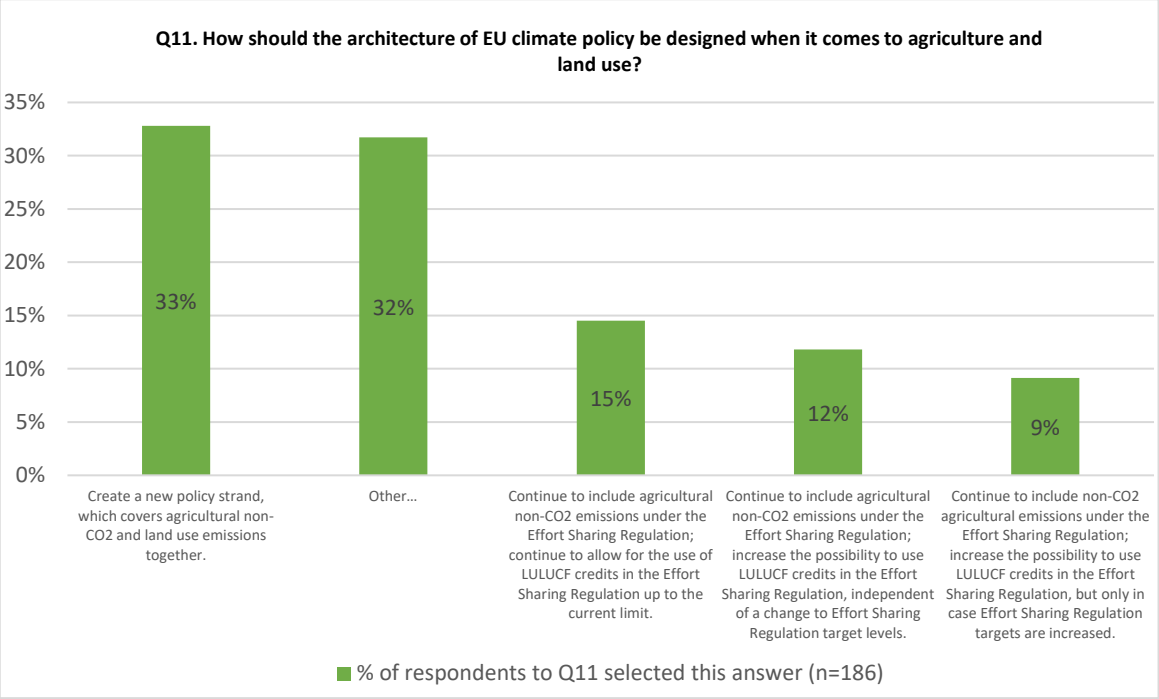


Figure 105: Q11. How should the architecture of EU climate policy be designed when it comes to agriculture and land use?

Stakeholders were asked how they believe EU climate policy for agriculture and land use should be designed. About a third of respondents (33% / 61 respondents) believe the EU should create a new policy strand which covers agricultural non-CO2 emissions and land use emissions together. Another third of respondents selected the option “other” and provided a different view or agreed with the options outlined but added comments, as explained below. 15% / 27 respondents believe that agricultural non-CO2 emissions should continue to be included under the Effort Sharing Regulation (ESR) and LULUCF credits allowed in the ESR up to the current limit. Another 12% / 22 respondents believe that agricultural non-CO2 emissions should continue to be included under the Effort Sharing Regulation (ESR) and the possibility to use LULUCF credits should be increased regardless of a change in ESR target levels. Finally, 9% / 17 respondents believe that agricultural non-CO2 emissions should continue to be included under the Effort Sharing Regulation (ESR) and the possibility to use LULUCF credits should be increased, only if ESR targets are increased.

59 stakeholders provided additional comments on the design of an EU climate architecture for agriculture and land use. The feedback shows a spectrum of opinions ranging from not allowing flexibility from LULUCF with any other sector, to a desire to see LULUCF credits used towards ETS emissions too. A large number of respondents disagreed with the idea of flexibility between the LULUCF sector and other sectors, including agriculture and other land use, as well as ESR. This was seen as the best option to maintain transparency around emissions in each sector and to not compromise ambition in those sectors.

Many respondents would like to see a separate emissions reduction target for the agricultural sector for CO2 emissions and other emissions (including non-CO2) caused by livestock farming, fertilisation and soil-based emissions, while keeping the forest sink separate. These stakeholders expressed disagreement with the idea of an AFOLU sector because it would lead to considering non-CO2 emissions from agriculture under the same climate policy pillar. The idea that the forestry sector should stay separate was expressed quite strongly.

A number of stakeholders agreed with the idea of an AFOLU pillar offering flexibility to the agricultural sector, which is seen as a sector where possibilities to cut emissions are low. Two respondents were in favour of an AFOLU pillar with payments for ecosystem services to

agricultural and forest producers protecting and restoring natural sinks including peatlands, grasslands and using agroecology.

Another number of stakeholders expressed they would like to see increased flexibility to use LULUCF credits also with the ETS sector, as well as increasing the flexibility with ESR, particularly for those industries where emissions are going to be hard to abate in the future. Fewer stakeholders, among those providing comments, would like to see a continuation of the current approach, where non-CO2 emissions are considered under the ESR and LULUCF credits are allowed under ESR, with one respondent expressing this should be done regardless of the change in target.

Other comments were made by stakeholders who did not have a strong opinion on the design of a climate policy architecture for agriculture and other land emissions, but who wished to express a specific point. Two respondents said that the chosen policy should account for differences in regions and landscapes as highlighted by territorial policy, but also increase harmonisation across sectors and Member States. Another respondent added that, in order to estimate total sequestration and emissions from terrestrial ecosystems, carbon balance from all ecosystems must be estimated, not just forests. This includes all green biomass, also grasslands and shrublands which store carbon below ground.

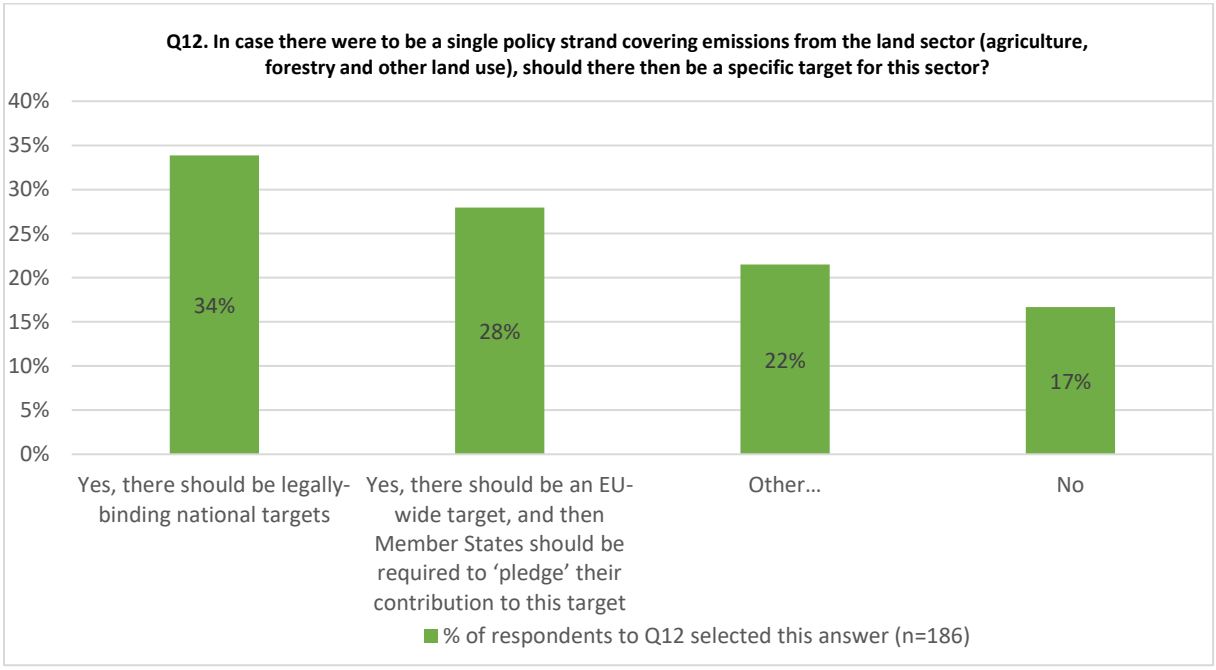


Figure 106: Q12. In case there were to be a single policy strand covering emissions from the land sector (agriculture, forestry and other land use), should there then be a specific target for this sector?

Stakeholders were asked about their views on the need for target, if the EU created a single policy strand covering emissions from the land sector (agriculture, forestry and other land use). As shown in

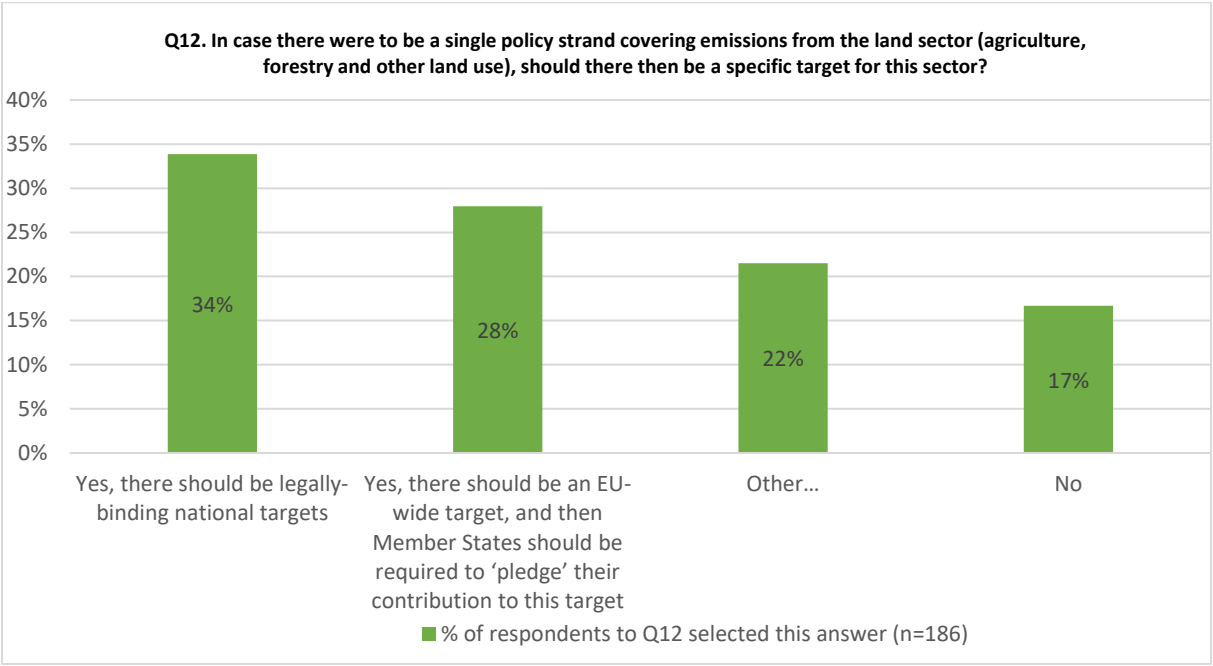


Figure 106 more than a third of respondents (34% / 63 respondents) agree with setting legally binding national targets. Another third (28% / 52 respondents) believe there should be an EU-wide target to which Member States should be required to pledge their contributions. 22% / 40 respondents selected the option "other" and provided a different view or agreed with one the options outlined but added comments, as explained below. 17% / 31 respondents believe there should be no targets for the land sector.

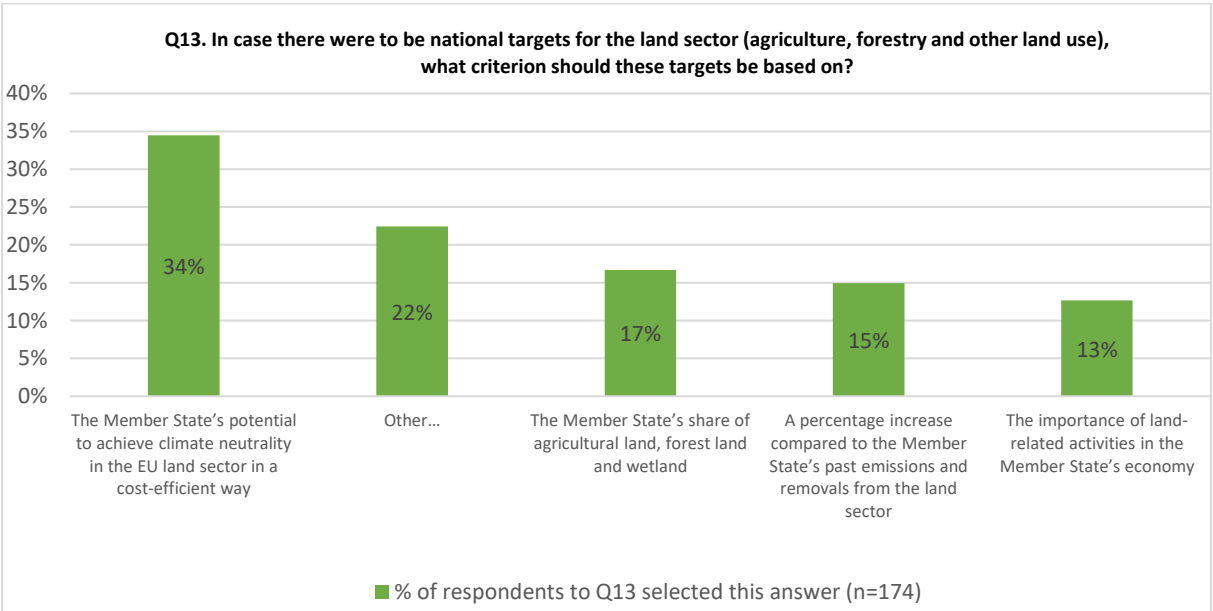


Figure 107 - Q13. In case there were to be national targets for the land sector (agriculture, forestry and other land use), what criterion should these targets be based on?

**1 stakeholder who submitted by email provided more than one response for this question*

As shown by the responses to question 12 a majority of respondents is in favour of a specific target for the land sector, including agriculture, forestry and other land use (62% / 115 respondents). Stakeholders were further asked what criterion a potential national target for the land sector should be based on. As shown in

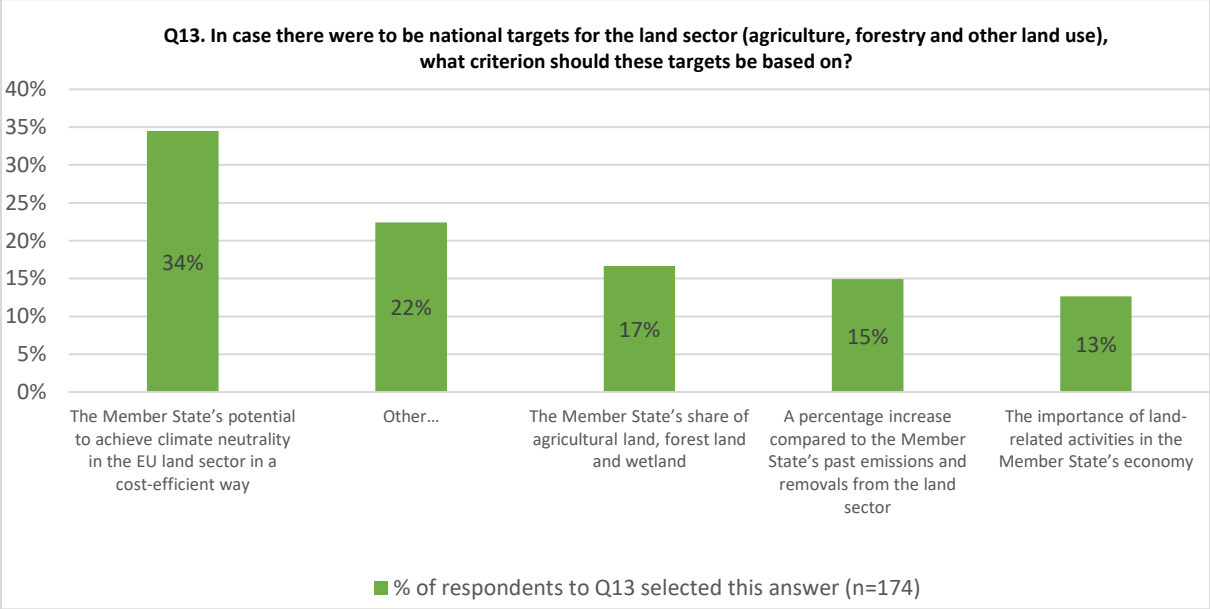


Figure 107 more than a third of respondents (34% / 60 respondents) believe the criterion for a target should be the Member State's potential to achieve climate neutrality in the EU land sector in a cost-efficient way. 22% / 39 respondents selected the option "other" and provided a different view or agreed with one the options outlined but added comments, as explained below. The second most popular criterion (of the ones outlined in the OPC) was the MS' share of agricultural land, forest land and wetland (17 % / 29 respondents). This was followed by a percentage increase compared to the MS' past emissions and removals from the land sector (15% / 26 respondents), and the importance of land-related activities in the MS' economy (13% / 22 respondents).

The open text answers given by respondents for the questions 12 & 13 which focus on the AFOLU sector often overlapped with the open text answers given for question 6 on the best policy approach. Stakeholders often mentioned that a new sector should be subject to separate or no overarching targets and that there should be no flexibility (i.e. offsetting) between it and other sectors. The majority of responses were in support of having a separate LULUCF target but not an AFOLU target. Furthermore, the subsectors in an AFOLU sector should still have their own respective targets for which MS would need to pledge their contributions. One stakeholder also suggested that while the base should be national targets, there should be an opportunity for member states to "pool" their contributions.

One stakeholder expressed that, if an AFOLU target were to be created, it would have to take into account the specific territorial challenges that impact food production in each country to prevent the reduction of agricultural land. As for the responses to question 6, stakeholders asked for an impact assessment assessing the potential effects of the creation of an AFOLU sector. Many stakeholders expressed they would prefer a combination of criteria for setting the targets. A concern was raised regarding the criterion of the potential to increase the net sink of a MS in a cost-efficient way, because of the challenge of estimating this in a consistent way across MS to produce comparable numbers. It was said that more transparency could be achieved by using the criterion of a percentage increase compared to the Member State's net sink in a baseline specific to each land use category, since such an approach could build on publicly available and reviewed reporting data on historic emissions and removals.

16. Synthesis Report on Article 10 Reports

Abstract

This synthesis report covers the analysis of the final submission of EU Member States' (MS) reports covering the period 1st January 2013 to 31st December 2020 based on the requirements laid out in Article 10 of the Land use, land use change, and forestry (LULUCF) Decision 529/2013. These reports describe national policies and measures (PaMs) in the LULUCF sector. Summarising the reports involved the development of a set of parameters such that the content of the reports could be cross-compared. MS take a wide variety of policies and actions in the LULUCF sectors (forestry, agriculture, and wetlands), and conclusions can be drawn from these reports to grasp how the sector can be improved. The state of the EU LULUCF sector is one where the net removals from the land sector are decreasing slowly due to a variety of factors. The report herein covers 398 different PaMs presented by the MS. 24 reports were evaluated as the UK is no longer in the EU and Germany, Portugal and the Czech Republic have not yet provided their submissions. Much of the content within this synthesis report can also be connected and compared to the previous analysis of the mid-term Art. 10 reports conducted in 2017.

Abbreviations

AECM	Agri-Environmental Climate Measures
CAP	Common Agricultural Policy
CEE	Central and Eastern Europe
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
FRL	Forest Reference Levels
GAEC	Good Agricultural and Environmental Conditions
GHGI	Greenhouse Gas Inventory
GVA	Gross Value Added
HWP	Harvested Wood Products
LPIS	Land Parcel Identification Systems
LULUCF	Land use, land use change, and forestry
MRV	Measurement, Reporting and Verification
MS	Member State
NECP	National Energy and Climate Plans
PaMs	Policies and measures
RDP	Rural Development Programme
SOC	Soil organic carbon

EU COUNTRY CODES	AUSTRIA (AT) BELGIUM (BE) BULGARIA (BG) CYPRUS (CY) CZECH REPUBLIC (CZ) GERMANY (DE) DENMARK (DK) ESTONIA (EE) GREECE (EL) SPAIN (ES) FINLAND (FI) FRANCE (FR) CROATIA (HR) HUNGARY (HU) IRELAND (IE) ITALY (IT) LITHUANIA (LT) LUXEMBOURG (LU) LATVIA (LV) MALTA (MT) NETHERLANDS (NL) POLAND (PL) PORTUGAL (PT) ROMANIA (RO) SWEDEN (SE) SLOVENIA (SI) SLOVAKIA (SK)

16.1. Introduction

Under the European Green Deal's new 2030 EU Climate target plan, the European Union set a goal to reach a 55% greenhouse gas reduction by 2030 compared to 1990 levels and, even more ambitiously, reach climate neutrality by 2050. A key player in these targets is the land sector and its ability to remove carbon from the atmosphere and counterbalance emissions from, e.g. industrial sources. The emissions from forestry, agriculture, grasslands, grazing lands and wetlands are regulated under the Land use, land use change and forestry (LULUCF) Regulation. Under the most recent impact assessment of the 2050 climate neutrality plan concluded in Spring 2020, the current policy framework is insufficient, and several climate policies will be subject to revisions. Among these is the LULUCF Regulation.

Due to its role as a net sink in the EU, the LULUCF sector must be carefully examined and regulated in order to achieve its full potential. The treatment of the land sector in general should be done with a certain amount of sensitivity as it also has a function of producing material biomass and agricultural products. Not to mention, the sector also provides numerous ecosystem services such as protection of biodiversity, temperature regulation, as well as nutrient and water management. While the sector has been a net sink in the EU, with forestland doing a majority of the removals, the sink has slowly been decreasing. Based on projections towards 2050, as stipulated under the European Green Deal, the sink will only experience a slight decrease followed by an increase until emissions from transport, power, industry, residential sources, etc. will be balanced by the removals from land use and forests (alongside carbon removal technologies).

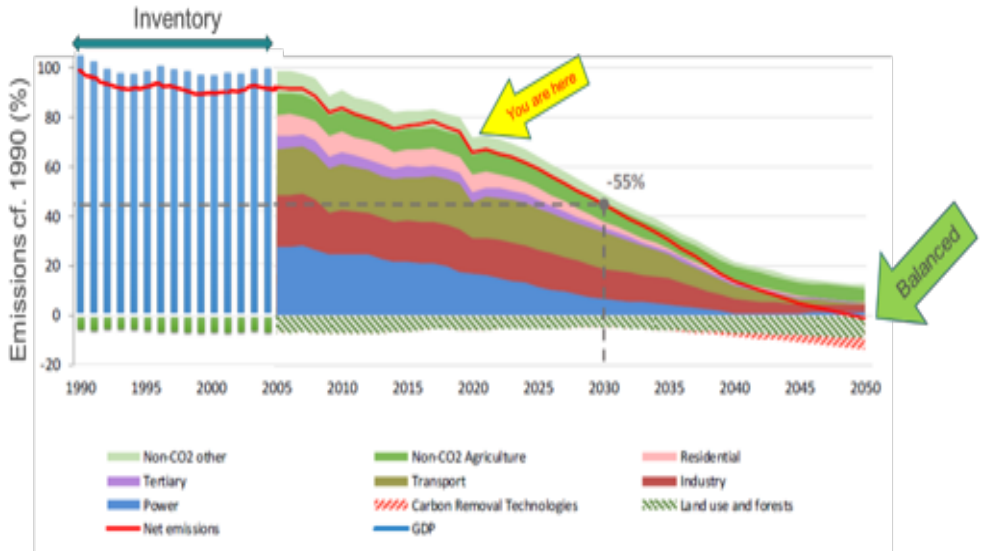


Figure 108: Pathway to climate neutrality. Source: European Commission, 2020[67].

A comprehensive synopsis of the state of the LULUCF sector and the actions that are currently in place to improve the land sector sink can help to boost the sector's mitigation capacity and pave the way to 2050. This synthesis report provides an overview of the national policies and measures in place within the EU MS. The overview is based on final reports submitted by the

[67] European Commission, (2020). Commission Staff Working Document Impact Assessment. *Stepping up Europe's 2030 climate ambition investing in a climate-netureal future for the benefit of our people*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176

MS, within the LULUCF Decision[68] (Decision no. 529/2013). The decision set reporting obligations for MS. Article 10 of the Decision requires MS to submit three reports covering the information on their current and future LULUCF actions to limit or reduce emissions and maintain or increase removals resulting from the LULUCF activities such as afforestation, deforestation, forest management, cropland and grassland management, and wetlands management. More information on this Decision can be found in Appendix A of this report.

16.2. Background

The aim of this report is to provide a qualitative summary of the MS reports submitted to the European Commission based on Article 10 of Decision 529/2013. The methodology used to produce this report can be found in Appendix B. The Art. 10 reports cover the accounting period of 1 January 2013 to 31 December 2020 and include information on emission estimates and removals for the accounting period, an analysis of potential to limit or reduce emissions, as well as a description of measures and policies that are in place or under implementation. This synthesis report provides a systematic summary of the reports. It is important to note that due to Brexit, the United Kingdom did not submit the report to the Commission and the Czech Republic, Germany and Portugal did not submit reports in time for the writing of this report. Therefore 24 reports were analysed.

The nature of these reports is such that while the subsections required by the Commission are the same, the content within the subsections are not homogenous. The length of the reports and content within varies so in certain parameters, the MS are not comparable. Yet, this report will attempt to present standout cases and a broad overview of the reports and the state of the LULUCF sector in the EU.

The basis for the synthesis report is the policies and measures (PaMs) that are presented by the MS in the Art. 10 reports. PaMs are not strictly defined as each MS presents its national actions in a different manner. In some cases, MS have referred to their legal requirements and regulations (e.g. Forest Codes or Acts) as a PaM through which standards are set for the LULUCF sectors. In other cases, a PaM is simply an action or measure that is embedded within a larger programme or initiative. Under this study a PaM is to be understood as any relevant, currently implemented action that is presented by the MS while taking into consideration the different definitions of PaMs across the MS.

Due to the fact that three member states did not submit their reports to the European Commission, it was agreed that for the purpose of this study and maintaining the coherence of the report, data from the mid-term evaluation report would be used to extrapolate the information for the countries that did not submit their final Art. 10 report.

16.3. Overview of the LULUCF Policies and Measures in the EU Member States

[68] Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities

Within the MS reports, the PaMs have varying degrees of detail and specificity. The difference in granularity within the report means that the data presented herein should be interpreted with some level of trepidation. For example, in some cases the measures within the Rural Development Programmes (RDP) are listed out separately by the MS, while in other cases, RDP as such is an overarching measure in forestry or agriculture. To this point, 398 PaMs were reported. Following the methodology of the previous study, the PaMs per MS per intervention are shown in the graph below.

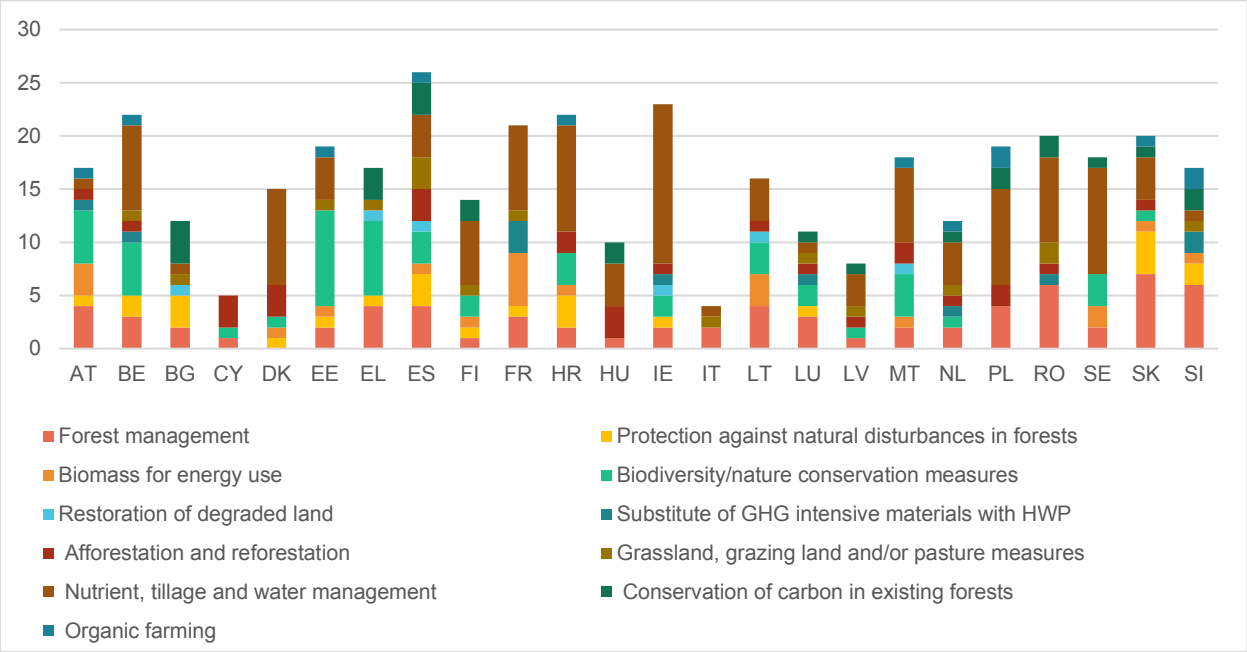
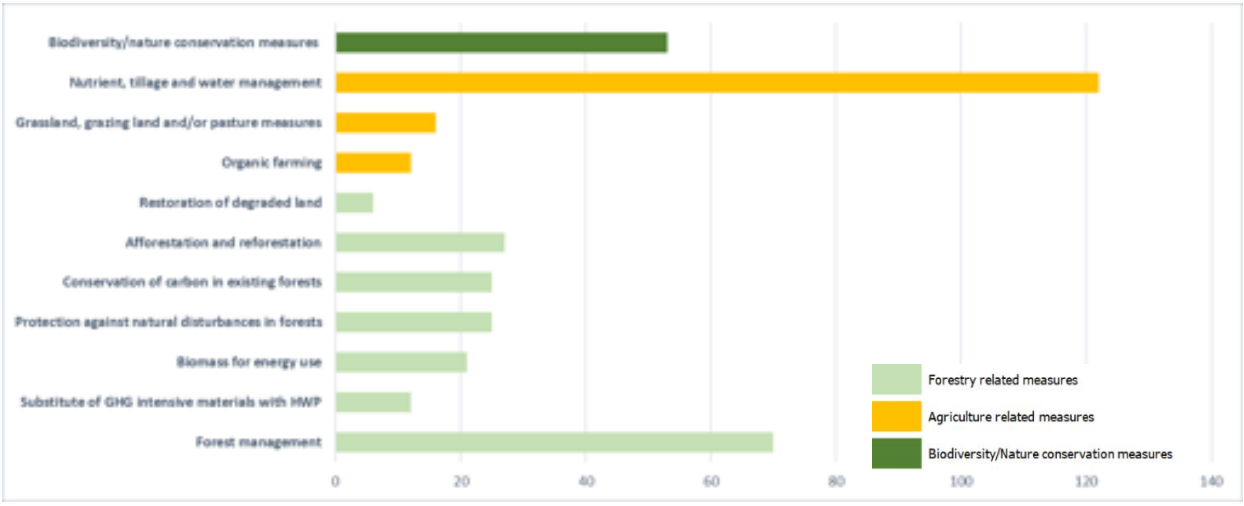


Figure 109. Reported PaMs per type of intervention by MS.

While this presentation of the MS and the most frequent intervention types is useful, it is also necessary to look at the types of interventions in a more focused way. The Figure 110 below shows the overall count of intervention types across the analysed PaMs. These set the scene for the section below as it gives a thorough breakdown of all of the PaMs from the important land sectors in LULUCF (forestry, agricultural soils, organic soils).

Figure 110. Number of PaMs per type of intervention (overall count).



Most common PaMs presented by the MS

As it is clear from Figure 110, the main focus for forestry policies is in forest management. In the case of this report, forest management is viewed as any management for preserving and protecting forests in order to make them the most economically and ecologically valuable. Most MS have overarching forestry policies that promote the incomes of forest owners while also boosting long term sustainability. The potentials for forest management in terms of emissions are very significant and the mitigation potentials going forward presented by a number of MS are very high.

With regard to agriculture, there are two main pathways that MS employ, the first being through the RDPs within Pillar II of the CAP and the second being EU directives on fertilizers. Both of these pathways are categorised within the intervention *Nutrient, tillage and water management.* Many of the MS cited the Nitrates Directive[69] as one of their key policies within LULUCF and nutrient management. The main pathway though, is through the CAP. MS are highly reliant on the CAP and in most of the Art. 10 reports, the importance of the mechanisms under the CAP Greening Payments and within the RDPs have set the scene for the entirety of the LULCUF sector. The CAP Strategic Plan which is under development for 2023-2030 will have extremely broad impacts on the MS. IE, PL and HU outline their plans within the new CAP thoroughly and emphasize their reliance on the funding that is coming from the current policy period. Yet, there are still some standout PaMs that are undertaken by MS outside of the CAP that should be highlighted.

MS PaMs beyond CAP

The main actions within forestry are within forest management for improving sustainable timber production, but there are also a few countries that have a focus on natural forest regeneration. NL has a PaM within '*trees, forest and nature*' for expansion of forest and trees into woodland areas. This encompasses multiple goals including increasing recreational areas, urbanisation challenges, spatial quality, etc. These areas are assumed to undergo management in the future but not harvest. Another unique case is CY's activities in LULUCF as they all revolve around indigenous tree afforestation. The goal within these activities is to plant 300,000 trees per year by 2030 (currently they are planting around 70,000 per year).

Many of the MS that have much smaller areas or have problems with over-urbanisation are stuck between using land area for domestic agriculture to support the growing population and afforesting the limited land area that is left. MT, for example, has no commercial forestry and all the afforestation measures are strictly to improve nature areas for conservation and recreational purposes. On the other side, LU has a sizeable wood product sector and therefore is not active in any natural afforestation measures. This is cited multiple times within the relevant report and as a key challenge for the country.

With regard to reforestation after natural disturbances, the main measure type is within the RDP, as part of CAP Pillar II. Both HR and EE use RDP to co-finance restoration of forests to improve resilience against fires. Yet, there are multiple MS that have policies outside of the CAP with attention to protection and regeneration after natural disturbances. The SI Forest Act for example provides full funding through subsidies to regenerate areas in which spontaneous regrowth is too slow. In HR, one of main concerns and drivers of their LULUCF PaMs is the degraded land and forest area from the post-war period. The consequences of the war caused a disruption in the structure of forest stands and led to a decrease in growth in forests due to lack of cultivation planning. HR's Forest Management Plan for the period has been and will continue to be focused around establishment of proper stand structures.

FR has multiple PaMs that standout, particularly with their attention to soil carbon. Their most pioneering initiative is Label Bas Carbone, a voluntary carbon market programme certifying

[69] Council directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)

and providing payments for carbon sequestration through, e.g. afforestation, hedge planting, orchard preservation, etc. This type of measure has a sweeping trickle-down effect into other MS' attention and potential to pay landowners per ton of carbon.

Sources of financing

As outlined above, the funding from CAP is the most important source for agricultural PaMs. Most MS state the value of the CAP for rural development, yet the distribution of the funding is often not abundantly clear within the reports. Within some reports the contribution from national vs EU funding is explicitly stated for each measure under RDP. In other reports, this value is not reported at all. BE, AT, HR, and BG are examples where the exact amount of funding that is coming from EU sources and from national funding is explicitly expressed. LT provides exact costs associated with all national programmes (mainly through the Inter-institutional action plan for the Strategy for the National Climate Change Management Policy). The main source of funding for the LULUCF measures stated is typically through The European Agricultural Fund for Rural Development (EAFRD), CAP Pillar II or the European Agricultural Guarantee Fund (EAGF), CAP Pillar I. National support apart from CAP for LULUCF by MS covers research programmes, large scale strategies or national climate change policies. Co-financing is supported through the EAFRD and other EU funds.

While not every country outlines its specific finance objectives or amounts, it is important to highlight some of the MS that have directed a significant amount of money outside of EU funds to LULUCF (see Table 21).

Table 21. Some examples of the pure national funding within the EU MS .

MS	Sector	Source	Amount
NL	Trees, Forest and Nature	State climate funds	EUR 51 million
	Peat meadows	State funds for peat restoration	EUR 100 million
FI	Forest regeneration	2018 investment	EUR 252 million
DK	Agriculture	Biochar research	EUR 3 million
	Organic soils	Accounting for emissions from organic soils	EUR 1.2 million
ML	Afforestation	Afforestation for recreation	EUR 400,000
SE	Forestry	Forest subsidies (2003-2019)	EUR 2.3 million
CY	Afforestation	Tree planting along roads	EUR 85 million
IE	Peatlands	Funding for peatland restoration (33,000 ha)	EUR 108 million
FR	Agriculture and forestry	Recovery plan will support preservation and strengthening of land sector	EUR 1.2 billion

16.4. Policies and Measures (PaMs) introduced by MS in LULUCF sector

While the main types of measures and sources of funding are outlined in the section above, it is necessary to go more into depth within the individual MS as well as understand the types of

PaMs that are the most common. There are several ways in which the PaMs from all the MS can be classified. Knowing the most frequent pathways for LULUCF action can promote policy advisory and inform decision makers the ways in which the highest uptake for environmental management is achieved. To this extent, seven different classifications as seen in Figure 111 below were chosen to organize the most typical policy instruments and further classify the analysed PaMs.

Figure 111. Breakdown of main policy instruments per the PaMs

It is clear from the figure above that the highest percentage of PaMs fall within the CAP either within Pillar I or Pillar II. This is not a surprising result as nearly every Art. 10 report stressed their reliance on the CAP. The second most typical type of policy instrument falls within both the categories of Legal requirements and standards and Plans or strategies. Legal requirements or standards are defined as either overarching country acts or required management standards for forests (e.g. requirement to submit forest management plans every 10 years). Plans and strategies are typically action plans developed in connection to a certain sector and sometimes further support legal acts. State funded economic incentives include subsidy programmes, tax breaks or other financial incentives for carbon removals. IE, for example, provides grants from their Agricultural Department to increase and support the production of HWPs. Other EU economic incentives is the catchall for EU funded initiatives outside of the CAP (i.e. funding through Natura 2000). Other national initiatives are PaMs that may not be strictly defined by the MS within the Art. 10 reports. Information/awareness PaMs are ones that include research or public awareness initiatives such as SI's Public Awareness PaM aimed at promoting the efficient use of woody biomass and its use to improve ambient air quality.

16.4.1. Forestry

The forestry sector is highly important to the MS both economically and environmentally speaking, yet many of the forestry policies are old policies with the motive to promote production, as opposed to climate mitigation or LULUCF activities. Some of the MS within Central and Eastern Europe (CEE) that were under the communist block also have newer policies that were spurred by the economic transition. The reports from these MS (LT, LV, EE) pointed out that the opening of markets in the early 90s caused arable land to be abandoned and unplanned, thus natural reforestation took place. MS have cited that this abandoned land is overgrown with vegetation that lacks proper management. As this area has not been managed over the past 30 years, there has been a levelling off of the land's potential to have sustainable and efficient removals.

Forestry

The intervention pathways within the forestry sector are forest management, protection against natural disturbances, afforestation and reforestation, and conservation of carbon in existing forests. Within this scope, biodiversity and conservation PaMs are included. It is difficult to differentiate the countries that rely the most on forestry as the sector is significant in most MS. According to Eurostat data, the countries with the highest output of forestry and logging are SE, DE, FR, FI and PL with varying levels of Gross Value Added (GVA) as a percentage of GDP. For FR, a majority of their forestry PaMs are devoted to promoting wood products by removing barriers to using HWPs in construction for example. Their 'Tall buildings made out of wood' Plan is a standout policy among forestry reliant MS. In LV, forestry and logging contributed to 1.9% of total GVA in 2018 while having a relatively smaller forestry sector with regard to output.[70] FI, despite a high reliance on the forestry sector has limited PaMs, one of which being a broader Climate Strategy that is not connected explicitly to LULUCF. It is important to note that most of the forestry policies across nearly all MS are partnered with timber production; economic and environmental sustainability are dual objectives.

AT has nine PaMs in relation to forestry, some of which are simply to safeguard forest conservation and improve the stability of forest ecosystems. There are also PaMs within AT that are in connection to timber production, yet it is one of the few countries that recognizes the need for conservation and biodiversity protection within forests (i.e. through Natura 2000). A similar case to AT, is BE that has forest expansion and afforestation initiatives for long term conservation purposes across its three regions (Flanders, Wallonia and the Brussels Capital Region). The Foret de Soignes for example is a region where no deforestation is allowed and is under strict protection. CY is an interesting case as the only PaMs listed are connected to afforestation, yet they are only regarding afforestation of indigenous trees along roads and highways and in urban areas.

Biomass for bioenergy

The use of biomass (woody biomass or crop residues) for energy purposes to replace GHG intensive feedstocks was a common theme across the MS, yet the PaMs mentioned usually referred to the use of woody biomass for bioenergy. Bioenergy can help MS to meet goals within the EU, especially related to the Renewable Energy Directive but woody biomass for energy can in turn have a detrimental effect on forest areas. It is also a cross-cutting PaM as it is related to the use of residues from agriculture in bioenergy. The countries with specific PaMs relating to biofuels from the forest or agricultural sector are SI, SK, IE, FR, LI, and MT (partly through their RDP). BG and AT both have renewable energy action plans for boosting agriculture and forestry in bioenergy.

Another intervention type in the forestry sector is in promoting the HWP pool to increase the already significant climate mitigation potential. From Figure 110 it can be seen that this is one of the least common PaMs from the Art. 10 reports. Still, BE, IE, LU, and SK all have policies related explicitly to HWP. In recent years, the HWPs have been touted as a central player in climate mitigation objectives as wood products are able to store carbon outside of the forest area and can replace more energy intensive materials such as steel, cement or plastic. SE reported a removal from HWP as high as -18,000 kt CO_2 in 2018 as well as in projections for 2019, which is well beyond the average removal across the rest of the EU.

Mitigation potential in forest areas is significantly higher than in agricultural areas. In the EU Commission's Impact Assessment of 2020, the need for technical management and forest conservation is imperative for soil carbon sequestration and in ensuring that MS can remain

[70] Eurostat, (2020). Forests, forestry and logging. https://ec.europa.eu/eurostat/statistics-explained/index.php/Forests,_forestry_and_logging#:~:text=The%20growing%20stocks%20of%20timber,and%20Poland%20(10.0%20%25)

sinks, especially with the Green Deal's target of climate neutrality by 2050.[71] From the five countries that are overall emitters within the LULUCF sector (IE, DK, MT, SI and LT), the necessity to have highly productive forestland to counteract the emissions that typically come from cropland is clear. In IE, the national target of 8,000 ha of afforestation per year is expected to result in an initial decrease in removals peaking in 2035 at zero net emissions and removals followed by an increase resulting in net removals of around -3,100 kt CO_2eq by 2050 (a decrease in removals from the current value). SI provided the technical mitigation of potential forestry measures showing that increasing the carbon stock in living biomass has a 5,201 kt CO_2eq per year potential. The measure with the next highest potential is much lower at 1,668 kt CO_2eq per year demonstrating the weight of this type of PaM.

16.4.2. Agricultural lands and soils

The PaMs that were the most common for agriculture and soils among the MS reports were mainly encompassed within broad EU policies such as the Natura 2000 legislation, the Nitrates Directive, and in some cases the Renewable Energy Directive. The most significant PaMs, though, were within the MS' RDPs as part of CAP Pillar II. There are three main agriculture measures under the RDP that were reported by almost all MS and are presented within the EAFRD measure codes:

Table 22. RDP Measures related to agriculture and MS implementation.

RDP Measure Code	Description	Member State
Measure 01 – Knowledge Transfer	Provision of information and training to improve performance and social environmental sustainability of businesses operating in rural areas.	SI, EE, AT, HR, IE
Measure 10 – Agri-environment climate	Many sub-measures related to biodiversity, soil, carbon sequestration. Typically, these include permanent grasslands, orchard preservation, etc.	IE, RO, AT, BE, MT, LV, SK, PL, ES
Measure 11 – Organic Farming	Support per hectare of agricultural land to farmers who convert to or maintain organic farming practices and methods.	MT, IE, RO, AT, BE, SK, PL, ES

While the RDP is highly valuable in funding for MS, it is still focused on income boosting in rural areas and has less of a focus on carbon sequestration or soil organic carbon. Organic farming (RDP Measure 11 and part of Pillar I, Greening Payments) for example clashes with some land-use sink objectives as it requires more land area for cultivation. While it maintains nutrients in the soils better and results in more sustainability in the long term, it still might cause that land that would otherwise be used for forest or even wetland area is needed to produce organic produce. AT goes beyond simply stating organic farming as a measure and has introduced soil-friendly farming systems to help the humus contents of organically farmed soils; this is significant as nearly a quarter of AT's agriculture is organic.

16.4.2.1. Agri-environmental climate measures

Many of the PaMs within the agri-environmental climate measures (AECMs) are connected to using crops that can fix nitrogen (i.e. legumes) and use of cover crops. MS are given flexibility with regard to these types of measures and it is clear that certain measures may have a higher

[71] European Commission. (2020). Impact Assessment: Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people. Available at: https://ec.europa.eu/clima/sites/clima/files/eu-climate-action/docs/impact_en.pdf

impact on one MS than another due to the makeup of their soil. LV focuses on using legumes in a mixture with other crops resulting in higher inputs of organic material and aiding in the replacement of mineral fertilizers with nitrogen fixing plants. PL has a voluntary commitment programme such that farmers can choose to employ more sustainable ways of crop and livestock production management through specific tillage management, a ban on using urea in granular form, and regeneration of soils through liming. IE also implemented a farm scale liming programme among other methods for extra attention to nitrogen application (as part of the derogation review of the Nitrates Directive).

Within AECMs and other environmental measures of rural development, MS encourage farmers to employ more sustainable soil management focused on less fertilization (FI, IE, BE), better nutrient management (IE, PL), use of organic fertilisers (HR), and support of extensive farming systems (PL, IE, HR). Agroforestry systems are also reported by a few MS for increasing of sequestration and protecting soils alongside operations related to maintenance of landscape features (BE, HR, PL), establishing rows of trees along agricultural lands (DK, FR).

Attention to biodiversity

The connection between agricultural production and biodiversity protection is a key theme across the EU and is the third most common type of PaM reported in Art. 10 (see Figure 110), especially through payments under the Natura 2000 directive. BE, HR and HU all have AECMs connected to biodiversity within maintaining permanent grasslands, while EE is focused on protecting biodiversity in horticulture. The use of buffer strips, wetlands protection (HU, BG, AT, BE), and agro-forestry helps to protect local flora and fauna within the MS. IE, through the LIFE Programme, implemented a LIFE IP Peatlands and People PaM, which aims at restoring and enhancing rehabilitation of National Parks and Wildlife Services.

16.4.2.2. Policies and Measures (PaMs) related to soils

While most of the LULUCF PaMs across the MS are related to agricultural production on mineral soils, there are many MS whose PaMs promote carbon removals in organic soils. There are a few key countries who have PaMs that prevent drainage in wetlands and limit peatland extraction. BE, BG, DK, LU, SK, SE, IE and HR all have wetlands protection programmes and DK has four separate policies on wetlands and provides subsidies for the restoration of wetlands on private land. The countries with the highest percentage of wetlands and all over the EU average are IE (5.6%), SE (5.4%), FI (5%), EE (4.4%), LV (2.4%) and DK (1.9%).[72] Across these countries, only SE, IE and DK have wetland protection and drainage limitations; the rest are not focused on wetland areas at all.

PaMs related to wetlands

There are a few MS that do not have any organic soils, according to their Art. 10 reports. LU, for instance, states that the country has no organic soils or peatlands and therefore, has no PaMs connected to organic soils. Nevertheless, there is one PaM that is under implementation and is partially relevant to the country; according to the report '*Measures to prevent drainage and to incentivise rewetting of wetlands'* is partially in place and partially relevant for LU yet with no plans for additional policies related to this. Due to the nature of their soils, both CY and EL have very low areas of wetland and organic soils. FI, despite having 5% wetland cover and

[72] Note that this data is pulled from Eurostat data from 2015 including the United Kingdom within the EU average, https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20180201-1

wetlands being the second largest land area after forest land there are no explicit PaMs on rewetting. The climate programme for Finnish agriculture stipulates peatland protection as nearly 6 million ha are drained for peat production which makes up 4% of the total primary energy supply. The FI PaMs are focused on conservation and directing any peat extraction to sites that have already been drained or degraded. SK has an Action Plan on wetlands which covers four strategic goals on addressing the drivers of wetland loss then further conserving and managing them based on these drivers.

Restoration of degraded soils and land is connected both to mineral and organic soils and several MS take particular attention to nutrient management on organic soils (DK, NL SE, FI, LV). DK has five different PaMs connected to organic soil management. There are not many PaMs that explicitly target restoration of degraded land and these are spread across both agriculture and forestry, where afforestation may be used to restore land that has been degraded by agriculture to the point of abandonment.

16.4.3. Research programmes

Research initiatives can be classified under the *Information/awareness* policy pathway from Figure 111 as well as under RDP Measure 01 (Knowledge Transfer) from Table 22. Research programmes or initiatives related to improving data and reporting make up a much smaller portion of the PaMs in the Art. 10 reports but are highly valuable to LULUCF. LULUCF monitoring is rather resource-intensive and there is evidence of scarce data and insufficient reporting requirements such that MS do not feel obligated to take key attention to soil carbon. Soil organic carbon (SOC) measurement has been one of the topics of key interest in land use and it also presents a key barrier for incentivizing Measurement, Reporting and Verification (MRV) within payments for ecosystem services, for example. In general, improving data and consistency across MS will help to simplify monitoring and eventual reporting processes.

Research on soil

DK will begin in 2021 to conduct research on emission factors for organic soils in order to improve the validity of emissions reported to the Greenhouse Gas Inventory (GHGI) as well as to boost policy instruments related to the rewetting of organic soils. In addition, they have an ongoing research initiative on the potential for using biochar as a tool for carbon storage. NL's National Knowledge Programme on Soil Subsidence, Evaluation and Knowledge Development, addresses issues from specific meadow areas, including sustainable business and land management models, knowledge development from pilot projects (2019 – 2021) in order to identify the technical potential and feasibility of measures, like submerged drains. SE's 'Focus on Nutrients' initiative estimates the effect of cropping measures in order to determine the type that is most effective for carbon sequestration.

FR has several research initiatives connected to both forestry and agriculture. Within the new Strategic Forest and Wood Fund FR will finance innovative projects connected to woodland management and marketing of HWPs. Alongside this, a call for projects within the AMELIO programme was launched in 2019 with the aim to improve poor and dying stands. In relation to carbon storage in agricultural soils, FR also has multiple PaMs related to research and improving carbon stock. The PaM, 4 for 1000 "Soils for Food Security and Climate" initiative, has resulted in findings regarding carbon stock improvement in the first 30 to 40 centimetres of soil to improve food security and slow emissions from mineral soils. EL has two PaMs funded by the EU LIFE Programme, ClimaTree and OliveClima, that are centred on defining and developing accounting and monitoring frameworks for tree-crops' CO_2 sequestration as well as generally identifying farming practices that lead to higher carbon sequestration and passing this information onto farmers. Farmer awareness of these types of measures is very important for uptake and for the future of broader initiatives in the EU for carbon farming or results-based payments for tcarbon sequestration.

AT, HR, DK, EE, FI, NL and SI have programmes that are connected to raising awareness for nature conservation and environmental protection. These programmes alongside the RDP's knowledge transfer measure help to support educational programmes and eventually increases farmer's attention to improving their land's potential as a carbon sink. EE and FI are actively educating farmers on environmentally friendly agricultural practices and benefits to nutrient retention for long term sustainable land. IE launched an online nutrient management planning programme to improve the nutrient status of soils and to lower fertiliser usage.

In some MS, PaMs are connected to information on a broader level such that stakeholders are brought together on a common platform. In SI, one PaM aims to increase the level of competence of target groups through different forms of knowledge transfer. With improved competence, the target groups will be able to enhance their competitiveness, use resources more efficiently, improve environmental efficiency and contribute to sustainable development in rural areas. EL also has a dedicated platform for stakeholder communication and platforms for dissemination of knowledge.

16.4.4. Reporting and Accounting

While reporting and accounting PaMs are not common across the MS, there are several that deserve attention due to their potential for upscaling within the rest of the EU. The main accounting measure as mentioned above is through the Forestry Accounting Plans as required by the most recent Commission report on implementing Forest Reference Levels (FRLs) and improving GHGIs. In DK, as mentioned above, the research programme to improve emission factors on organic soils has implications for LULUCF as it will improve validity of emissions reported within GHGIs. In IE, plans to include managed wetlands in the 2021 to 2025 commitment period is a challenging measure due to the nature of wetland emissions measurements. This PaM is important as a majority of IE's wetlands are used for peat extraction. While not explicitly related to reporting and accounting, RO's National Strategy for Sustainable Development includes activities related to traceability and data to ensure that tracking and data consolidation are at the forefront. EL is actively working on new accounting and monitoring systems for tree-crops through ClimaTree and hopes to see uptake in other EU MS.

16.4.5. Additional information on Member States' actions

Three MS did not did not submit reports for the final round, however, the Commission believes that their previous actions within LULUCF are still relevant for the overall analysis of the sector. PT did not submit their first or second reports and DE did not submit a mid-term report so the information may be more limited for these MS. It was agreed with the Commission and the authors of this report that the summary of the three MS would be extracted from an "*Analysis of LULUCF actions in EU member states as reported under Art. 10 of the LULUCF Decision: final study"* prepared by IEEP in 2017[73] in order to provide a full picture of LULULCF actions within the EU. The data from these countries has not been mixed into the data within this report, as the scope of this task is to provide an overview of the most recent updates in the LULUCF sector.

CZ submitted both of the initial and mid-term reports. The country has a distinct focus on climate resilience and climate adaptation strategies for the LULUCF sector, which according to the analysis, is contrary to many of the other MS' strategies. Like most other MS, the CAP

[73] Paquel, K., Bowyer, C., Allen, B., Nesbit, M., Martineau, H., Lesschen, J. P., & Arets, E. J. M. M. (2017). *Analysis of LULUCF actions in EU member states as reported under Art. 10 of the LULUCF Decision: final study*. Institute for European Environmental Policy IEEP.

is of high significance to CZ for reducing emission from fertiliser use and enteric fermentation. The measures under cross-compliance standards in CAP are connected as well to the GAEC standards that are specifically defined for CZ, which is not necessarily the case for the other MS. In addition, CZ is one of five MS that has designated environmentally sensitive permanent grassland (ESPG) outside of the already designated Natura 2000 sites, indicating an attention to biodiversity conservation. CZ also employs multiple interventions that highlight the importance of soil protection and management including within the CAP Pillar II (RDP), urban and land use soil protection measures, and the Nitrate Directive.

DE is applied a regional approache with a particular stress on the bioeconomy, namely through the supply of mainly forest biomass to replace fossil resources. In addition, there is a heavy emphasis for DE on grassland management as well as the restoration and protection of peatlands through, e.g. the purchase of key peatlands by the state. One notable project is the rehabilitation of moorland with specific targets noted at state (Länder) level for converting 30% of moorland to natural management by 2020. For forest conservation, DE also has several reported PaMs including actions towards taking forests out of production, a dedicated Forest Climate Fund, and some research initiatives on the capacity for carbon storage by HWPs. The last notable PaM in DE is an attempt to improve rules and reporting on grassland conversion.

Due to the fact that PT did not submit any out of the three reports, there is no information that can be written about their LULUCF actions within the scope of this task.

16.5. Potential mitigation actions for the 2021-2030 period

The data across the MS varies with regard to the period going into 2030, which is to be expected as Decision no 529/2013 does not require a future projection beyond the year 2020. Some MS report mitigation potentials for each measure as well as yearly projections, while others simply provide a projection of the 2019 and 2020 period for the LULUCF categories. The methods for projections are also highly differing. Finding estimates on overall LULUCF is also difficult to capture as the MS all report different iterations of the main categories.

16.5.1. Development of the strategies and future actions plans

Much of the future possibilities for the sector across the MS is through PaMs classified as a *Plan or Strategy*. 23% of the total PaMs are within this category (see Figure 111) and typically have a broad target going into 2030 or 2050. The LULUCF sector is usually a sub-part but is still mentioned as a key sector to achieve the targets outlined within the PaM.

Broader policies in the MS include LT's Strategy for the National Climate Change Management Policy until 2050 which also includes an inter-institutional action plan and thoroughly outlines the potential of measures within the LULUCF sector in environmental protection and rational use. MT's Sustainable Development Vision for 2050 employs a number of broad environmental measures to enhance sustainability and includes biodiversity and soil protection as key features. RO has two separate overarching initiatives on climate change, namely the National Strategy on Climate Change and Economic Growth and National Action Plan for the Implementation of the National Strategy on Climate Change. IE's Climate Action and Low Carbon Development Bill 2020 plans to drive a 7% yearly reduction of GHG emissions across the next decade (to 2030).

16.5.2. Forestry

In addition, the LULUCF Regulation[74] (EU) 2018/841 requires MS to submit national forestry accounting plans including proposed FRLs for the 2021 to 2025 accounting period. Some MS do not discuss the accounting plans in their Art. 10 reports but many mention these plans within the most recent NECP submissions. In general the main type of plans and strategies, if they are not broad climate action plans, are related to the forestry sector. EE's Forestry Development Plan is focused on sustainable forest management in order to improve diversity and productivity and capacity for regeneration. FI's National Forest Strategy aims to maintain a carbon sequestration level of 10-17 $mtCO_2$ per year across Finnish forests. In FR, the Forest Renewal PaM has a budget of EUR 150 million and aims at 45,000 ha of improved, regenerated or reconstituted forests before the end of 2024. EL's National reforestation plan includes plans for reforestation of 50,000 ha of burned and degraded land by 2026.

16.5.3. Agricultural land and soil

The future aim of agricultural and soil PaMs will be characterized by the CAP Strategic Plan, yet only a few MS mention their actions within this plan as this only begins in 2023. IE, PL, HU and FR are the four MS that outline the future of CAP within their PaMs. IE provides a list of potential measures that will be undertaken as part of this and has involved a lengthy stakeholder and consultation process for implementation at its onset. These include new agri-environmental initiatives such as the rewetting of farmed peatlands, soil organic carbon improvement measure for tillage soils (SOCIMTS), National Soil Sampling and Analysis Programme 2021, Farm Environmental Study Initiative, Re-Opening of Organic Farming Scheme, Pilot on Results-based Agri-environment Scheme, and New/enhanced EIP measures. For HU, the CAP Strategic Plan will take into account objectives within biodiversity and the Farm to Fork Strategy.[75] PL linked the initial public consultation process for the upcoming submission for the post-2020 CAP Plan and explained that the process has been slow due to such high interest in the process. FR has also begun its post-2020 CAP stakeholder consultation process to devise the most relevant mechanisms specific to the country's needs. Among the identified needs were, for example, the importance of maintaining permanent grasslands to preserve existing carbon sinks.

In DK, the Climate Forest Fund for reestablishment of wetlands plans to reduce carbon loss through wetlands by 15 $MtCO_2eq/ha/year$ starting in 2021 as well as plans for 15,000 ha of rewetted land between 2021 and 2029 and 5,000 ha between 2021-2024. In FI, there are multiple PaMs related to sustainable food. One of these PaMs is called “Steps towards environmentally friendly food” and has future objectives to improve the efficiency and reduce emissions per litre or kilogram of agricultural production. In FR, the Good Carbon Diagnosis PaM aims to discern the potential for GHG reduction and carbon storage at farm level as well as ultimately result in 4,000 to 5,000 kt CO_2eq 'good carbon' between 2021-2022. In IE, the Ag-Climatise contains a roadmap for climate neutrality in the agri-food sector by 2050 (particularly through biogenic methane). NL plans for precision agriculture to be implemented on at least 50% of arable land by 2030 (i.e. strict nutrient management through time-specific dosage of fertilizer). On top of this, the Peatland Protection Plan will affect approx. 90,000 ha of peat meadows with 10,000 ha of conversion to peat moss cultivation. PL's Framework Action

[74] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU

[75] As these are already recommendations from the Commission within the EU CAP framework, this is not significant in the sense that it is not going beyond what is already required. Yet, it is still pertinent to point out the countries that are mentioning the importance of the post-2020 CAP.

Plan for Organic Farming will be updated to improve organic food and farming; this framework is important as it is outside of the scope of CAP.

16.6. Challenges and Solutions

The MS reports have a wide variety of PaMs that can lead to some interesting insights. For example, there are a number of MS-defined challenges that can provide key understanding into the gaps that exist within the political sphere of LULUCF. Many of the main issues within the MS are associated with the fact that the LULUCF mitigation potential is decreasing.

In many MS, the challenges listed come with potentials for solving them, as well as the drivers that lead to the listed challenged. The following section will outline the way each of the five main challenges are given attention within the Art. 10 reports, namely through the reasoning provided by the MS.

The challenges can be summarized into five main categories and further addressed one by one through recommendations and/or solutions cited by the MS themselves:

1. Decreasing sink/forested area or significant period of one or more of the LULUCF sector being a source (DK, AT, BG, CY, FI, HU, IE, LV, LT, MT, NL, SK, and ES)
2. Mature forest stands (EE, IE, LV, SI, DK and SK)
3. Data fluctuations and gaps (BE, FI, EL, LU, MT, PL, SI, and FR)
4. Abandoned land (particularly in CEE countries) (EE, LV, MT, HR, and LT)
5. Nutrient management problems leading to unproductive soils (EE, MT, PL, and ES)

16.6.1. Decreasing or stagnant sink

In AT, cropland has been a net sink since 2000 and yet in 2016 has become a net source. This is a similar problem that can be seen in BG where LULUCF is a sink, but the potential to remove carbon has been steadily decreasing. Many countries have experienced decreases in their forestland and in DK the forestland recently has become a net source of 402 kt CO_2eq (the entire LULUCF sector is a source for DK in 2018). Between 2013 and 2017, deforestation exceeded afforestation in NL resulting in a net deforestation in the country during this time period; similarly, FI saw a slight decrease in forested area due to land use change. Both NL and FI have significant LULUCF PaMs that should have lasting impacts on their land use sectors, yet it is still difficult to maintain the land area due to high land prices or competition for land (NL). As has been mentioned above, many smaller countries with high urbanization are plagued by land area issues such that afforestation is a trade-off for productive arable land.

The decreasing or stagnant sink as mentioned in almost half of the MS has several connections across the MS reports analysed herein. In CY, the sink has been decreasing due to an attributed conversion of land to cropland management in the early 2000s. In FI, decreased afforestation is directly tied to the halting of state subsidies in 2008 that provided payments for farmers willing to forest their arable lands. In addition, FI cites the need to afforest on organic soils but specifies that the emissions would not be large enough to see any real results. Instead of afforestation, the blocking of drains on these lands as well as afforestation with species that can grow in wet conditions could increase the removals from forestland. In NL, net deforestation is due to the fact that the fight for land in the country is high and therefore production on arable land overtakes any real push for afforestation.

As is clear from several MS' PaMs that were established before 2000 or in the early 2000s, there is less focus on environmental management. These types of policies result in outdated management practices as they never undergo an overhaul that is strong enough to see any change. The need for brand new policies in the LULUCF sectors is necessary for the sector to increase its capacity for carbon removals.

16.6.2. Mature forest stands

One of the main causes of a decreasing sink in forest land, is the ageing of EU forests: mature forest stands are slowly becoming less efficient with regard to carbon removals. This was cited explicitly in four reports, and is a common problem for forest lands and a crucial barrier to the sector's ability to be a sink; forests require attention and a time investment to grow back and regain their potential. This challenge goes hand in hand with the heavy reliance on forests in MS to balance the emissions that result from cropland or grassland management. Shifting attention to the potentials of cropland in partnership with forestry or conservation (agro-forestry, buffer strips) could lower the pressure put on forestlands.

In DK, mature forest stands are part of the reasoning behind the decreasing sink of forestland. DK specifically outlines how younger trees are needed to regenerate the old forests. Even with decreasing emissions from cropland, the forestry sector in DK is not efficient enough to counteract these emissions and is a source. Yet DK is a country which pays particular attention to wetlands and their potential for carbon removals and is a standout MS in this regard. In SK, the forest age (on average 80 years) is also due to ownership fragmentation making management a difficult objective on this type of land. In IE, an increase in recent years of harvest rates and a shift in the age class structure under standard silvicultural assumptions and rotation ages are the reason of the projected peak of removals from afforestation.

Many PaMs in SI already address the issue of mature forests and in general tackling this issue is a long-term process that may cause net emissions at the start. This is clear from LT, where a reform for the forestry sector was established at the onset of their independence but with a focus on private ownership and management. The result was an inefficient policy that did not put effort into the replanting process such that forest areas are now overly mature. Policies take a long time to set in, so this should be taken into account when establishing new PaMs or initiatives in the MS. Many of the solutions that have potential to improve forest age problems are already reflected heavily in the PaMs presented in the MS.

16.6.3. Data gaps and fluctuations

Data and monitoring of the LULUCF sector has been a prominent problem driver within the sector and mentioned implicitly or explicitly in eight of the Art. 10 reports. In some cases, data on past emissions fluctuate wildly from one year to the next; in SI, there was a 6,200 kt CO_2eq increase from forestland between 2013 and 2014 causing an overall net emission of 900 kt CO_2eq in 2014. According to PL, the projected removals from afforestation are supposed to decrease by nearly 2,000 kt CO_2eq between 2018 and 2019 (from around -3,000 to -1,847) with no clear reasoning behind the drop. In EL, there is a lack of data on relative stock change factors; carbon stock changes have been assumed to be equal to zero for the cropland remaining cropland category and there is also no data on certain activities such as burning.

In general, the reports are lacking with regard to the certainty of their quantitative data and each MS employs a different methodology and different sources for land use and GHG emission determination. Several MS employ, for example, the CORINE land cover data base (CY, EL, MT, IT, IE), while some rely on their Land Parcel Identification Systems (LPIS) which are required as a critical source of data under the CAP. Discrepancies across data sources can also hinder comparability between the MS as well as result in inaccuracy in the data.

In RO, the problems with inaccuracy are addressed in their own development of a new Organic Soil Map which contributed to recalculations over the entire 1989-2019 time series. These types of re-estimations are common in MS as reference levels are altered, for example, yet not many MS are active in developing and finding new forms of data, unless required by the EU. The increased inclusion of LPIS, as it is required for farmers under CAP, signals the potential that the EU has in influencing the MS actions in data management and use of common

platforms. For forestry, FI has a high fluctuation in the forest land category but this can be attributed to changes in the international market. Lack of data in MT is being tackled through the nitrates database where farmers are now required to map their land area. This mapping is still in progress, but could contribute to better data within the country and surrounding geographies.

Solutions to data problems can be partly combatted through a farmer database where the potential benefits are explicitly stated (in partnership with RDP's knowledge transfer). Using these types of databases can start with simple information such as fertilizer use and land area and then upscaled to include information that can then be utilized further in improving LUUCF actions on the EU level.

16.6.4. Abandoned land in Central and Eastern European (CEE) countries

Another significant challenge that is common across the MS, but primarily seen within the CEE countries, is abandoned and then mismanaged land. Understanding geographic challenges is necessary for improving the LULUCF sector as some solutions or attention can be directed into certain areas and may have a stronger effect than in across the rest of the EU. In four of the CEE countries (EE, LV, HR, and LT) the occurrence of post-Soviet (LV, LT and EE) or post-War (HR) land abandonment due to the opening of markets caused degraded land to be overtaken by natural regeneration. Due to insufficient planning in EE, the primary species that regrew in the abandoned land was grey alder wood, a tree species that is less economically or ecologically valuable than another species that may have been selected if regeneration had been state planned (i.e. spruce or broad-leaved species). In the case of LT, the transition to independence in 1991 resulted in a forest are that was poorly accounted for due to the disregard for small, private forests.

In CEE countries this issue has been explicitly stated so the awareness of the problems in their abandoned lands is clear. The problem solving for this issue comes with a necessary and broad overhaul of the areas that have been affected in order to maximize their potential. In many cases, the natural regeneration of land with grey alder wood, for example, is also connected to mature forests due to the fact that these forests have been growing unmanaged for over 30 years. HR has dedicated its entire national forest programme to improving the forest stands that grew back after the post-war period. This type of understanding is highly useful for development of future policies, as there is no one-size-fits-all solution.

While the opening of markets and a reduction of pressure on local farmers is a positive development for rural economic development, the ecological effects are important to consider as well. While the RDP in CAP Pillar II has made an initial attempt to cross-cut these objectives, the weight is on boosting rural incomes with a sub-focus on environmental management. This is not the case for the post-2020 CAP; environmental objectives will take the forefront for the new CAP and the MS' Strategic Plans. In some ways, the requirements through EU directives and regulations in the current sphere and in the Green Deal will prohibit land abandonment in this regard.

16.6.5. Nutrient management

The final challenge that was commonly cited by the MS was nutrient management problems leading to unproductive soils. As many of the Art. 10 reports listed the Nitrates Directive or the Water Framework Directive, this is in part already one of the main considerations for mineral soils in the MS. Protection of water bodies and retaining nutrients in agricultural land is often at the forefront of MS' PaMs. Some MS also mentioned the need for nutrient management to protect wetlands, for example. In MT a major issue has been the protection of wetlands that are located in proximity to agricultural areas and also within recreational parks where overuse

has caused erosion in some areas as well. Also, when land is degraded or poorly managed, it may be abandoned and left to overgrow. Both MT and LV mentioned this as a broad issue that should be considered when planning afforestation or revegetation in degraded land areas.

In DK, there is a specific target to have 380,000 ha of catch crops in 2021 to reduce nitrate leaching. The country has also put significant funding into research on organic soils, including the potential for biochar to help soil store carbon. BE used to be one of the few countries that measured SOC, yet stopped in recent years due to its complexity. PL's understanding of its own soils being highly acidic has fuelled a number of PaMs in the country. LT also specifies ways in which its cropland is inefficient, namely through usage of outdated technologies, lack of proper machinery, unfavourable farm structure and a low level of producer co-operation.

Nutrient management will potentially be upscaled in the upcoming CAP Strategic Plan for 2023-2030. More focus on biodiversity as well as use of various types of AECMs will increase nutrient management in the entirety of the EU. CAP is currently the main measure employed across MS so this will have broad-reaching agricultural management potential. In addition, improving SOC measurement on a wide scale will result in more accurate nutrient information as well as understanding of the PaMs that work best. For example, PL has done extensive research into tillage management as well as understanding how reduced tillage or no-till could impact its soils. This has larger effects on the understanding of LULUCF overall. The variability between the state of soils in the different MS also means that their PaMs should reflect this.

16.7. Conclusion

The Art. 10 reports from the MS provide a necessary look into the LULUCF sector in the EU. While there are many MS with highly effective and innovative LULUCF policies, there is still room for improvement at the EU and the MS level. EU climate policy through the Green Deal, for example, has made significant strides in its attention to the land-use sector and its role to climate neutrality. There are several ways in which the Art. 10 reports can set the path for a continued focus on LULUCF. One of the main strategies going forward is the new post-2020 CAP that will be in effect starting in 2023. The CAP envelopes a majority of the agricultural PaMs cited across the MS and is a vital source of finance. With the new CAP's objectives of improving attention to climate action, there could be a distinct change in the way that MS manage their cropland.

The 24 final reports submitted within the accounting period to 2020 vary in terms of substance, specificity and policy-level. After the submission of the mid-term reports and the assessment that followed,[76] an outline for the Art. 10 reports was proposed in order to improve the consistency of the reports' content. However, due to the heterogeneity of the MS and the complexity of the LULUCF sector, it was difficult to implement a strict requirement on how data on PaMs should be presented, with the consequence that reports do not contain the same kind of information.

Focussing instead on the types of actions that have the most uptake across the EU can help paint a picture for the sector going forward. *Nutrient, tillage and water management, forest management,* and *biodiversity/conservation measures* were the most common type of intervention among MS. Forest management interventions typically were cited within the scope of improving timber production and sustainable harvest, indicating a strong tie between economic objectives as well as environmental ones. *Nutrient, tillage and water management* PaMs were almost entirely CAP financed, most often through RDP. Again, the intersection

[76] Paquel, K., Bowyer, C., Allen, B., Nesbit, M., Martineau, H., Lesschen, J. P., & Arets, E. J. M. M. (2017). *Analysis of LULUCF actions in EU member states as reported under Art. 10 of the LULUCF Decision: final study*. Institute for European Environmental Policy IEEP.

between income improvement and climate action is a clear pathway to effective PaMs within the MS.

The main conclusion from this summary of the Art. 10 reports, is that through key attention to the challenges laid out above, the EU LULUCF sector can aid in the balancing out of emissions by 2050. It is already clear from the PaMs presented that many MS are going above and beyond and have a very keen understanding of the sector. Through short-term actions such as strengthening data collection the sector as well as implementation of focussed PaMs in certain geographies (i.e. CEE countries), the sector can reach its full potential.

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