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Improved GHG inventories for better forest policies: JRC work in 2020-2023

Final report on Forest Monitoring for Policies (ForMonPol)
Lot 1: Improved GHG Inventories for better Forest Policies (InFoPol)

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Contents

Abstract

This report describes the work carried out under the Administrative Arrangement "Forest Monitoring for Policies", Lot 1 (Improved GHG Inventories for better Forest Policies).

Within the task "thematic policy action development", the JRC focused on clarifying the connections between the accounting in the Land Use, Land-Use Change and Forestry sector (LULUCF) and other sectors, such as trade-offs and synergies among climate change mitigation options. It highlighted an ongoing rapid decline of EU forest sink, which may hamper the fulfilment of the EU climate targets and requires rapid actions to be stopped and reversed. The JRC also made substantial improvements to the Carbon Budget Model (CBM) to enhance its flexibility and speed, making it more fit to address future modelling needs.

Under the task "greenhouse gas (GHG) inventory development", the JRC conducted extensive work on the annual EU LULUCF GHG inventory until 2022, supporting the MS to improve the quality and completeness of GHG inventories, including through bilateral contacts, roundtable discussions, expert presentations and workshops. However, GHG inventory gap analyses for each Member State show that there is still room for significant improvement, especially in the light of the new reporting requirements under the latest EU LULUCF legislations.

On the task "tracking progress and compliance", the JRC played a pivotal role in the adoption of Forest Reference Levels for 2021-2025 (Reg. 2018/841) and supported the implementation of EU reporting and accounting requirements. Overall, reporting on LULUCF has consistently improved across countries, with enhanced completeness and fewer review findings over time. As a result, confidence in LULUCF estimates has increased, thanks to the collective efforts from GHG inventory compilers, the EU/UN review process, and knowledge-sharing initiatives such as the annual JRC LULUCF workshops.

Foreword

This final report describes the activities carried out within Lot 1 (Improved GHG Inventories for better Forest Policies, "InFoPol") of the Administrative Arrangement Forest Monitoring for Policies ("ForMonPol") between DG Climate Action (DG CLIMA) and the Joint Research Centre (JRC) during 2020-2023. The work carried under Lot 2 (Tropical moist Forest Monitoring, "TroFoMo") of ForMonPol is reported in a separate document[1].

The work within InFoPol was conducted by the LULUCF team of the Forests and Bioeconomy Unit (D.1) of the Joint Research Centre (JRC). For Task 2b, the JRC also received additional funding from DG CLIMA through co-delegation, which was used to recruit external experts for technical and scientific support on specific topics.

The purpose of this report is to provide an overview of the work conducted under InFoPol and to describe the main findings and lessons learned. Most of the activities are documented separately in more comprehensive reports, as referenced in this report. In addition, the JRC provided frequent ad-hoc support to DG CLIMA and the Member States (MS) through mail exchange and internal briefings on specific technical issues. The main findings of these exchanges are reflected in the conclusions of this final report, where applicable.

The InFoPol project work coincided with the Covid-19 pandemic and related restrictions, which continued at various extents through more than half of the project time. Because of the pandemic, some planned activity was cancelled (JRC LULUCF 2020 workshop, under task 2) and some others were delayed. Most prominently, the start of the co-delegation work with external experts under task 2 was delayed to 2022, which meant that the extent of the work had to be reduced compared to the original plans. Nevertheless, these force majeure-conditions were counterbalanced by well-attended JRC LULUCF workshops in 2021, 2022 and 2023, and successful conduction of external expert work during 2022-2023, focusing specifically on support to the MS with regard to increasing monitoring needs under the revised LULUCF regulation 2023/839.

[1] Achard, F., Bourgoin C., Vancutsem, C. ForMonPol Project – Final Report of Lot 2- TroFoMo Lot 2 (Tropical moist Forest Monitoring) Key Outcomes. Upcoming JRC technical report.

Acknowledgements

The work described in this report builds on a tight collaboration between the JRC and DG CLIMA (C.3). The authors thank in particular Simon Kay, Rene Colditz, Valeria Forlin, Stina Jansson and Christian Holtzleitner for the fruitful exchanges and excellent collaboration over the course of the AA. The work has also greatly benefitted from various exchanges with the LULUCF experts in the EU Member States and associated countries, the EEA, and the broader scientific community, and we look forward to continuing to work together also in the future.

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Executive summary

This document is the final report describing the activities carried out by the JRC under the Administrative Arrangement (AA) "ForMonPol" (Forest Monitoring for Policies), Lot 1 "InFoPol" (Improved GHG Inventories for better Forest Policies). The work within this AA was conducted from 2020 to mid-2023. Within the Land Use, Land-Use Change and Forestry (LULUCF) sector, the JRC's role in Lot 1 encompassed three main tasks: (i) thematic policy action development, (ii) greenhouse gas (GHG) inventory development, and (iii) tracking progress and compliance for the LULUCF commitments under the Kyoto Protocol and EU Decision 2013/529.

While the detailed description of the work is provided in the main text, this executive summary focuses on the policy context, on the main findings and lessons learnt for each of the three tasks of the AA, and on an overview of related and future JRC's role.

Policy context

The role of the LULUCF sector in the EU's climate policy has increased progressively, and the JRC has had a pivotal role in providing scientific advice in both the development and the implementation of the EU LULUCF policy.

While the LULUCF sector was not part of the Union's climate policy target of reducing emissions by 20% by 2020 (compared to year 1990), the sector's climate performance was counted towards the Union's net emission targets under the second commitment period of the Kyoto Protocol (2013-2020). The accounting rules were determined in Decision 529/2013/EU, covering afforestation, reforestation, deforestation, forest management, harvested wood products, cropland management, grazing land management, revegetation and wetland drainage and rewetting. There was however notable flexibility for the Member States (MS) to decide on the activities they would include in the accounting.

From 2021 onwards, the commitments detailed in the first binding EU regulation on LULUCF, Regulation (EU) 2018/841, started to apply. In this LULUCF regulation, the MS have binding commitments to ensure that accounted emissions from land use are at least compensated by an equivalent removal of CO_2 from the atmosphere through action in the sector in the period 2021-2030. All MS will follow the same accounting rules, with accounting for forest land being based on a MS-specific projected forest reference level (FRL).

The 2018 LULUCF regulation was revised in 2023 as part of the overall review of climate-related policy in the EU, mandated by the European Green Deal. The revised LULUCF regulation 2023/839 brought the LULUCF sector into a fully integrated part of the EU's climate policy, and simplified the accounting rules from 2026 onwards. Instead of accounting baselines on specific land accounting categories, like it was under the Kyoto Protocol and in Reg. 2018/841, from 2026 onwards all net emissions reported by the MS will be considered for the climate targets. Furthermore, the MS will have an obligation to report carbon stock changes in all carbon pools and in all land reporting categories. On the EU level, the MS have committed to a LULUCF sink of at least -310 Mt CO_2e in year 2030, which is to be achieved through individual LULUCF targets for each MS. Achieving this target will bring the EU's overall emissions reductions commitment to -57% in 2030, compared to the net emissions in 1990, and pave way to the Union's climate neutrality by 2050 and beyond, as set in the European Climate Law.

Main findings and key conclusions

Opportunities and challenges for the LULUCF inventories as their importance in climate policy increases. The EU legislation (Regulation 2018/841 and 2023/839) has progressively included the entire LULUCF sector in the EU climate targets, aligning it with other GHG sectors (Grassi et al. 2018a; Vizzarri et al. 2021; Korosuo et al. 2021). Simultaneously, there is a growing recognition of its crucial and increasing role in achieving EU climate neutrality. While this presents opportunities, it also poses challenges. Ambitious climate goals necessitate greater confidence in estimates, which can be achieved through enhanced monitoring efforts. In this context, efforts should be directed towards transitioning to higher tiers for specific areas and generating spatially explicit estimates.

Overall development of the LULUCF net emissions (task 1, section 2.1 of this report). The increasing importance of the LULUCF sector in climate policy has revealed the need to clarify better the linkages between LULUCF and other climate policies, especially those related to biomass use (Grassi et al. 2021; Camia et al. 2021). It is especially important to acknowledge that emissions from biomass burning for energy are accounted for in the LULUCF sector and therefore zero-rated in the energy sector. In contrast, while LULUCF includes the carbon stored in harvested wood products, such as sawnwood, wood panels or paper, the substitution benefits

of using wood over other materials is not shown directly. Instead, they are reflected as a change in the emissions from other sectors' emissions. Nevertheless, the LULUCF sector has become an integral part of the EU's climate policy portfolio, and the development of the LULUCF sink will have a direct impact on the EU's emissions reduction achievements in 2030. The scientific analysis conducted within this AA found that the current main drivers of the LULUCF sink – forest growth and forest harvests – are both developing against the climate targets (Korosuo et al. 2023). Reasons for this development are manifold: the past sink was partly explained by the relatively young age structure of forests which are now maturing; harvest levels have increased; and increased impacts of climate change and natural disturbances have led to both decreased growth and increased salvage logging. Reversing these trends is fundamental for getting on track towards the EU climate targets for 2030 and beyond. However, the analysis also revealed substantial recalculations by the MS in the recent years, pointing to a need to improve the timeliness of the data on which the MS reporting of GHG emissions is based on.

The fundamental improvements made to the JRC's forest carbon modelling tool CBM will help to assess the MS results and project possible future scenarios, including potential impacts of climate change and different wood uses (Pilli et al. 2022; Blujdea et al. 2022). Importantly, the model is also increasingly able to incorporate data from remote sensing and other sources, in order to develop near-real time estimates of the LULUCF sink development (Pilli et al., upcoming).

Improvements in the quality and completeness of GHG inventories (task 2, section 2.2 of this report). The work with the MS and their LULUCF GHG inventories under this AA showed clear improvements in the quality and completeness of GHG inventories over the past decade, accompanied by a greater awareness of the increasing role of LULUCF in climate change mitigation. The JRC's efforts, including under this AA, have played a crucial role in promoting a common understanding among Member States and policymakers, ultimately supporting the confidence on LULUCF GHG fluxes and their tracking towards the EU climate targets. The MS GHG inventories – submitted annually to the EU as individual submissions, but also compiled together into an annual EU submission (by the JRC until 2022) – have received fewer remarks from the UNFCCC reviewers over time. The internal QA/QC work made by the JRC until 2022 submission was clearly successful in helping the MS to correct errors and improve consistency of the submitted estimates over the years.

However, while the LULUCF GHG inventories have gradually improved over the years, the requirements from the EU legislation have developed even more. The recent inclusion of the entire LULUCF sector into more ambitious EU climate targets necessitates greater confidence in estimates and additional monitoring efforts. The gap analyses done on the MS submissions 2021 and 2022 showed that several MS are not fully prepared for new monitoring requirements (Abad Viñas 2021, 2022 in Annexes). In particular, there are clear challenges in generating higher tier estimates for carbon pools that are likely significant in the MS inventories, and generating spatially explicit estimates for land use conversions, required by LULUCF regulation 2018/841 by the reporting year 2021. Furthermore, the monitoring requirements in the revised LULUCF regulation 2023/839 require at least tier 2 reporting for all carbon pools in all land reporting categories, and tier 3 estimates for a number of specific areas by reporting year 2026. To support the MS in preparing for the future requirements, the JRC coordinated a group of external experts who provided technical advice to the MS in the topics of moving to higher tiers for soil carbon, the linkages between public and private GHG inventories, and in using earth observation data to support the GHG inventories (Bellassen et al. 2023; Olesen 2023; Herold, upcoming).

Tracking compliance with the LULUCF legislation (task 3, section 2.3 of this report). In the scope of this AA, the JRC supported DG CLIMA and the MS extensively in the implementation of the LULUCF commitments under the second commitment period of the Kyoto Protocol, and in development of the first EU regulation on LULUCF, Regulation (EU) 2018/841 and its revision 2023/839. This work included various forms of support to the MS with the increasing reporting requirements, technical assessment of the national forest accounting plans and the forest reference levels (FRL) (Vizzarri et al. 2021; Korosuo et al. 2021) and scientific and technical advice for improving the LULUCF accounting systems especially for forests. As a result, the EU accounting system for forests' climate impacts has moved step-wise from accounting against a projected baseline (for years 2013-2020 and 2021-2025) to a full inclusion of all reported net emissions in the MS-specific climate targets for 2030.

During the Kyoto Protocol, accounting against forest management reference levels (FMRL) improved the integration of forests and the whole LULUCF sector into climate commitments. However, the Kyoto Protocol accounting approach was found to have some drawbacks. Voluntary accounting of management activities hampered comparability of different MS, and the possibility to include policy expectations in the FMRL was found to give leeway to projection of too loose baselines, whose achievement would not need real climate action to take place (Grassi et al. 2018a). In LULUCF regulation 2018/841, these drawbacks were amended: the

mandatory accounting categories were clearly defined for all, and the baseline for forest land would strictly follow past management practices, with no expectations for future policy development.

However, while improving completeness and accuracy of the national GHG inventories is clearly a positive thing, these improvements tend to lead to a change in the numerical values in accounting. These changes need to be reflected in technical corrections of the accounting baselines (under the Kyoto Protocol and 2018/841) or methodological adjustments of the emissions targets (under 2023/839). This means that when assessing progress against the LULUCF climate targets in the EU or MS level, in addition to comparing a single year's reported value to the target for that year, it is necessary to also consider whether changes made into the GHG inventory time series are likely to lead to a technical correction in the accounting target. The need to ensure comparability of the MS targets and the GHG inventories will remain essential also in the future, referred to as methodological adjustments to the targets in the revised LULUCF regulation 2023/839.

Furthermore, serious efforts to improve the timeliness and robustness of the GHGI estimates also for the most recent reporting years is now essential. This will be the case both for living biomass as well as other carbon pools. Given that compliance against the targets will be assessed in the same year when the full compliance period is reported (i.e. in 2027 for the first submission presenting estimates for 2025, and in 2032 for the compliance towards the 2030 target), non-timely GHG estimates may have serious consequences. The timeliness of the MS inventories will directly affect the countries' comparability under the LULUCF regulations 2018/841 and 2023/839, and also their performance against the climate targets and their credibility.

Related and future JRC work

The JRC will continue to actively contribute to the science-policy interface of LULUCF, while the responsibility of preparing and checking the EU LULUCF GHG inventory was transferred to the EEA from 2023 onwards. In particular, the JRC will work on forest carbon modelling, collaboration with Member States to improve inventory quality, continuing to promote knowledge-sharing initiatives such as the annual JRC LULUCF workshop, and support to DG CLIMA in designing and monitoring forest-related climate mitigation policies.

Furthermore, the JRC LULUCF team has a strong scientific international dimension, including supporting the preparation of IPCC Assessment Reports (e.g. IPCC 2019b), having quantified the role of LULUCF in the countries' emission reduction pledges made in Paris (Grassi et al. 2017), leading an international effort to reconcile land-related estimates between global models and country GHG inventories (Grassi et al. 2018b, 2021b, 2022, 2023), and developing the LULUCF module in the EDGAR emission database (Crippa et al. 2022).

1 Introduction

1.1 Policy context

At the time of launch of the Administrative Agreement ForMonPol, the EU was delivering on the 2020 climate and energy package, which aimed to reduce emissions by at least 40% by 2030, with projected emissions of 60% by 2050, compared to 1990 emissions. The long-term policy and strategies laid out by the Commission sought to ensure that sinks and reservoirs, including forests, are conserved or enhanced with a view of meeting the ambitious greenhouse gas emissions reduction targets of the Union by 2030 and to reduce emissions to net zero by 2050, in line with the Paris Agreement. To help achieve these goals, Regulation 2018/841 on Land Use, Land-Use Change and Forestry (EU 2018a; hereafter, '2018 LULUCF Regulation') set out a robust accounting system and a binding commitment for each Member State to ensure that accounted emissions from land use are at least compensated by an equivalent removal of CO_2 from the atmosphere through action in the sector in the period 2021-2030. The Regulation built on Decision 529/2013/EU, which broadened the coverage of LULUCF accounting, and set up a plan for improving the Monitoring Reporting and Verification (MRV) process of GHG emission and removals. A central part of the 2018 LULUCF Regulation is the accounting regime for managed forest land, which relies on projected forest reference levels, in which the JRC had a central role in both the concept development (Grassi et al. 2018a) as well as in the review of the national forest reference levels for each MS (Vizzarri et al. 2021, Korosuo et al. 2021).

The von der Leyen Commission that came to office in 2019 ramped the climate mitigation targets up considerably. A European Green Deal (EC 2019) presented in December 2019 proposed to make Europe the first climate neutral continent in the world by 2050, and the following 2030 Climate Target Plan proposed to raise the emissions reduction target of 2030 to 55% reduction compared to 1990 emissions. These ambitions were agreed by the co-legislators and set into the first European Climate Law in 2021. In connection to that, all climate-related legislation in the EU was reviewed, including the 2018 LULUCF regulation. The Commission Impact Assessment (EC 2021a), to which the JRC contributed extensively, highlighted the need to stop and reverse the decline of the LULUCF sink in the EU, and proposed to simplify the accounting framework for the LULUCF sector and enhance the sector's climate contribution through a binding target. This approach was endorsed by the Parliament and the Council, and the revised LULUCF regulation 2023/839, entered into force in May 2023. In the 2023 LULUCF regulation (EU 2023), the EU MS collectively commit to achieve net removals of -310 Mt CO_2e in the EU LULUCF sector in 2030, with individual LULUCF targets for each MS. In addition, the 2023 LULUCF regulation requires the MS to improve land monitoring, including a requirement for nationally-specific estimates (at least IPCC Tier 2) of all carbon pool changes, and enhanced monitoring of specific areas, such as those with high carbon stocks or high biodiversity values.

1.2 Role of forests and forest management in climate policy

The forest-based bioeconomy can contribute to climate mitigation by increasing the carbon storage in forest land and in harvested wood products (HWP) and by substituting GHG-intensive materials or energy from fossil fuels, thereby avoiding GHG emissions in other sectors. In all reported years (i.e. since 1990), both forest land and HWP have acted as net carbon sinks in the EU, removing on average about -400 Mt CO_2e/yr and -38 Mt CO_2e/yr, respectively, during 1990-2021 (EEA 2023). Thanks to these sinks, the overall LULUCF sector, which also includes the net GHG sources from other land uses (i.e. cropland, grassland, wetlands, settlements), was a net sink of about -230 Mt CO_2e/yr in the latest reported year 2021, corresponding to ca. 7% of total EU GHG emissions excl. LULUCF. The EU GHG inventory, as a sum of the MS' GHG inventories, reports a total LULUCF sink of at least -300 Mt CO_2e/y for 1995-2016, with a clear decrease thereafter to -230 Mt CO_2e in 2021 (EEA 2023). It is noteworthy that this decrease is driven by the substantial decline of the sink in forest land since 2016.

Enabling the EU to become climate neutral by 2050 (EC 2020a) has been estimated to require, on top of a drastic decarbonisation of energy, transport, industry and other sectors, that the net sink from LULUCF reaches about -425 MtCO_2e/yr (EC 2020b) in order to compensate for the remaining GHG emissions, e.g. from agriculture and some industrial sectors. For forest land, this scenario was in 2020 estimated to imply increasing the net sink from the level of -360 Mt CO_2e/yr to -450 Mt CO_2e/yr by 2050 (EC 2020b). Consequently, the climate mitigation potential in conjunction with other sustainability aspects related to using wood to replace GHG-intensive materials and for energy are attracting increasing attention in scientific and policy discussions. However, as discussed in Korosuo et al. (2023 – see details in section 2.1.3), the development of the forest sink has recently developed rapidly against the climate change mitigation targets.

Furthermore, forests provide many ecosystem services other than wood supply and carbon sequestration, such as regulation of the water cycle, protection against erosion, hosting and conservation of biodiversity, and provision of cultural and social benefits. At the EU level, modern forest management attempts to balance different services while taking into account the existing complex interactions and the needs of society, considering the forest as a "multi-functional" system (Forest Europe 2020; Mauser et al. 2021). While many of these ecosystem services have clear co-benefits with climate change mitigation and adaptation, there are also some essential trade-offs, in particular between forest carbon stocks and bioeconomy development, that need to be weighed carefully when designing forest-related climate policy.

1.3 Overview of recent JRC institutional activities relevant for this Administrative Arrangement

Beyond the specific tasks foreseen in the Administrative Arrangement (see below), the JRC LULUCF team has in parallel been involved in a number of policy-support and scientific activities.

As part of the EU GHG monitoring mechanism (EU 2013a), until 2022 (end of the Kyoto protocol 2nd commitment period) the JRC was responsible for the LULUCF sector in the EU GHG inventory submitted annually to the UNFCCC. This means checking MS' GHG inventories (under both the Convention and the Kyoto Protocol), supporting MS in improving the completeness and quality of their estimates, compiling the EU-level estimates and writing the relevant chapters of the EU GHG inventory, and participating to the UNFCCC review process. Furthermore, in the last decade, the JRC has supported DG CLIMA on a number of technical and scientific issues emerging during LULUCF negotiations at both UNFCCC level (Kyoto protocol and Paris Agreement), EU level (Decision 529/2013 (EU 2013b), Regulations 2018/841 and 2023/839), through institutional work and dedicated AAs. The JRC is also involved in the UNFCCC review process of GHG inventories for other countries.

Since 2023, the task of checking the EU LULUCF GHG inventory is carried out by the EEA. The JRC will continue to be active in the science/policy LULUCF interface, particularly in forest carbon modelling, in working with MS on science and methods to improve quality of LULUCF inventories, and in supporting DG CLIMA in the design and monitoring of forest-related climate mitigation policies. This work will be reflected, among others, in the annual JRC LULUCF workshops that will continue to be organized by the JRC.

Furthermore, the JRC LULUCF team has a strong scientific international dimension, including supporting the preparation of IPCC Assessment Reports (e.g. IPCC 2014, IPCC 2019a, IPCC 2019b), having quantified the role of LULUCF in the countries' emission reduction pledges made in Paris (Grassi et al. 2017), leading an international effort to reconcile land-related estimates between global models and country GHG inventories (Grassi et al. 2018b, 2021b, 2022, 2023), and developing the LULUCF module in the EDGAR emission database (Crippa et al. 2022).

1.4 Aim of this Administrative Arrangement

Under the Administrative Arrangement Forest Monitoring for Policies ("ForMonPol"), the JRC supported DG CLIMA within two distinct sets of work. This final report describes the activities carried out within Lot 1 (Improved GHG Inventories for better Forest Policies, "InFoPol"). The work carried under Lot 2 (Tropical moist Forest Monitoring, "TroFoMo") of ForMonPol is reported in a separate document (Achard et al., upcoming).

Within InFoPol, the work was structured into three main tasks:

1) Thematic policy action development, delivering up-to-date scientific compendium of potential actions; analysis of forest mitigation potential, including the geographical scope of application; technical determination of data requirements for implementation (and hence, link to GHGIs).
2) Inventory development, to help the MS inventories to comply with Regulations 2018/841 (LULUCF) and 2018/1999 (Energy Union Governance) requirements.
3) Tracking progress and compliance under the LULUCF legislation under the Kyoto Protocol (Reg. 525/2013 and Decision 529/2013), and preparation for compliance under 2018/841 and 2018/1999.

The specific sub-tasks under each main task and their results are outlined in the next sections.

2 Tasks carried out within this Administrative Agreement

The tasks performed under this Administrative Agreement are outlined below according to the three prioritized themes described above.

2.1 Task 1: Thematic policy action development

Within this task, the main aim was to identify potential improved forest mitigation actions in the EU, including optimized forest management and harvested wood product (HWP) supply pathways, and exploring the impact of different scenarios on the overall forest mitigation potential (sink, energy and material substitution). The work was conducted through analysis of the scientific literature, of the latest GHG inventories and through forest modelling, involving also substantial model development.

In addition, the JRC has carried out an overarching work supporting LULUCF policy action development, including providing clarifications on GHG reporting and accounting of LULUCF and supporting DG CLIMA, DG ENER and DG ENV in the preparation of LULUCF and forest-related legislation. The following sections firstdescribe this overarching work, and then provide a more detailed description of the specific tasks done under task 1.

2.1.1 Overarching work supporting LULUCF policy action development

The climate impact of forests is complex, as forests both absorb and emit GHGs: biomass growth and accumulation of carbon in forest soils removes carbon from the atmosphere, while biomass burning (in wildfires and for energy production) and biomass decay emit carbon to the atmosphere. Furthermore, carbon is stored in wood used for harvested wood products (HWP), such as sawnwood, panels and paper. According to international agreements, in the GHG inventories all these removals and emissions of GHGs that originate from managed lands are reported in the LULUCF sector. To avoid double-counting, emissions from biomass burning are rated as zero in the energy sector. In opposite, the climate mitigation benefit of wood that is used to substitute fossil-based fuels or products is not reported separately, but instead is indirectly shown in the reporting through reduced fossil-based emissions.

These reporting modalities create often confusion, and may lead to misinterpretation of the EU climate policies and mitigation potential of forests, risking to distort policy development. In 2020, the JRC provided DG CLIMA detailed analyses of different reports that were, from opposing angles, found to overlook the role of LULUCF reporting in the overall climate mitigation framework (JRC comments on EASAC report on forest Bioenergy in May 2020; JRC analysis of the CEPI study authored by P. Holmgren on material substitution in Sep 2020). In the analyses, the JRC emphasized the need to consider the GHG inventories as a whole: contrary to what was claimed by EASAC in 2020, bioenergy is not considered climate neutral, but the emissions are instead fully accounted in the overall GHG inventories, as part of the LULUCF sector. On the other hand, contrary to what was suggested in the CEPI study in 2020 in the Swedish context, the GHG reporting and EU legislation do not neglect substitution impacts of wood products; these are considered as reduced emissions on non-LULUCF sectors. In both cases, it is necessary to emphasize the role of the LULUCF sector as a part of the overall climate monitoring framework – and similarly, the impacts of the EU LULUCF regulation cannot be fully assessed without a holistic view over the whole EU climate-related legislation.

Furthermore, the JRC has provided extensive inputs to the Staff Working Document (SWD) of the EU Forest Strategy[2], including the quantification of the sink in 2050 associated with the 3 Billion trees initiative by 2030[3], and extensive inputs to the Impact Assessment (IA) of the proposed revised LULUCF regulation in 2021[4].

[2] SWD/2021/652 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0652&qid=1672909643093
[3] SWD/2021/651 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0651&qid=1672917506492
[4] SWD/2021/609 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=SWD:2021:609:FIN

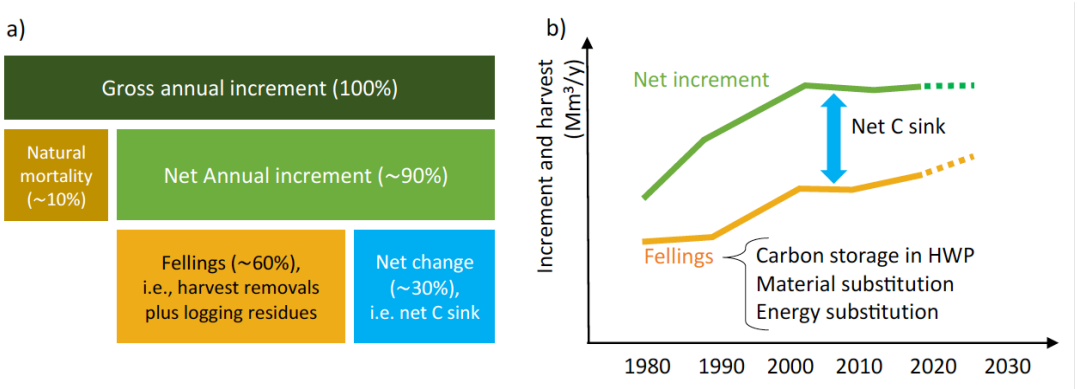
2.1.2 Assessment of forest mitigation potential and links with other sectors

In 2021, the JRC published two reports on assessing the forest mitigation potential and the links with other GHG sectors.

1) Policy brief on the role of the forest-based bioeconomy in mitigating climate change through carbon storage and material substitution (Grassi et al. 2021a) prepared together with the Bioeconomy Knowledge Centre. The policy brief explained the role of forests in the EU climate policy, the main components determining the net carbon sink (see Figure 1 below) and discussed the unavoidable trade-offs between utilization of the forest resources for bioeconomy development and the consequent impacts on the forest sinks, which need to be taken into account when deciding on forest-related policy action. The policy brief raised broad interest among the policy makers, and was discussed in several meetings within the Commission, including presentations to eight different Cabinets. The key messages of this report are summarized below:

1. Assessing the role of the forest-based bioeconomy in mitigating climate change requires a "system-perspective", considering all possible options: increasing carbon stocks ('net sink') in forest land and in Harvested Wood Products (HWPs), and using wood to substitute other materials or fossil fuels.
2. Reducing the harvest appears the easiest option to increase the net forest sink in the short to medium term (2030-2050). However, this option would have negative socioeconomic impacts in the forest sector and would likely lead to a net forest sink saturation in the long term.
3. Increasing the harvest would make more wood available for carbon storage in HWPs and for material substitution. However, in the short to medium term, the potential additional benefits from HWPs and material substitution are unlikely to compensate for the reduction of the net forest sink associated with the increased harvest.
4. A further increase in the net annual forest increment, through forest management practices and new forest area, is necessary to reverse the current trend of declining sinks and thus align the contribution of the forest-based bioeconomy with the EU goal of climate neutrality by 2050.
5. Part of this extra increment could also increase the potential for carbon storage in HWPs and for material substitution. A shift towards greater use of wood products with longer service lives and substitution benefits can enhance their climate change mitigation benefit.
6. A holistic assessment is essential to guide policies that ensure that the forest-based bioeconomy makes an effective and resilient contribution to climate change mitigation. For example, where a future increase in harvest is expected because of age-related dynamics in managed forests or adaptation needs, then using this 'unavoidable' extra harvest for storing carbon in wood products and for material substitution would bring climate benefits compared with a business-as-usual scenario of wood use.

Figure 1. a) Main components determining the net carbon sink (blue box) in forest biomass; the numbers are approximations for the EU (2004-2013). b) Conceptual illustration of the historical trend in the net increment and fellings of forest biomass and their short-term projected evolution. Natural disturbances are included partly in natural mortality and partly in fellings (i.e. salvage logging). Original source: Figure 3 in Grassi et al. 2021a.



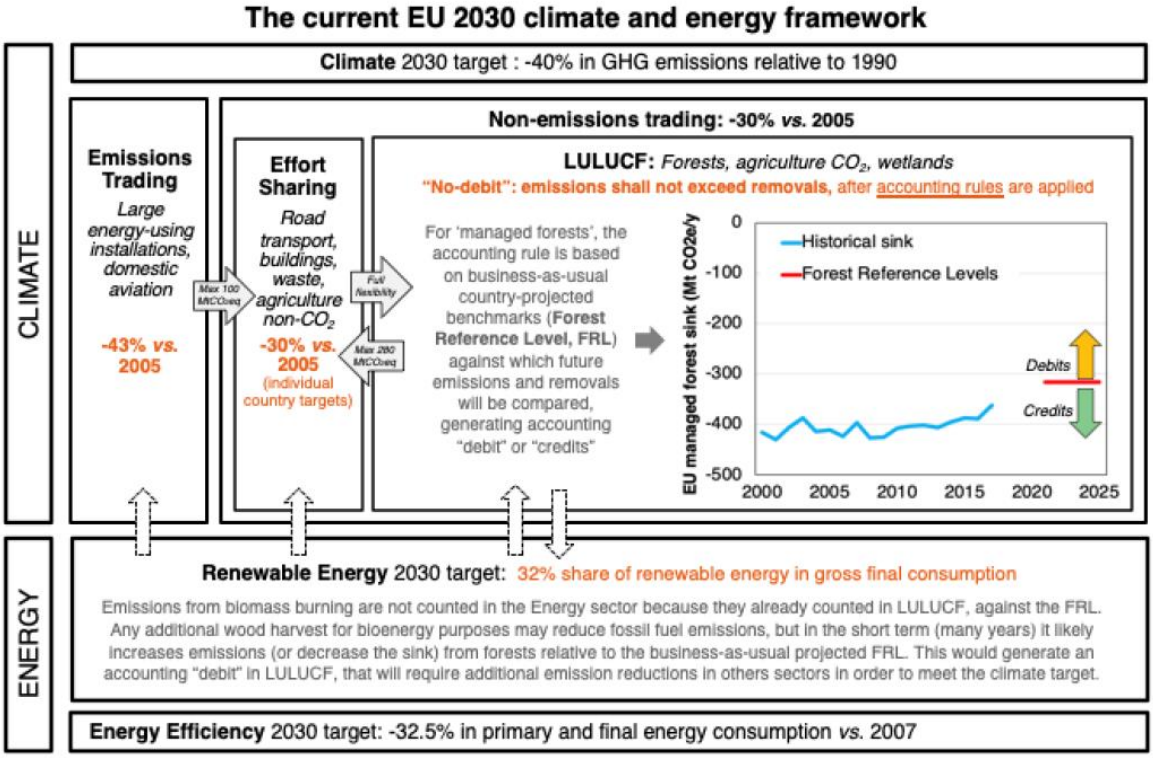
2) The use of woody biomass for energy production in the EU (Camia et al. 2021). Among other things, this report clarifies the interconnected nature of the different parts of EU legislation – especially the LULUCF regulation (EU 2018a) and Renewable Energy Directive (EU 2018b, EC 2021b). In particular, these links are discussed in chapter 5.3 in Camia et al. (2021; as exemplified in the Figure 2 below), and were reflected in the Executive Summary:

"Bioenergy is not accounted for in the energy sector because these emissions are already counted in the LULUCF sector (Regulation 2018/841) as a change in carbon stocks. Therefore, it is incorrect to say that bioenergy is assumed "carbon neutral" within the broader EU climate and energy framework. The carbon impact of any change in management or wood use relative to a historical period is fully counted in the LULUCF sector, against the FRLs. The consequence of this approach is that trade-offs exist: any additional wood harvested for bioenergy purposes (or a greater energy use of wood) may reduce fossil fuel emissions under the ETS or effort sharing sectors but will also generate an accounting debit in LULUCF if it brings emissions beyond the FRL, for example if this extra harvest goes beyond the harvest expected in the FRL and is not compensated by an equivalent extra forest growth. Since any LULUCF accounting debit would require additional emission reductions in other sectors to meet the country climate target, the overall climate benefit of any extra wood used for bioenergy should be carefully evaluated. We identify factors that may potentially lead to unintended outcomes, for example, increased carbon emissions due to an excessive use of forest bioenergy. These factors include a mismatch of policy incentives for different target groups (REDII stimulates bioenergy demand by economic operators, while LULUCF disincentivises countries to harvest beyond certain limits) and poor communication among actors. Managing the risk of unintended outcomes requires, first and foremost, a greater awareness by countries of the REDII/ETS-LULUCF links and the associated trade-offs. This awareness should then be reflected in the national relevant plans (National Energy & Climate Plans), through coherent policies and financial incentives at national and local level, combined with a timely and reliable monitoring of the use of wood for energy production. As a general principle, prioritising residues and the circular use of wood remains key for maximising the positive climate impact of wood-based bioenergy. Qualitative criteria have been proposed in the literature to identify bioenergy pathways with low risks of increased carbon emissions compared to fossil fuels in agreement with many of the win-win pathways identified in this report. These criteria may help the implementation of energy and climate legislation by countries and bioenergy operators."

Furthermore, the report provides a detailed analysis of the availability and sustainability of different types of forest biomass that could potentially be used as energy feedstock. This report has become a cornerstone of the discussion on biomass used for energy in the EU, and has contributed widely to better understanding of the sustainability of wood biomass use in the EU among policy makers, industry, and the NGOs. In particular, the suggested need to link the National Energy & Climate Plans and LULUCF targets is now reflected in the agreed revision of the RED Directive[5].

[5] Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. PE/36/2023/REV/2. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202302413

Figure 2. Schematic representation of the EU 2030 (EU27+UK) climate and energy framework, including the targets (orange text) for each legislation. The figure refers to the EU climate target of –40% in 2030 relative to 1990, which has subsequently been updated to –55%.. Original source: Figure 30 in Camia et al. 2021.



2.1.3 Analysis of the EU LULUCF targets for 2030

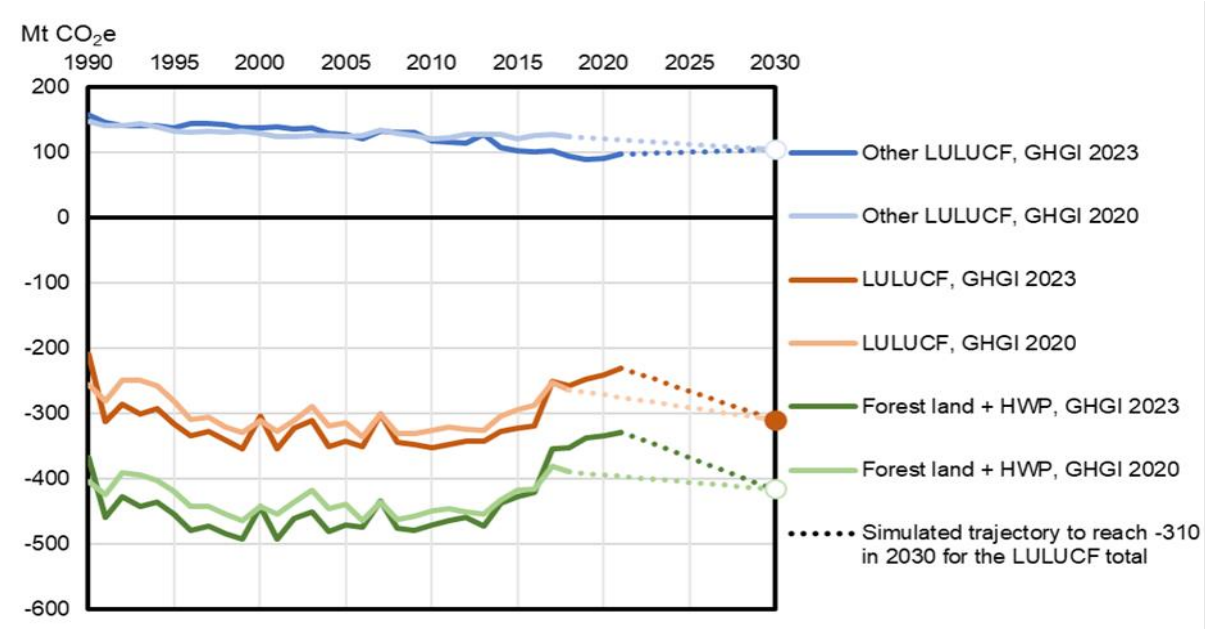
A recent JRC scientific study (Korosuo et al. 2023) evaluated to what extent the forest sink is on track to meet the 2030 climate goals of the EU. For this assessment, we use data from the latest national GHG inventories and a forest model (Carbon Budget Model). The findings indicate that on the EU level, the recent decrease in increment and the increase in harvest and mortality are causing a rapid drop in the forest sink. Furthermore, continuing the past forest management practices is projected to further decrease the sink. The paper also discusses options for enhancing the sinks through forest management while taking into account adaptation and resilience.

As discussed in the study, the contribution of the LULUCF sector to the overall emissions reduction target of -55% in the EU is limited to a maximum of -225 Mt CO_2e/y (EC 2021a). Achieving the LULUCF sector target of -310 Mt CO_2e in 2030 will elevate the total EU GHG emission reduction to approximately 57% compared to 1990 (Urrutia et al. 2021). However, the sector is now rapidly moving against the targets: while the gap was 42 Mt CO_2e (2016-2018 vs. 2030) at the time of the proposal that led to revised LULUCF regulation 2023/831 and the target of -310 Mt CO2e, in only three years this gap has already widened to 80 MtCO_2e (2021 vs. 2030) (see Figure 3 below).

The recent decrease of the EU forest sink may jeopardize the fulfilment of the overall LULUCF sector target for 2030. If the recent negative development continues, even the overall 55% emissions target for the EU may be at threat. In 2021, the LULUCF sink was -230 Mt CO_2e, which is 45 Mt CO_2e weaker than the sink only three years earlier (2016-2018; the period used as a basis for setting the LULUCF targets for 2030), and only 5 Mt CO_2e stronger than the sink on which the 55% emissions reductions target relies on. Stopping and reversing the negative trend calls for rapid changes in land management, especially in forests. Furthermore, natural disturbances are expected to increase with the ongoing climate change (e.g. Forzieri et al. 2022), making the situation even more difficult. The challenge is that actions to improve GHG removals (carbon accumulation in biomass or soils) are typically reflected only after several years or even decades. Limiting forest harvests is one of the few actions with a short-term positive impact on sinks – however, it is associated with direct socioeconomic impacts and therefore is politically very difficult to enforce. In addition, it may also have adverse impact on climate change mitigation in the long term. Nevertheless, it is now clear that on the EU level, and in

many MS individually, there is no room for further increase in forest harvest levels without serious consequences on the EU LULUCF commitments and on the EU climate targets in more general.

Figure 3. Trends of EU-27 net emissions and removals for LULUCF, Forest land + HWP, and other LULUCF categories, as reported in the GHGI 2020 and GHGI 2023, and a comparison between the trajectories needed to reach the agreed target of -310 Mt CO2e for the total LULUCF sector in 2030. The additional net removals initially needed for the -310-target are assumed to be split equally between Forest land + HWP and other LULUCF categories, reflecting the modelling underpinning the Impact Assessment for the revised LULUCF regulation (EC 2021a). Original source: Figure 5 in Korosuo et al. 2023



An important part of the paper is a section that clarifies the role of common concepts in forest management – net annual increment, harvest and mortality – in determining the forest sink. These concepts and their interconnections are in our experience often misunderstood. In particular, it is important to note that pure maintaining the sink in the forest means that the forest stock is continuously increasing, i.e. that increment remains higher than harvest. In contrast, increasing the sink requires that forest increment increases at a faster rate than the harvest, or inversely that harvests decrease relative to increment. That is, enhancing the sinks requires a substantially stronger effort from forest management than the traditional concept of sustainable yield, which is achieved when the harvest remains below increment.

As conclusions, our findings in the study use the latest GHG inventory data to show that the EU forest sink is quickly developing away from the EU climate targets. Stopping and reversing this trend requires rapid implementation of climate-smart forest management, with improved and more timely monitoring of GHG fluxes. This enhancement is crucial for tracking progress towards the EU's climate targets, where the role of forests has become – and is expected to remain – more prominent than ever before.

2.1.4 Updates in the Carbon Budget Model (CBM)

The JRC has almost a decade of experience in using the Carbon Budget Model (CBM-CFS3) both at EU and at country level. The CBM-CFS3 is an inventory-based, yield-data driven model that simulates the stand- and landscape-level C dynamics of above- and belowground biomass, dead wood, litter and soil (Kurz et al. 2009). In support of EU policy, it can be applied to 25 MS (all EU MS excl. Malta and Cyprus), based on a specific parametrization of the original model's assumption and on the EU administrative, ecological and silvicultural conditions (e.g., Pilli et al. 2016c). The results have been scientifically peer-reviewed in a large number of publications and science reports (e.g., Pilli et al. 2013; Pilli et al. 2016a; Pilli et al. 2016b; Pilli et al. 2022) and used to support LULUCF legislation, and in particular the development and implementation of the Forest Reference Level concept (Grassi et al. 2018a; Korosuo et al. 2021; Vizzarri et al. 2021). The following sections

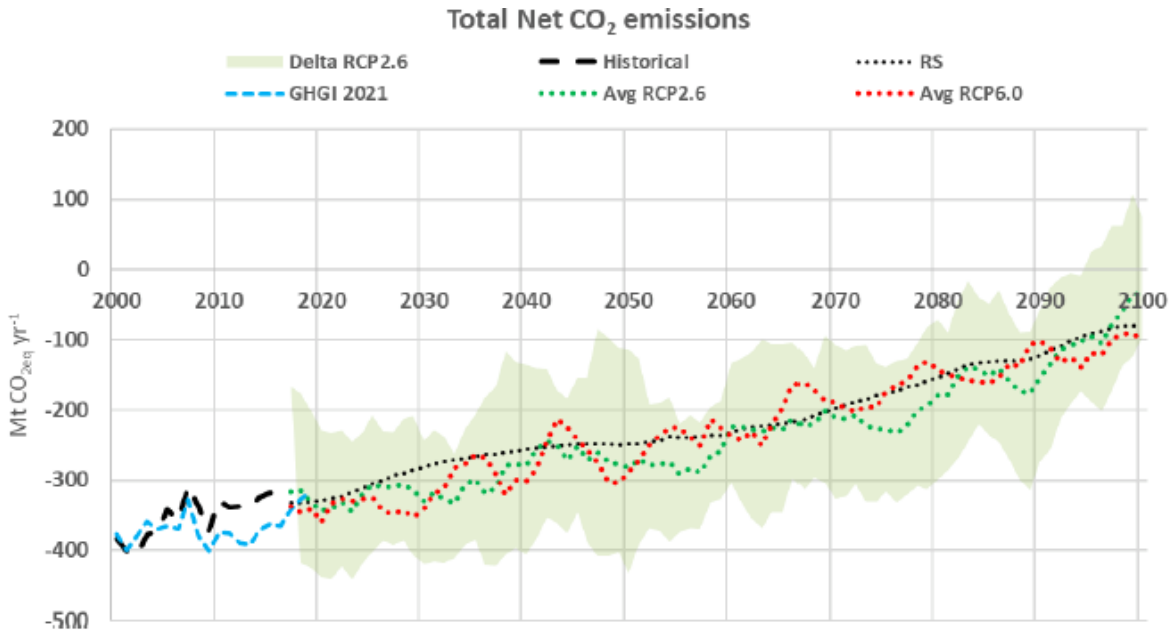
describe the substantial improvements that occurred in recent years, largely as part of the AA FORMONPOL: (i) Inclusion of climate effects in the CBM projections; (ii) Major modelling update of the CBM; (iii) Towards near real-time proxy estimates for forest C fluxes.

2.1.4.1 Inclusion of climate change effects in the CBM projections

Forest growth models typically do not consider the expected impact of climate change (e.g. CO_2 fertilization, changes in temperature or precipitation, etc.). A JRC study (Pilli et al. 2022) combined the output provided by four land–climate models – run under two different Representative Concentration Pathway scenarios (RCP2.6 and RCP6.0) – to parameterize the input data used in CBM. This hybrid modelling approach allowed to quantify the impact of climate change and forest management in the long-term (i.e. to 2100) evolution of the EU27+UK forest carbon budget. This approach was tested using a business-as-usual (BAU) scenario, based on the continuation of the management practices applied by EU MS and the UK within the historical period 2000–2015. It is important to note that this study does not explore a specific policy scenario but describes a methodological framework.

The results of this study highlight that, under our business-as-usual case, the EU27+UK forest carbon sink would substantially decrease in the coming decades. The main driver of the long-term evolution of the forest carbon sink is the ongoing ageing process of the European forests, mostly determined by past and ongoing management. In addition, climate change may further amplify or mitigate this trend. Due to the large uncertainty in climate projections, in 2050 the net carbon sink may range from -100 to -400 Mt CO_2e yr^{-1} under RCP2.6 (see Figure 4). These results suggest that while a change in management practices would be needed to reverse an otherwise declining trend in the sink, climate change adds a considerable uncertainty, potentially nearly doubling or halving the sink associated with management.

Figure 4. Net CO2 emissions (reported as $MtCO_2e$ yr^{-1}, with negative values conventionally depicting CO_2 removals from the atmosphere) estimated within the historical period, under the reference scenario (RS) and under RCP2.6 and RCP6.0 (reported as the average values estimated from different climate models within each RCP scenario). The figure also reports the net emissions reported from the 27 EU MS and the UK, according to the GHGI 2021 (referring to the category Forest Land Remaining Forest Land, as reported in UNFCCC CRF Tables in 2021), and the range between the minimum and maximum values estimated under RCP2.6. All values derived from the present study are reported as 5-year moving averages, referring to the category Forest Land Remaining Forest Land, excluding HWP net emissions. Original source: Figure 9 in Pilli et al. 2022.



2.1.4.2 Major modelling update of the CBM

Under this AA, the forest sector modelling capacity of the JRC was improved substantially, jointly with funding from DG RTD N° 013 KCB (LC-01591551, run by JRC Biomass group).

The forest land component is now modelled by an EU-specific version of CBM, named EU-CBM-HAT, aimed to develop a version of CBM which is more flexible, faster to run and designed to cover all GHG sources and sinks related to forest land and wood use (see figure 5 below). This new version is designed to support policy formulation, implementation and evaluation as well as scientific investigations. A specific technical report published by the JRC provides both for the scientific background behind the development and the user guidance of the model (Blujdea et al. 2022).

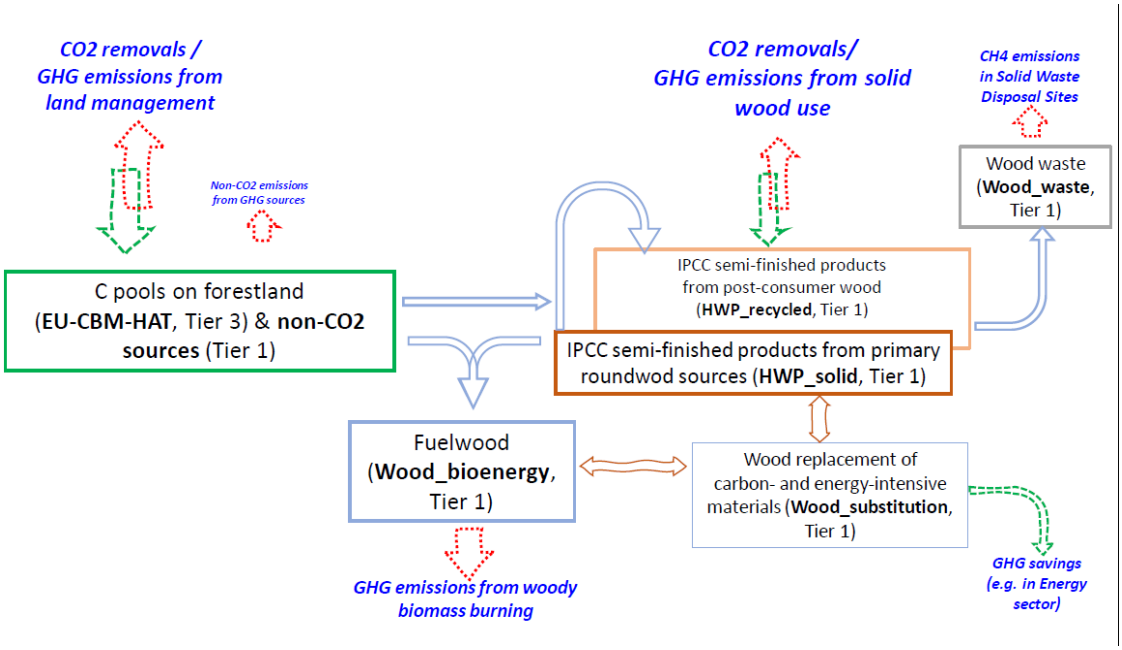
The EU-CBM-HAT is conceptually identical to the CBM-CFS3 model, but enables for a faster assessment of multiple scenarios, including different forest management strategies and higher specificity in salvage logging after natural disturbances, various harvest levels and use of wood materials (industrial roundwood and fuelwood). The EU-CBM-HAT core package integrates three packages:

1. "libcbm" (as a C++ rewrite of CBM-CFS3 Version 1.2) as the forest growth and disturbances simulator (developed by Forest Carbon Accounting team of the Canadian Forest Service);
2. "COMBO", as the tool for the combination of different scenarios; and
3. "HAT", as the harvest allocation tool (both in Python, developed by the JRC).

One of the strengths of the improved model is the rule-based allocation of industrial and fuelwood demands. The model is open-source (released and maintained by the JRC), with a dependency to the open-source libcbm model released and maintained by the Canadian Forest Service. The development incorporated into EU-CBM-HAT provides for an increased transparency of the modelling chain for forest-related applications associated with GHG reporting and mitigation strategies.

Additionally, a downstream module simulating emissions and removals from wood use is plugged into CBM. Conceptually it embeds IPCC default approaches for all sources (HWP, waste, non-CO2 emissions), but using JRC-specific datasets, e.g., harmonized EU woody biomass flows (Cazzaniga et al. 2022 and EUROSTAT accounts data (e.g., on waste and recycled wood). The novelty is also that the forest sector framework is plugged into an upstream model, GFPMx (Global Forest Production Model, an implementation of Buongiorno 2021 by Rougieux et al., report/scientific publication in preparation), which models the wood production and trade based on economic scenarios of wood demands (e.g. socioeconomic pathways). Other examples of interoperability of the forest sector model include POTEnCIA and CAPRI (Barbosa et al. 2023).

Figure 5. Integration of EU-CBM-HAT within the forest sector model. Boxes represent the tools for modelling pools size across forest land and wood use chain. Solid arrows represent material fluxes. Dashed arrows represent GHG fluxes.



Based on this new modelling framework the JRC launched an overall revision of all the main input data implemented by EU-CBM-HAT, including steps toward moving the modelling capacity from spatially-referenced to spatially-explicit (see later). At this purpose, all previous model runs, calibrated against the data available to 2015 and based on the CBM-CFS3 model, were moved to the new model, and updated to 2020, assuming the period 2010–2020 as historical period for the model calibration (Pilli et al., upcoming). In particular, for each country, we updated all the main input data used by the model. Specifically:

1. Data on age structure, volume and increment, when available, were updated, according to more recent National Forest Inventories, based on data collected within the period 2008-2012, assuming, for most of the countries, 2010 as starting year for the calibration period. Volume and increment data reported at country level were also harmonized, to a common definition, taking into account other ancillary information provided by literature (see Avitabile et al. 2023; Gschwantner et al. 2019).
2. The total forest area was spatially distributed, for most of countries, at NUTS2/3 level, according to the information directly reported by NFI and to ancillary data based on an integrated assessment of forest biomass maps, field plots and national statistics (Avitabile et al. 2020). For each country, the area was also distributed between forest area available (FAWS) and not available (FNAWS) for wood supply, taking into account the assessment of a harmonized definition of FNAWS, as described in Avitabile et al. 2023. Most of forest management practices were assigned to FAWS. Within the historical period 2010-2020 for all the countries (except Hungary, Italy and Ireland) the forest area was assumed as constant and calibrated against the total forest area assessed by Avitabile et al. (2023), for the year 2020.
3. All assumptions on forest management activities, such as rotation length and the share of harvest provided by final cut for even-aged stands were revised taking into account of specific information reported by literature, such as the National Forestry Accounting Plans submitted by EU MS under the 2018 LULUCF regulation (Korosuo et al. 2021). These data were used as a basis for assessing the management practices applied within the historical period 2010-2020, further calibrated against the amount of harvest removals reported by countries.
4. The update of the database also includes more consistent background data on conversion volume-to-biomass, based on JRC sub-contracts with NFIs, e.g., Specific Contract No. 17 "Use of National Forest Inventories data to estimate biomass in the European Forests", in the context of the "Framework contract for the provision of forest data and services in support to the European Forest Data Centre" Reference: 2012/ S 78-127532 of 21/04/2012. 15th April 2016 by Lea Henning, Kari T. Korhonen, Adrian Lanz & Thomas Riedel.
5. The total amount of harvest was updated according to the data reported by FAOSTAT, and further compared with other data sources to assess possible inconsistencies. The harvest was further

distributed at country level, between coniferous and non-coniferous species, taking into account also the share of industrial roundwood and fuelwood, as reported by FAOSTAT. For each country, we defined a set of silvicultural practices applied to each forest type and management system (i.e., even-aged and uneven-aged high forests, coppices, etc.) specifically calibrated against these input data, also including specific assumptions on the removals of logging residues, both within the ordinary management practices and after major natural disturbance events (salvage loggings)

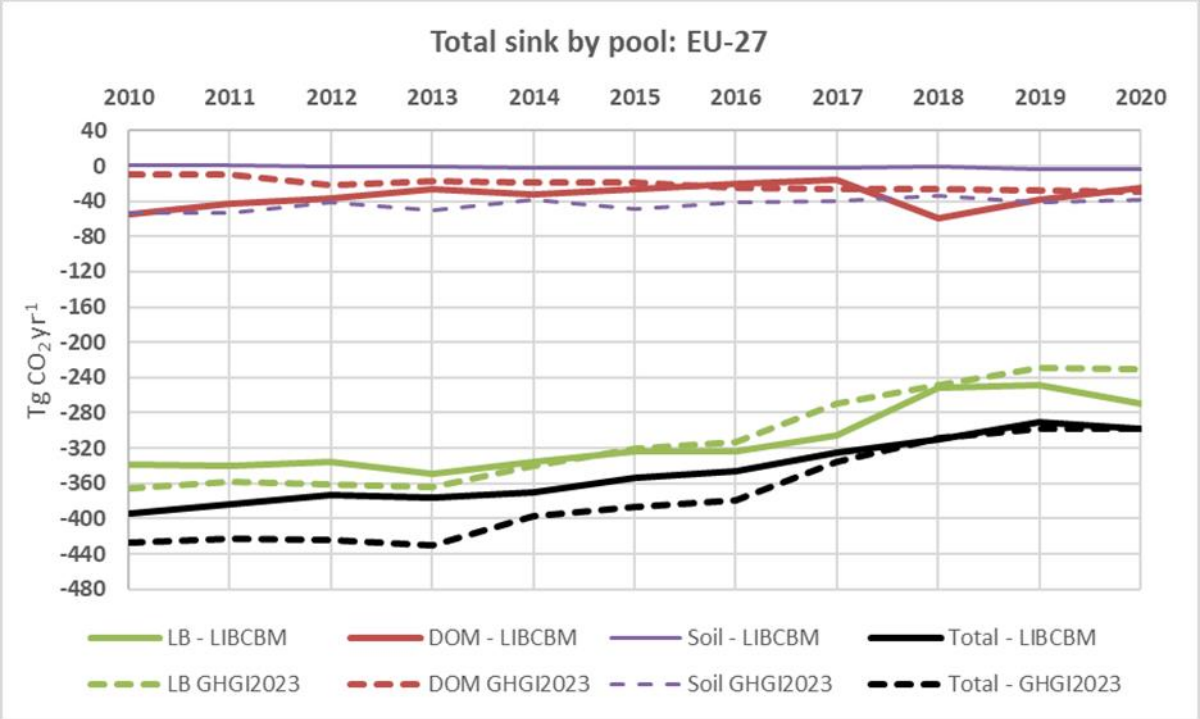
6. For each year, the amount of harvest assigned to final cut or major management practices (including salvage logging due to natural disturbances), were spatially distributed, at NUTS2/3 level, according to specific data collected by remote sensing (see Ceccherini et al. 2020).
7. All simulations included the impact of major natural disturbances, mostly assessed through the amount of salvage logging derived from data provided by countries (see Avitabile et al. 2023). Forest fires, distributed at NUTS2/3 level, were also included in line with data reported by EFFIS, further integrated with data directly provided by countries (i.e. CRF tables).
8. Additional tools use historical data reported to UNFCCC for projections of conversion from forests and to forest, for the selected projection period.
9. A further additional tool is available to generate time series for the natural disturbances during the projection period. This one contains a Weibull generator built on historical record of disturbances in JRC database (2021) on salvage logging, so emulating natural disturbances for the simulated period with similar frequency and magnitude as in the past.

All model outputs were compared, for the historical period 2010-2020, with other data sources including the countries' GHGI, to assess the consistency of the overall net forest carbon sink, the volume and increment data reported by literature, and other assumptions such as the distribution of harvest demand or the stock assigned to living biomass and dead wood pools. One major outcome of the update of the model background data would be full consistency of volume-biomass-carbon for the merchantable component, so expected improved comparability to NFIs estimates.

Preliminary EU-CBM results of the forest sink at EU scale for forest land following the calibration exercise are shown in Figure 6 below.

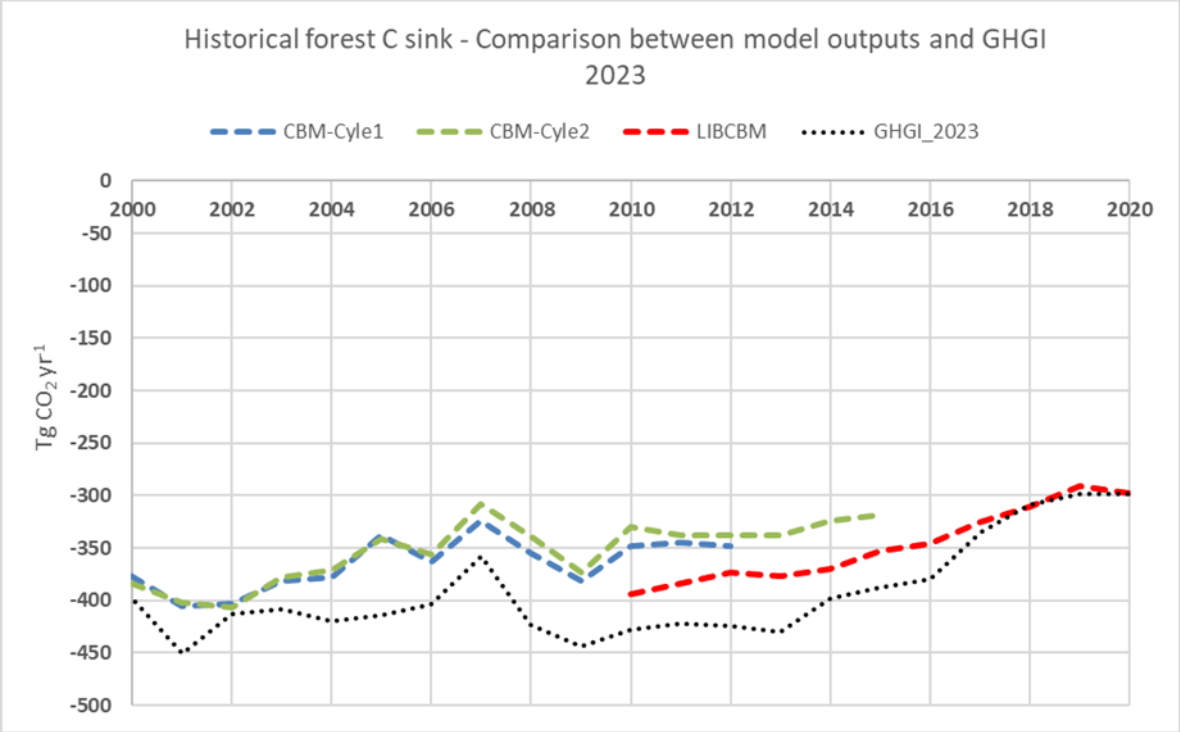
We note that, while a spatially-explicit version of CBM is used in Canada (G-CBM), at present it cannot yet be used in the EU, due to the lack of spatially-explicit inputs. We will continue exploring the options of using proxies like biomass map for 2020 by Avitabile et al., with the view of producing spatially explicit CBM estimates in the medium term (a few years).

Figure 6. Total C sink estimated by EU-CBM-HAT and reported by EU countries' GHGI (2023) for the categories FL-FL, L-FL (afforestation) and FL-OL (deforestation), further distinguished between living biomass (LB), dead organic matter (DOM, including DW and litter) and soil (only including mineral soil for GHGI data). GHGI data do not include CY and MT. Original source: Figure 18, Pilli et al., upcoming..



These results can also be compared with previous estimates provided by CBM-CFS3 model runs. A first assessment focused on the historical period 2000–2012 and considered 26 EU countries (including UK and excluding MT and CY) with a total forest area equal to about 146 Mha. The area included about 138 Mha classified as Forest Management (at time step zero of the model runs), 8 Mha (in 2012) of afforested land, and 2.8 Mha of deforestation. Due to this last component, the area classified as Forest Management slightly decreased during the model run, but this area decrease was compensated by an increase in afforestation. Unproductive forests (according to countries' GHGIs) and overseas territories were not included in this study (see Pilli et al. 2016a, b for details). A second assessment, focusing on the historical period 2000–2015 and including the same countries considered by previous study, considered a total forest area equal to about 156 Mha in 2015, without specific distinctions between various land use categories (see Pilli et al. 2022). Figure 7 shows the comparison between the total net C sink provided by these assessments with the corresponding C sink provided by libcbm-component of the new EU-CBM-HAT.

Figure 7. Comparison between the total net C sink reported by GHGI 2013 for EU-27 (excluding MT and CY), and the values estimated by the present study and by previous studies using the CBM-CFS3 model: CBM-Cycle 1, focusing on the historical period 2000 - 2012 and CBM-Cycle 2, focusing on the historical period 2000 – 2015. Original source: Figure 20, Pilli et al. upcoming JRC technical report.



2.1.4.3 Near real-time proxy estimates for forest

One of the main goals for improving the forest modelling capacity and updating the CBM model was to pave way for a modelling framework that, in combination with earth observation (EO) tools, can produce "near real-time" proxy estimates of forest net emissions in each MS, to complement the MS GHG inventories that report estimates for the year two years prior to the inventory submission (e.g. GHGI 2023 reports emissions until 2021). With the near-real time estimates, modelling can provide proxy inventory results up to inventory year -1. This will combine the historical period (2010-2020, assumed as fixed calibration period) with modelled results to integrate the impact of most recent harvest and natural disturbances (from 2021 onwards) detected by EO.

As a first step, the modelling framework is based on the calibration of forest management activities and natural disturbances detected by remote sensing within the last historical period (i.e., 2016-2020) against the ones applied by CBM (based on MS statistics) within the same time interval. The main management activities and natural disturbances already considered within the historical period were recalibrated, from 2021 onwards, against the most recent remote sensing data (up to December 2022), to estimate the direct impacts of these drivers on the evolution of the forest C sink at country level. It should be noted that at present we use LANDSAT to detect forest management activities and natural disturbances from remote sensing, which captures rather large tree cover changes (i.e. clear cuts), using the methodology of Ceccherini et al. (2020). This approach has limitations in the detection of small-scale silvicultural practices. In the future, greater resolution data from Sentinel satellites will be considered. In addition, most changes occurring below the canopy cannot be detected by optical instruments, potentially leading further to an underestimation of actual harvest wood, which needs to be considered when interpreting the results. Potential future additional steps may also include the inclusion of the impact of climatic drivers (e.g. droughts) as estimated from remote sensing (spectral indexes), which determine inter-annual variations of the net annual increment that are not linked to direct management practices or abrupt natural disturbances.

Based on the preliminary results, it was found that generally EU data have a good correlation with the total harvest reported by most MS within the last decade. We can therefore estimate the expected evolution of the harvest rate during the last two years (HR_{2021} and HR_{2022}) using as proxy the relative variation of the disturbance rate detected by EO data, according to the following relation:

$$HR_{2021} = HR_{2020} \frac{EO_{2021} - EO_{2020}}{EO_{2020}}$$

$$HR_{2022} = HR_{2020} \frac{EO_{2022} - EO_{2020}}{EO_{2020}}$$

Where, HR_{2020} are total removals reported by FAOSTAT for 2020, EO_{2020}, EO_{2021}, EO_{2022}, is the total area affected by disturbance events (either natural or human induced) as reported by EO data for 2020, 2021 and 2022 respectively.

The preliminary results indicate a slight increase in the total harvest removals at EU level in 2021, compared to 2020. In contrast, the EO data pointed to a substantial decrease in the harvest at EU level relative in 2022, rather uniformly distributed across Central European countries, while in northern Europe the total harvest was estimated to have remained broadly at the same level between 2021 and 2022. These findings point to a clear increase of the forest sink for year 2022, compared to 2021. The preliminary proxy estimates for LULUCF (presented in Working Group 1 meeting in October 2023) indicate similar development. However, given that many MS have made substantial changes to their GHG inventories for forest land reporting, the work on near-real time estimates with the CBM model is being further refined to better reflect the MS-specific details incorporated in the national GHG inventories.

2.2 Task 2: GHG inventory development

Within this task, the JRC's work aimed at improving the quality of MS GHG inventories (with a focus on managed forest land) in light of the new requirements under Regulation (EU) 2018/841 and Regulation (EU) 2018/1999 and later also considering the revised LULUCF regulation 2023/839. The work was conducted through structured gap identification, technical support and capacity building to MS.

In addition, the JRC has carried out an overarching work supporting GHG inventory development, including checking the EU LULUCF GHG inventory until 2022, support the transfer of GHG inventory's checks to EEA as from 2023, support to the Climate Change Committee's Working Group 1, and participating to EU-funded research projects GHG inventories. The following sections first describe this overarching work, and then provide a more detailed description of the specific tasks done under task 2.

2.2.1 Overarching work on GHG inventory development

2.2.1.1 Work within the QA/QC of the EU LULUCF GHG inventory

The work done for GHG inventory development is linked to the institutional work on LULUCF inventories, where the JRC was responsible for the compilation of the LULUCF-related chapters in the EU GHG inventory until the submission in 2022. Within the overall task of compiling the National Inventory Reports 2020[6], 2021[7] and 2022[8] and the related tables in Common Reporting Format (CRF), the JRC performed a detailed QA/QC of the LULUCF inventories under Reg (EU)525/2013, including handling of MS GHG data submitted under Decision 529/2013 (data download, extraction, formatting, filtering, and storage), and preparation of the Facilitated Tables to report under Decision 529/2013. From 2023 onwards, the submissions will be done under Reg 2018/1999. Until 2022, the QA/QC process for the LULUCF sector done by the JRC was as follows:

1. The MS submit their annual GHG inventories to the Commission by 15 January
2. The JRC performed initial checks on LULUCF data, and communicated any specific findings to MS by 28 February using a dedicated online tool
3. MS check their national data and respond to specific findings by 15 March

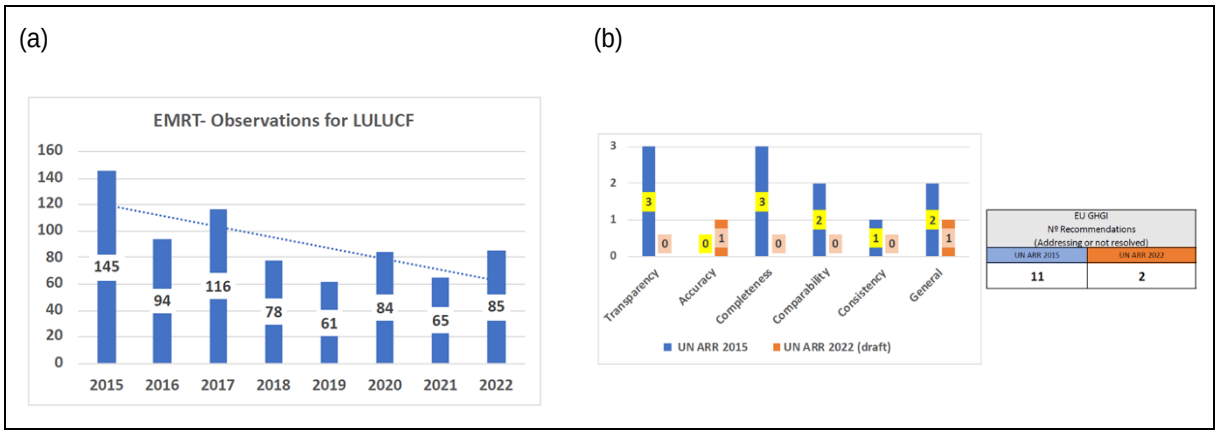
[6] European Union. 2020 National Inventory Report (NIR). https://unfccc.int/documents/228021
[7] European Union. 2021 National Inventory Report (NIR). https://unfccc.int/documents/275968
[8] European Union. 2022 National Inventory Report (NIR). https://unfccc.int/documents/461931

4. The JRC prepared the LULUCF chapters in the final EU GHG inventory report by 15 April so that they can be submitted to the UNFCCC. If needed, a resubmission was prepared by 27 May.

The results of the annual EU LULUCF GHG inventory are reported in detail in each year's National Inventory Report (NIR) for the EU[9]. This report includes both a compilation of the data reported by each MS, as well as a detailed description of the sector-specific QA/QC process and its findings, verification undertaken and improvement efforts made and planned (chapter 6.4 in the EU NIR); and a compilation of the recalculations made by the MS, including changes made in response to the review process and the related impacts on emission trend (chapter 6.5 in the EU NIR). The efforts put into LULUCF QA/QC have clearly been successful, as demonstrated by the decreasing number of remarks given to the MS in the initial checks over years (Figure 8). As a consequence of these initial QA/QC checks by the JRC, the MS were able to correct mistakes before the final submissions to the UNFCCC. In result, the EU LULUCF GHG inventory – reflecting the sum of the MS submissions – has been found to almost eliminate the need for recommendations by the UN review team from 2015 to 2022, the final year of the JRC QA/QC checks (Figure 8).

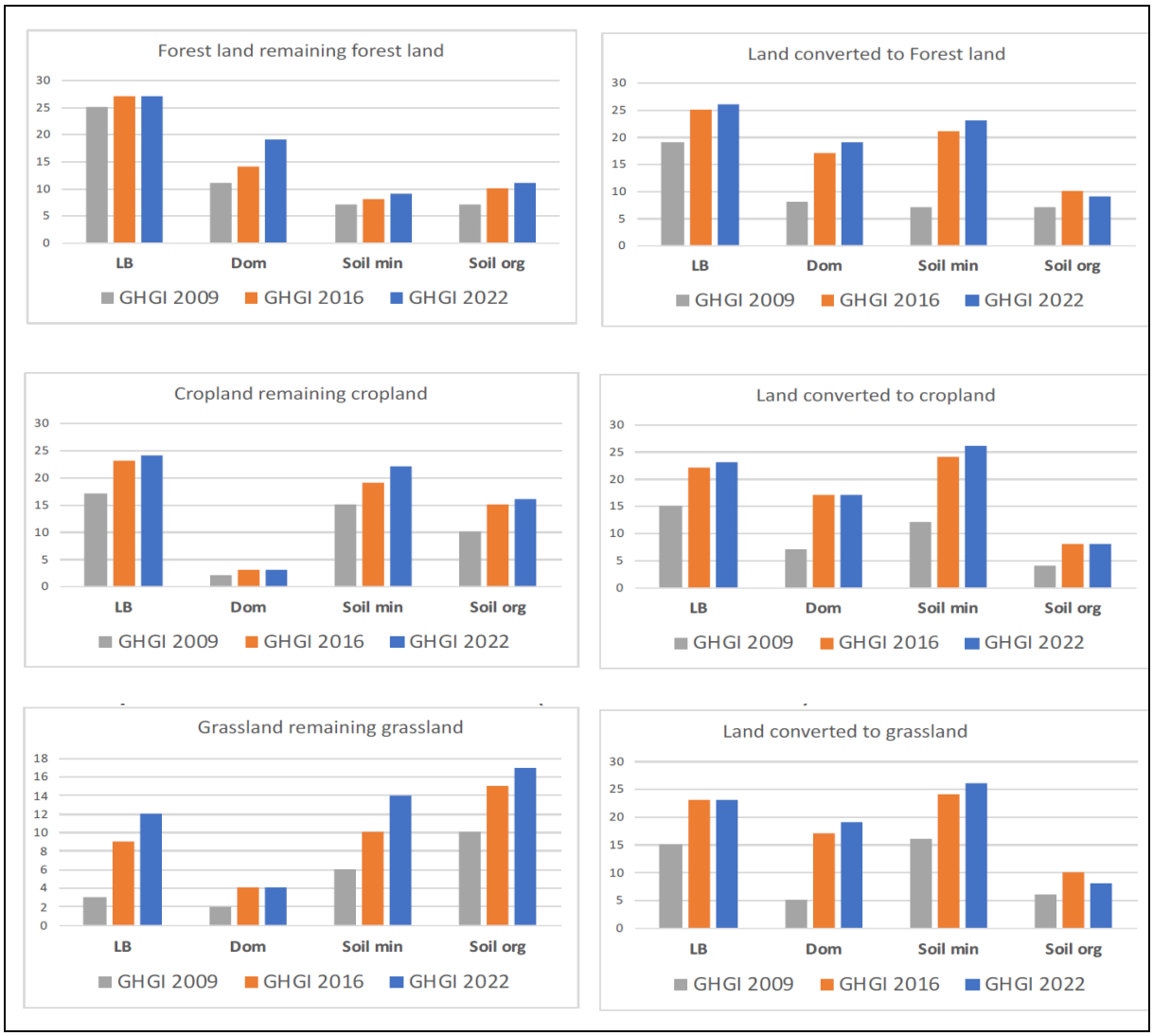
[9] The different years' submissions can be retrieved from: https://unfccc.int/ghg-inventories-annex-i-parties/2023

Figure 8. (a) Observations in the MS draft LULUCF GHG submissions made by the JRC during the initial QA/QC checks, and (b) recommendations by the UN annual inventory review reports (ARR) to the EU GHG inventory.



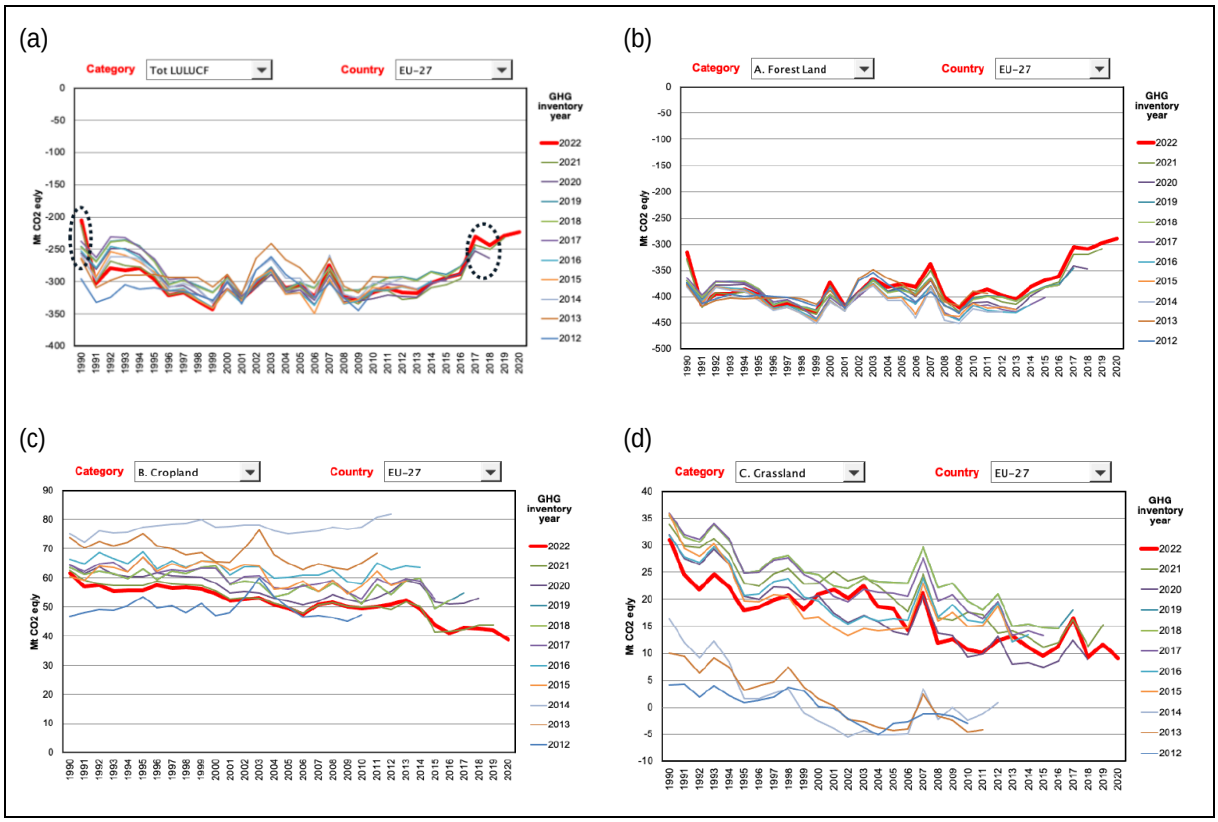
Over the years, the importance of LULUCF in the EU and international climate policy has increased substantially, as shown in the progressive commitments under the 2nd commitment period of the Kyoto protocol, followed by EU LULUCF regulation 2018/841 and further by its revision, Reg (EU) 2023/839. This development was supported by the JRC through a number of workshops, bilateral assistance to the MS, and participation in different EU-funded projects and initiatives such as LPIS development, Medinet project, and LUCAS soil data collection. As shown in Figure 9, in the EU as a whole, the completeness of the reported carbon pools is now substantially improved.

Figure 9. Completeness of the reporting in land reporting categories forest land, cropland and grassland (and their conversions) in the EU MS over time.



In addition to the completeness of carbon pool reporting in different land reporting categories, also the quality of the reported estimates has improved towards more robust estimates. As shown in Figure 10, the estimates between the different years' submissions have converged towards similar reporting especially in cropland and grassland, resulting in more stable estimates for the total LULUCF time series in the recent years. The recalculations reflect both improved completeness of reporting (as shown in Figure 9 above) and improved methodologies employed by the MS. However, for forest land – which is the land reporting category with clearly the largest net emissions in the EU – the estimates have been updated substantially in the latest years. This finding is discussed in more detail in chapter 2.1.3 of this report.

Figure 10. Reported estimates over time in the EU LULUCF inventory, in (a) total LULUCF, (b) total forest land, (c) total cropland and (d) total grassland. Note that the scales of the diagram are not the same.



2.2.1.2 Other overarching work on GHG inventory development

The JRC provided support also on several country-specific GHG inventory issues, such as the reporting of large carbon emissions in 1990 recalculated by Germany in the GHG inventory 2022. This recalculation is clearly shown also in the EU level (Figure 10). Germany reports these emissions to be due a massive windthrow. Improving the inventory to provide better annual data on the changes in living biomass pool resulted in an exceptionally strong peak of emissions for year 1990. The JRC assessment concluded that while the estimates for the time series of living biomass are now better reflecting the interannual variability of net emissions, the reporting was not correctly reflecting the dynamics between different carbon pools, and therefore the reporting by Germany is not in line with the principles behind the IPCC guidelines. The issue was discussed in meetings with DG CLIMA and counterparts from Germany, where the JRC explained the concerns regarding the methodology employed by Germany and provided concrete suggestions to address the problem. In short, in line with the reporting of similar events in other MS, the carbon loss from the living biomass should be mostly reported as a transfer to the dead organic matter or the HWP pool, and not assumed to be instantaneously oxidised as in the German GHG inventory. The issue remains unaddressed in the German GHG inventory, and as such also in the EU GHG inventory.

As a part of the planned transfer of the reporting obligations and QA/QC of the MS inventories to the EEA from inventory 2023 onwards, the JRC was proactively assisting the EEA in the preparations of taking up the new duties, through sharing of tools and data and advising and detailed guiding in their use. As a part of the preparations for the smooth transfer of duties and planning for future collaboration, the JRC supported EEA colleagues through ad-hoc meetings, where the recent findings and advances in the MS and EU inventories, as well as future development needs, were discussed in detail.

The JRC followed actively the work within Climate Change Committee's Working Group 1 (WG1), and participated in all its meetings, presenting the work done with the MS as a part of the QA/QC of the LULUCF inventories and the advances found in the checks, as well as the diverse capacity building activities of the JRC.

In addition, as part of the GHG inventory development, the JRC was closely following and advising on several Horizon 2020 and Horizon Europe projects. Within these projects, the JRC advised on the linkages

between forest monitoring, management and LULUCF policy development in the EU, and helps the project consortia to reach out to the GHG inventory community and assists in disseminating recent research results via e.g. the annual JRC LULUCF workshops (see later).

In the Horizon 2020 project *HoliSoils - Holistic management practices, modelling & monitoring for European Forest Soils*[10] (May 2021–Oct 2025), the JRC advised on the project application and participated as an associate partner and member in the Stakeholder and End-user Advisory Board. The project develops state-of-art methodologies and tools for monitoring and modelling forest soils and their carbon stock changes, and aims to harmonise available soil monitoring information to support decision making towards climate and sustainability goals.

Within Horizon Europe, the JRC is closely following three projects that address the needs and possibilities to monitor and manage the forests better for climate change mitigation and adaptation: *ForestPaths - Co-designing Holistic Forest-Based Policy Pathsways for Climate Change Mitigation*[11] (Sep 2022–Feb 2027), *PathFinder - Towards an Integrated Consistent European LULUCF Monitoring and Policy Pathway Assessment Framework*[12] (Sep 2022–Aug 2026) and *ForestNavigator - Navigating European forests and forest bioeconomy sustainably to EU climate neutrality*[13] (Oct 2022–Sep 2026).

2.2.2 Assessment of GHG Inventory gaps

The aim of this sub-task was to build on the QA/QC work and the annual review of NIRs, and to provide: (i) a robust method and tool(s) for GHG inventory gap analysis with respect to Land Accounting Categories (principally, though not exclusively, Reg 2018/841 Arts. 2 and 18) and IPCC (key category) requirements; (ii) detailed analysis of elements missing from the pre-2018/841 GHG inventory for 2020, 2021 and 2022 Member State submissions, focussing on identifying the extra effort required to bridge the gap to technical compliance.

The results of our work were documented in 2021 in the JRC report "Inventory development, including gap **analysis"** led by Raúl Abad Viñas. This report, which is attached to the present report as Annex 1, included an analysis of: (I) The impact on the result of the Key Category analysis when it is performed using land accounting categories of Regulation (EU) 2018/841; (ii) Tiers methods used for LULUCF reporting in each MS and their compliance with Regulation (EU) 2018/841; (iii) Differences on the significance of carbon pools when using land use subcategories or land accounting categories, and (iv) Issues raised by the UNFCCC CRF tables for compiling information on land accounting categories of Regulation (EU) 2018/841.

In 2022, the point (ii) of 2021 report was updated in a new report ("Assessment of Tiers methods used for LULUCF reporting and their compliance with Regulation (EU) 2018/841", Abad Viñas 2022) to reflect the improvements made in the GHG inventories for the reporting year 2020. An example of the analysis done, for forest land remaining forest land, is shown in Figure 11 below. The updated report, which is attached to the present report as Annex 2, concludes that a number of MS will need to put effort to move to higher Tier methods to comply with Regulation (EU) 2018/841, mainly MS using Tier 1 methods for estimating carbon stock changes in Living biomass, Mineral soils and Organic soils in Cropland and Grassland, but also those that use Tier 1 for Organic soils in Wetlands. Moreover, Dead wood and Litter in Forest remaining forests are pools that should be considered realistically reportable by almost all MS. We also note that while the reporting obligations for MS under Regulation (EU) 2018/841 started from GHGI 2023 onwards, from GHGI 2028 onwards all MS will need to report all carbon pools on at least on Tier 2 level under the revised LULUCF regulation 2023/839. This means that by 2028 at the latest, all MS should report country-specific numerical estimates of carbon stock-changes in all carbon pools and non-CO2 emissions in all land reporting categories in the LULUCF sector. The JRC has supported the MS in this task through a number of activities as described in the next section 2.2.3, and plans to continue the support to the MS also in the future.

[10] https://holisoils.eu/
[11] https://forestpaths.eu/
[12] https://pathfinder-heu.eu/
[13] http://www.forestnavigator.eu/

Figure 11. Example of the analysis done in the updated report for task 2 (Abad Viñas 2022), on the reporting status of emissions and removals from forest land remaining forest land.

MS	Living biomass		Dead wood		Litter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	64%	T2,3	4%	T2,3	IE	T2,3	32%	T2,3		
BE	100%	T2,3	T1		T1		T1			
BG	94%	T2,3	6%	T2,3	T1		T1			
HR	100%	T2,3	T1		T1		T1			
CY	100%	T2,3	T1		T1		T1			
CZ	81%	T2,3	5%	T2,3	12%	T2,3	2%	T2,3		
DK	63%	T2,3	3%	T2,3	22%	T2,3	T1		12%	T2,3
EE	64%	T2,3	3%	T2,3	T1		25%	T2,3	8%	T2,3
FI	65%	T2,3	IE	T2,3	IE	T2,3	18%	T2,3	17%	T2,3
FR	92%	T2,3	8%	T2,3	T1		T1			
DE	63%	T2,3	6%	T2,3	0,8%	T2,3	26%	T2,3	4%	T2,3
GR	100%	T2,3	T1		T1		T1			
HU	85%	T2,3	11%	T2,3	T1		T1		3%	T1
IE	50%	T2,3	IE	T2,3	7%	T2,3	1%	T2,3	42%	T2,3
IT	97%	T2,3	1%	T2,3	2%	T2,3	T1			
LV	66%	T2,3	26%	T2,3	T1		T1		8%	T2,3
LT	87%	T2,3	13%	T2,3	T1		T1		IE	T1
LU	89%	T2,3	11%	T2,3	T1		T1			
MT	100%	T2,3	T1		T1		T1			
NL	78%	T2,3	5%	T2,3	14%	T2,3	T1		3%	T2,3
PO	85%	T2,3	3%	T2,3	T1		9%	T1	3%	T1
PT	98%	T2,3	IE	T2,3	1%	T2,3	2%	T2,3		
RO	100%	T2,3	T1		T1		T1		0,1%	T1
SK	90%	T2,3	10%	T2,3	T1		T1			
SI	90%	T2,3	10%	T2,3	T1		T1			
ES	100%	T2,3	T1		T1		T1			
SE	49%	T2,3	11%	T2,3	12%	T2,3	19%	T2,3	8%	T2,3
IS	99%	T2,3	T1		T1		T1		1%	T1
Average	**84%**		**8%**		**9%**		**15%**		**9%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T - tier

2.2.3 Support for forest reporting and accounting for Member States

As a part of GHG inventory development, this task focused on supporting LULUCF reporting and accounting – especially in Forest land - through structured technical support, led by the JRC, and capacity building to MS, coordinated by the JRC and involving external experts, relevant data collection and data processing work-streams. The following activities were carried out:

i. The yearly "LULUCF workshop" organized by the JRC, to allow for sharing of common information and identification of new issues.

ii. Setting up roundtable discussions (starting in mid/late 2020) on specific topics (including dissemination of methods/tools, share of best practices), combined with short presentations by experts (external, JRC or MS). Due to timeline and COVID-19, it was not possible to set up a virtual platform to share information, as initially planned, but instead we decided to build the project reports into handbooks that serve partly the same purpose.

iii. Organization of country visits of JRC staff (where applicable, accompanied by CLIMA officers) to discuss and follow up on problems identified.

The original task description as recalled above relied on plans for direct contact and communication with the MS experts, and was therefore heavily affected by the Covid-19 pandemic and the related restrictions. As a result of the cancelled travel possibilities and rapid change to universal teleworking without face-to-face contacts with colleagues or stakeholders, the JRC LULUCF workshop in 2020 was cancelled, and the setup of the other capacity building activities were delayed and partly reduced from the original plans.

The yearly LULUCF inventory workshops organized by the JRC could however continue already in 2021 in online format, followed by hybrid meetings in 2022 and 2023 organized in the vicinity of Ispra and online. All these meetings gathered together 120-130 GHG experts from all EU MS, as well as from Iceland, Norway,

Switzerland and the United Kingdom. In hybrid meetings, ca. half of the participants joined in person, while the rest followed the meetings online, actively contributing through the online chat and direct questions to the audience.

The JRC LULUCF workshop in 2021[14] marked the occasion of wrapping up the forest reference levels. The 120 online participants shared experiences and insights into state-of-the-art and the current and future challenges for LULUCF reporting and accounting. Part of the workshop was also dedicated to the science for GHG inventories. The workshop hosted several case studies from Member States' representatives. The discussion with the audience was stimulated through the use of interactive polls on the most relevant topics of the workshop. A report of this workshop is available here: https://www.technopolis-group.com/wp-content/uploads/2021/11/jrc_lulucf_workshop_2021_report_final_1-1.pdf.

In 2022, the JRC LULUCF Workshop[15] could reconvene again in person, but also with a possibility for online participation. This year, the context of compiling the GHG inventories on LULUCF inventories was connected more distinctly to scientific development in the field. The workshop provided an overview of the main challenges for current and future LULUCF reporting, including experiences and best practices from Member States and other experts, with the primary aim to stimulate the continuous improvements of GHG inventories, and transfer the most relevant insights from scientific community.

In May 2023, the opening day of the 20th JRC LULUCF Workshop[16] fittingly coincided with the revised LULUCF regulation 2023/839 entering into force. The workshop was organized in the premises of the JRC in Ispra, again in a hybrid format with ca. 60 participants in person and ca. 60 following online. This time, the scope of the workshop was focused on specific topics, to support the MS with the new requirements introduced in 2023/839 and to engage all MS with the other capacity building activities undertaken in 2022-2023. Furthermore, the workshop served a platform to introduce the revisions in the LULUCF regulation to the GHG compiler network, to explain the transfer of QA/QC responsibilities from the JRC to the EEA, and to highlight the ongoing work and recent findings in the context of the H2020 and Horizon Europe projects HoliSoils, ForestPaths, ForestNavigator and PathFinder.

The other capacity building activities indicated in this subtask were undertaken in the form of co-delegation between the CLIMA and JRC. In this context, the JRC drafted Terms of Reference and recruited six fee-paid experts to support the MS in improving the quality on their GHGI and the compliance with Reg. 841/2018 and IPCC Guidelines, as well as to help the MS prepare for the upcoming improvement requirements under Reg. 2023/839.

The capacity building activities were designed based on a questionnaire shared in the 2022 JRC workshop, where the MS were asked to indicate their interest in participating in such activities, and to suggest topics of relevance for the development of their inventories. The response rate to the questionnaire was above expectations: all MS, as well as Iceland, Norway and Switzerland answered and were positive especially towards exchanging experiences with and learning from other countries. The topics of interest ranged from specific questions on specific carbon pools, to requests to get clarity on the requirements and assessed compliance with the LULUCF regulation. The topics with most interest from the countries were geographically explicit data and carbon stock change estimations for soil organic carbon and deadwood, and these were also chosen as the focus of the work for 2022-2023. In addition, based on the discussions in the JRC LULUCF workshop and on the written answers, the role of GHG inventories in supporting climate action was chosen as a topic for the capacity building activities.

Based on MS feedback, the JRC organized 3 online roundtable meetings in December 2022, divided broadly according to geographical regions[17]. These meetings served to take stock of the most important questions the MS are interested in, to identify needs for bilateral or multilateral support, and to share experiences among the MS. Two online workshops were organized in March to discuss challenges and opportunities in soil organic carbon reporting, with the same countries attending.

Many countries preferred online meetings over physical meetings, and there was also indication of reduced funding for travel in the associated organizations. Consequently, the initial plans of organizing regional workshops were replaced by focusing on dedicated sessions for the capacity building topics in the 2023 JRC

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14 https://forest.jrc.ec.europa.eu/en/activities/lulucf/workshops/workshop-2021/
15 https://forest.jrc.ec.europa.eu/en/activities/lulucf/workshops/workshop-2022/
16 https://forest.jrc.ec.europa.eu/en/activities/lulucf/workshops/workshop-2023/
17 Attendees included LULUCF experts from RO, EL, BG, IS, SE, LT, EE, PL, SK, SI, HU, IT, FR, LU, ES, BE, CH and NL.

LULUCF workshop instead. These sessions were organized partly in a plenary mode, and partly in breakout groups focusing on agricultural soils, forest soils, and the use of LULUCF data as enabler of climate action. This setup received very positive comments from the participants.

In advance of the JRC LULUCF workshop, the participants received also draft reports prepared by the external experts for comments. Based on the discussions in the workshop and the comments received, the experts then prepared final reports, of which three technical-scientific reports which will be shared with the MS GHG inventory teams (see Box 1). The reports were published as External JRC study reports in fall 2023. Each of the reports is structured in a form of "Frequently Asked Questions", and intended to provide independent scientific advice and reflections on topics where the MS will need to improve their inventories to comply with Reg. 2018/841 and 2023/839, and to better understand the development and user needs arising from policies driving climate action, such as carbon farming.

Furthermore, the experts worked with specific questions on the MS GHG inventories on a bilateral basis. This work focused especially on analysing the MS GHG inventories, in particular with the view of closing the accounting period under the Kyoto protocol[18] and advising the MS inventory teams on specific questions related to their LULUCF inventories[19].

Box 1. Abstracts of the FAQ documents prepared under the capacity building work.

Moving to higher tiers for soil carbon[20] – a report prepared by V. Bellassen, A. Lehtonen and E. Cienciala

The 2023 revised LULUCF regulation will require Tier 2 methods for monitoring all land and carbon pools by the end of the decade, and Tier 3 methods for a subset of land including, among others, forests and peatlands. This requirement is particularly challenging for soil carbon for which Tier 1 is still used by many Member States for several land categories. This document offers answers to frequently arising questions in the topic of higher methodological tiers for soil carbon pool monitoring, as well as practical advice on how to implement them. Regarding Tier 2, we suggest a step by step method to estimate reference carbon stock (SOCref) and carbon stock modifying factors (eg. FLU) using national datasets on soil carbon or international databases such as the LUCAS soil survey. We also propose a list of FMG emission factors for agricultural practices based on a literature review for the temperate zone. Regarding Tier 3, we distinguish between measurement-based methods (repeated soil inventories) and model-based methods. Measurement-based methods tend to be costly, but they are necessary as no model can guarantee an accurate national total in a context of environmental and management changes. Model-based methods allow to disentangle the different drivers of soil carbon changes and reduce the number of repeated measurements needed. Their evaluation, in line with the IPCC guidelines, is also discussed.

Linking public and private greenhouse gas inventories in the land use sector[21] - a report prepared by A. Olesen

For the past 30 years, national greenhouse gas (GHG) inventory compilers have relied on science-based guidelines and tools to estimate GHG fluxes and carbon stocks in the land use sector, with the goal of contributing towards climate change mitigation action.

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18 Ares(2023)4673256

19 Bilateral contacts with BG, EL, PL, LT; Ares(2023)4673256

20 Bellassen, V., Cienciala, E., Lehtonen, A., Moving to higher tiers for soil carbon, Korosuo, A., Blujdea, V., Rossi, S. and Grassi, G. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/056380, JRC134645. https://publications.jrc.ec.europa.eu/repository/handle/JRC134645

21 Olesen, A.S., Linking public and private greenhouse gas inventories in the land use sector, Korosuo, A., Roman Cuesta, R.M. and Grassi, G. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/113045, JRC135025. https://publications.jrc.ec.europa.eu/repository/handle/JRC135025

In the past 10-15 years, several frameworks, standards, tools, and rulebooks have emerged to support the private sector to develop their GHG Inventories, given the significant footprints of many corporations. Lately, there has been a booming of voluntary 2050 net-zero commitments and emissions reduction targets from the corporate world, which frequently count on land investments and/or rely on land mitigation as part of their carbon footprint reduction strategies. Initiatives like the Greenhouse Gas Protocol and Science Based Targets Initiative are among the most adopted by companies who wish to measure and disclose emissions, mitigation targets and trajectories. Recently the EU Green Taxonomy has introduced rules and criteria on how the financial sector and corporations must report and disclose their GHG fluxes and carbon stocks from their related land investments. Private and public rules are now starting to converge. Understanding the differences and the reasons behind them will be key to ensure the credibility of the data from multi-scale GHG Inventories and nested land climate action.

Options for increasing the use of Earth observation for improving LULUCF GHG inventories in Europe – a report prepared by M. Herold, upcoming

This document provides an expert reply to frequently asked questions (FAQ) that have been raised in a dialog between the European Commission (EC), EU member states and other experts towards an increasing role of Earth Observation (EO) data for improving LULUCF) greenhouse gas (GHG) monitoring and estimation in Europe. The answers are based on the guidance provided by the International Panel for Climate Change Guidelines (IPCC GL) where EO data are already used widely and operationally in the LULUCF monitoring by many countries worldwide, as well as for different policy frameworks.

In Europe the use of EO data is underpinned by the Copernicus program. This is the largest and most advanced EO program worldwide and can provide key data sources for the LULUCF monitoring of member states. The thorough experiences for using EO for environmental monitoring, the application of IPCC GL, and the long-term nature of Copernicus provide a solid base and confidence in enhancing the uptake of EO data in countries that are in need to improve their national LULUCF monitoring and assessments of climate actions in light of the recent evolving EU and national policies. This FAQ aims to enlighten some of pathways and considerations for the increasing uptake of EO data in the European LULUCF context.

2.3 Task 3: Tracking progress and compliance

Within this task, the JRC provided support in checking compliance with reporting and accounting requirements under relevant LULUCF legislation (Reg. 525/2013 and Dec. 529/2013; Reg. 2018/841 and Reg. 2018/1999), including: (i) support the adoption of Forest Reference Levels (FRL) for 2021-2025; (ii) support the implementation of the reporting and accounting requirements under KP and 529/2013, including checking compliance with 529/2013, assessment of pending issues in reporting and accounting, support the monitoring of Forest Management Reference Levels (FMRL) under the 2nd commitment period of the Kyoto protocol (2013-2020, KP2); (iii) simulation of accounting under KP2, for 529/2013 and 2018/841 in each MS. These three subtasks are illustrated in the following sections.

In addition, the JRC worked on overall tracking of progress and compliance, including assessing how the MS GHG inventories adhered to the UNFCCC reporting principles of transparency, completeness, consistency, accuracy and comparability (TACCC), and regularly participated to the Climate Change Committee's Working Group 5, providing inputs and analyses. The work done within this task was summarized for the MS and Commission during the WG 5 meeting in April 2023[22].

2.3.1 Support for LULUCF regulation 2018/841

In 2020, the JRC supported DG CLIMA intensively in the review of the revised National Forestry Accounting Plans (NFAPs) and the included Forest Reference Levels (FRL) under Reg. 2018/841, in preparation of the Delegated Act as stipulated in Art 8. The work entailed a thorough review of 27 NFAPs (26 EU MS + UK) and preparation

[22] https://circabc.europa.eu/ui/group/a07de0c7-2b11-49fb-978d-c53fe86f69de/library/7c8ca49d-e679-45d7-bea1-11f2161449b7/details

of assessment reports for CLIMA (including a detailed quantitative and qualitative assessment of each). Furthermore, given that Romania had not submitted an NFAP, the JRC prepared a surrogate NFAP and FRL for Romania *in locum tenens.*

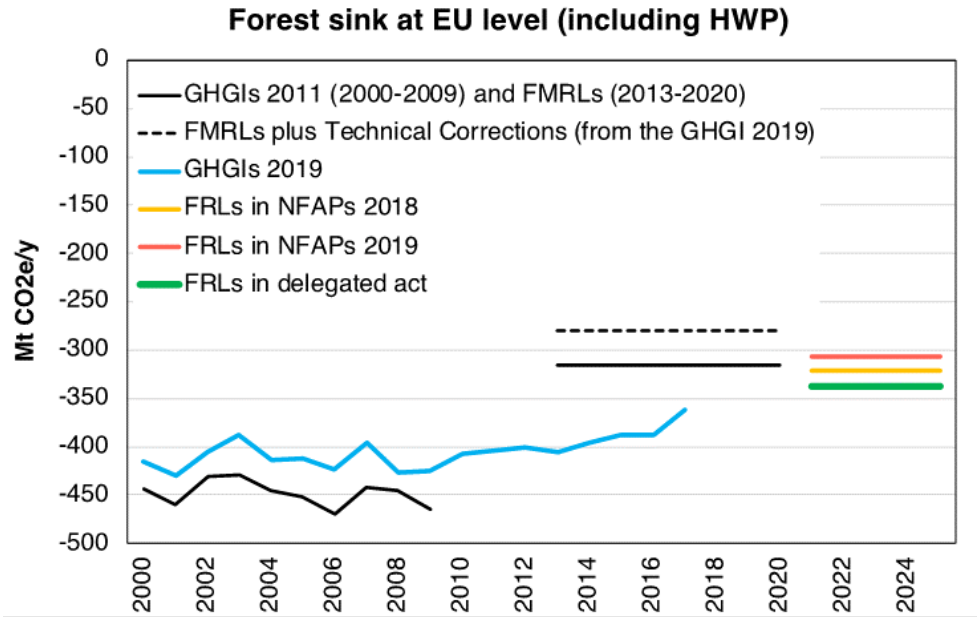
Whenever the assessment detected deviations to the criteria or elements of the Regulation (especially its Annex IV, which specifies the principles and criteria for setting the FRL), the JRC prepared an estimate of the related quantitative impact. In 11 cases[23], the assessment identified a deviation from the Regulation that was estimated to have a numerical impact on the forest reference level. In all these cases, the JRC attended meetings with the respective MS and DG CLIMA to discuss the findings and potential solutions. In nine cases, the MS agreed that there was a numerical error or missing information in the NFAP, and submitted a corrigendum to the NFAP. In five cases (BG, CZ, DE, CY, PL), the MS together with the Commission agreed to a recalculation of the FRL for the delegated act (in some cases this was in addition to a corrigendum by the MS). Based on the data and information provided by the MS, the JRC prepared these recalculations in close contact with DG CLIMA, and clarified them in detail to the respective MS. The assessment and its results are reported in detail in a JRC science-to-policy report (Korosuo et al. 2021), a scientific publication (Vizzarri et al. 2021), and a related Staff Working Document (SWD 2020/236) accompanying the delegated act under the Reg. 2018/841.

The assessment found that the Member States had generally followed the principles and criteria laid out in the LULUCF regulation. Furthermore, the NFAPs were found to provide a wealth of information on the forests and forest management practices in the Member States – some of which has not been available for the international community before – and in general include the elements required by the LULUCF regulation. All Member States projected the development of the forest net emissions for 2021—2025 as a continuation of the historical management practices, therefore excluding assumptions on policy development. While the submissions by the Member States were in general detailed and carefully prepared, the assessment identified in several cases minor issues that will need to be amended before the compliance check. The most common issues are related to methodological inconsistencies between carbon pools, greenhouse gases or forest area included in the FRL and those reported in the national greenhouse gas inventories. Some of these mismatches have already been amended by the Member States through Addenda or Corrigenda to the NFAPs. The remaining inconsistencies will be addressed through technical corrections to the FRLs at the end of the compliance period and therefore do not impair the reliability of the FRL as an accounting baseline. For five Member States, the assessment resulted in a recalculation of the Member State-proposed FRL by the Commission.

In numerical terms, the sum of the Member States' FRLs (incl. the United Kingdom) in the delegated act is a projected sink of -337 Mt CO2 y-1 for the period 2021–2025 (Figure 12). This projection is about 18% lower than the sink of -413 Mt CO2 y-1 reported by the EU 2019 greenhouse gas inventory on managed forest land for the period 2000—2009 (EEA 2019). The FRL projection is associated with a projected increase of harvest by about 16% over the same period, due to age-related effects. It is noteworthy that the FRLs project sustainable forest management practices as documented in the period 2000–2009, taking into account dynamic age-related forest characteristics, and do not represent an expected sink or expected harvest levels. Instead, the FRLs laid out in the delegated act provide a robust and trustworthy counterfactual for accounting the impact of mitigation actions on emissions and removals from managed forest land in the first compliance period 2021—2025.

[23] BG, CZ, DE, IE, EL, FR, CY, LV, MT, PL, FI

Figure 12. Development of the forest sink at the EU level (sum of all Member States' values), and its relation to the FRLs (according to LULUCF regulation) and to the FMRLs (according to the Kyoto Protocol). The technical corrections added to the FMRLs are from the GHGI 2019 and are not yet the final ones for the period 2013–2020. The FRLs proposed by the Member States in the draft NFAPs in 2018 are shown in yellow, the revised FRLs proposed in the revised NFAPs in 2019 are shown in red, and the FRLs as included in the delegated act are shown in green. The EU values shown include Croatia (not EU Member State when FMRLs were submitted) and the United Kingdom. Original source: Korosuo et al. 2021.



The JRC provided supported on the implementation of regulation 2018/841 also through other activities, including:

- A JRC report on a technical assessment of the LULUCF derogation request submitted by the Hungarian authorities[24]
- The discussion on natural disturbances in the Council in 2022, and with technical LULUCF experts from the Czech Republic in 2021-2022.
- Support in the review of NFAPs for Norway and Iceland. In addition the review of the NFAPs and FRLs of the EU MS, the JRC also participated in the EFTA LULUCF Expert Group and the technical assessment of the NFAPs and FRLs of Norway and Iceland, which followed the requirements of the EU regulation 2018/841. This work entailed an assessment of the draft NFAPs by Norway and Iceland, advising the EFTA Surveillance Authority in preparing the technical recommendations to the NFAPs and FRLs, and assessment of the revised NFAPs as part of the expert group.

Shortly after the delegated act setting the FRLs for the MS was finalized in late 2020, the work on the LULUCF legislation continued with the revision of the LULUCF regulation 2018/841, where the JRC supported DG CLIMA through comprehensive technical and methodological advice and analysis. In late 2020, as a part of the European Green Deal, the JRC provided initial input on accounting rules under the new LULUCF regulation (see Box 2). In particular, the JRC highlighted the opportunity to move away from the complex accounting rules for the LULUCF sector, and instead develop targets for the LULUCF sector based directly on the reported LULUCF net emissions. This approach was supported in the later stages of the negotiations for the revised LULUCF regulation, and finally adopted in the revised LULUCF regulation 2023/839.

[24] Ares(2021)7449486 https://pubsy.jrc.cec.eu.int/workflow/pubsy/requestView.html?requestId=126912&fromEmail=&scientific=

Throughout the preparation of the Impact Assessment (IA) for the revised LULUCF regulation (EC 2021a), the JRC supported DG CLIMA actively through numerical analysis and text inputs to the IA. The work included preparations of tools for comparing different accounting alternatives, advising the work of external consortium and consultants working for DG CLIMA, and in providing extensive input and comments for the Impact Assessment, both prior and within the Interservice Consultation.

Box 2: Towards more comprehensive and simple accounting rules for LULUCF

When the Kyoto Protocol was negotiated at the end of the 1990s, and subsequently modified for its second commitment period in the late 2000s, experience with LULUCF monitoring and reporting was absent or limited. As a consequence, Kyoto Protocol baselines and targets did not include the LULUCF sink. Nevertheless, in order to recognise the important impact of the sector for climate change mitigation, it was decided that LULUCF could generate credits or debits to be counted against the achievement of the target. To address the risk of diluting the effort in other sectors, only some emissions and removals could be considered as debits or credits, namely those due to additional and direct human-induced action. Since the IPCC could not develop generally applicable methods to identify with confidence the additional impact of human actions through direct observation such as national forest inventories (i.e., it was not possible to filter out direct human-induced effects from a highly variably natural background, including indirect human-induced effects such as CO_2 fertilization), a set of complex accounting rules was designed by policy makers as proxies for such additional and direct human-induced emissions and removals. These rules were meant to filter the reported LULUCF estimates with the aim to reflect better the impact of additional and direct human-induced mitigation actions.

When the LULUCF Regulation 2018/841 was drafted in 2016, one of its objectives was to maintain the internationally recognised accounting approaches of the Kyoto Protocol, albeit in a simplified framework. That approach is reflected in the way that the -40% target was calculated: similarly to the Kyoto Protocol approach, LULUCF was not directly included in the target, but the sector could influence its achievement by generating debits or credits. These debits or credits were calculated through comparisons to baselines and base years. However, this approach creates significant regulatory costs and is difficult to explain and communicate, which may hinder effective policy design and implementation.

In addition, the Kyoto-style LULUCF accounting was not compatible with the 2050 climate neutrality target, endorsed by the EU Council in December 2019. To track progress towards this 2050 target, the full LULUCF sink should be considered, instead of only its subset such as the accounted credits and debits under 2018/841. To be coherent with this 2050 target, the new intermediate targets should therefore include the LULUCF sink in the base year (1990) for the calculation of the needed emission reduction. This logic hinted towards the possibility to treat the LULUCF sector like any other sector in the proposed revisions of Reg. 2018/841, i.e. adding the full sink also when checking the compliance with the 2030 target. The sector would therefore be subject to explicit targets rather than governed by complex accounting rules determining the creation of debits or credits. Ultimately, this simplified methodology that places the same rules on the LULUCF sector as on any other sector in climate policy was adopted in the revised LULUCF regulation 2023/839. From 2026 onwards, all emissions and removals reported in the LULUCF sector will be considered when tracking progress towards the climate goals, with an EU-wide commitment to achieve a total LULUCF sink of -310 Mt CO_2e in 2030.

2.3.2 Support reporting and accounting under the Kyoto Protocol and Dec. 529/2013

2.3.2.1 Work conducted by the JRC

In the context of the reporting under the Kyoto Protocol (KP), the JRC:

— Extensively supported the implementation of Forest Management Reference Level (FMRL), including:

- An analysis of which MS (and why) needed support from the JRC to derive the technical correction (TC) of FMRL under KP2. The analysis was followed by meeting with the relevant MS, the coordination and tracking of the work among modellers (IIASA, EFI) and the MS supported, and the analysis of the models runs made. After these steps, new models run were used for technical correction only by Spain.
- Answering ad-hoc requests of support by MS on TC and FMRL.

— Ensured the closure of the 2nd commitment period of the KP (2013-2020), including the following tasks:

- Support to MS on addressing issues raised during their UNFCCC revisions, especially on technical corrections for those 14 MS whose FMRL was set with the support of the JRC, and tracking any LULUCF issue raised in Saturday papers received by MS.
- Participate to the UNFCCC revision of the EU GHG inventory (5-10 December 2023, centralized) and clarify/discuss/incorporate issues raised by the Expert Review Team that concern to the LULUCF and KP-LULUCF chapters of the EU GHG inventory.
- Support the preparation of the new EU CRF tables for the final resubmission of the EU GHG inventory 2022, taking into account all the MS resubmissions made by MS after 8th May 2022 (i.e. the cut-off date for the EU inventory submission in May), and including the estimation of the final technical correction of the EU FMRL.
- Re-writing/update as necessary the LULUCF chapters for the resubmission of the EU NIR of the GHG inventory 2022.
- Follow up of issues on KP-LULUCF arising during the true-up period. Among these, the JRC supported Slovenia in documenting in a comprehensive and clear way the causes of their large LULUCF accounting debit, due to an exceptional natural disturbance event.

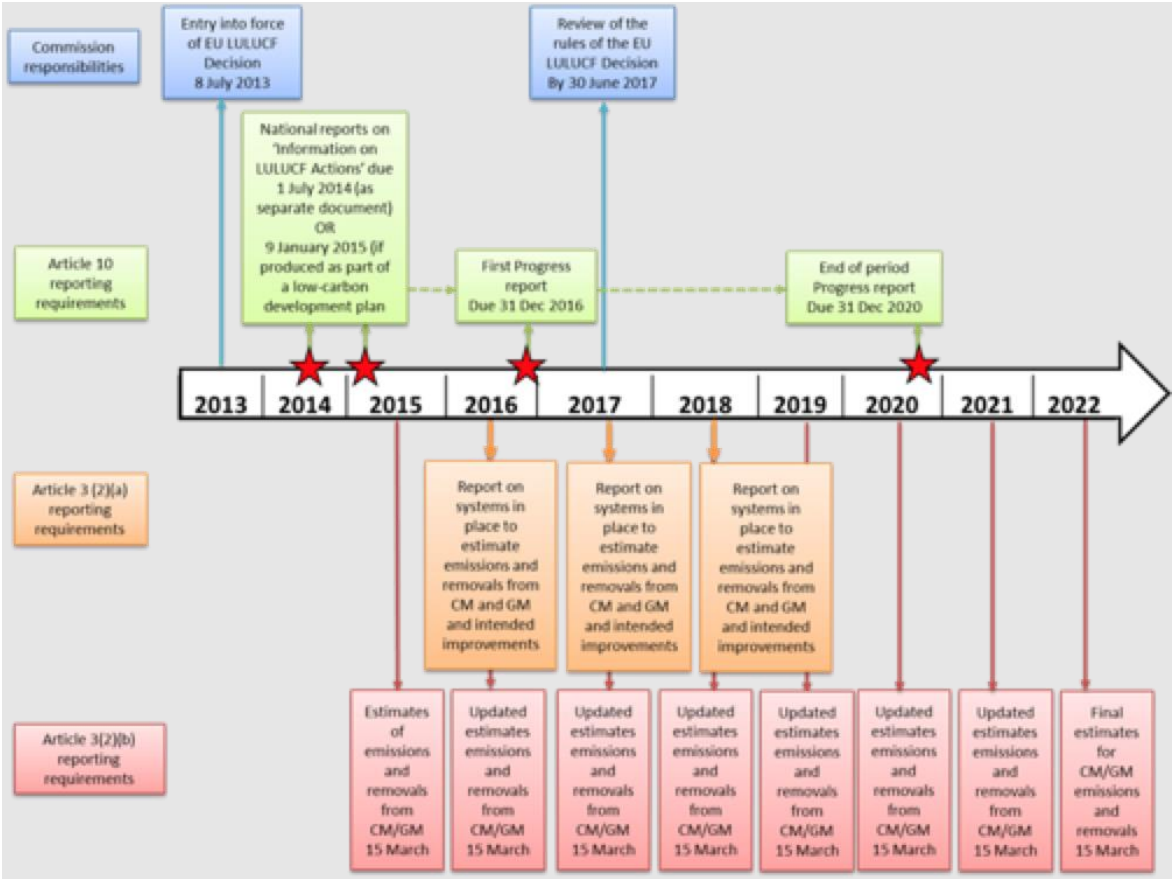
A detailed summary overview of the submissions under the KP was illustrated at the Climate Change Committee' WG5 (April 2023), and attached to this report as Annex 3.

Under this AA, the JRC supported the implementation of the reporting requirements under 529/2013 (up to GHG inventory submission 2022), complementing the institutional JRC work on Member States' LULUCF GHG inventories under Reg. 525/2013 (i.e. check of Member States' CRF tables and EU NIR compilation).

Decision 529/2013 was approved in May 2013 following a UNFCCC decision in 2011 (2/CMP.7) to revise the accounting rules for GHG emissions and removals from forests and soils. The goal is therefore the harmonisation of the accounting rules for emissions and removals from LULUCF, with the objective of including Agriculture and LULUCF in the EU Climate mitigation efforts. The Decision goes beyond UNFCCC requirements by making accounting of Cropland management and Grazing Land Management mandatory for all MS. Under the Decision, MS had to prepare preliminary accountings from 2016 onwards, with final estimates for accounting due in 2022.

The Decision 529 reporting process is portrayed in Figure 13. The standard submission under Decision 529 included the estimations, furnished within CRF tables, and the methodological information, prepared following the standard KP structure. Along with this, several reports were required.

Figure 13. The Decision 529/2013 reporting process, outlining what was required to submit in the different years.



Since the beginning of the submission process under Decision 529/2013, every year a "submission kit" has been sent to all MS, including a guidance document describing the submission process under the LULUCF Decision, and in particular highlighting what had to be submitted in the current year (e.g. the final submission in 2022, the Art. 10 Progress Reports, the reports on the systems in place), the deadlines for the submission, the format in which the data had to be submitted, and where the data had to be uploaded. Along with this guidance, a new set of "Facilitated CRF Tables" was sent to all MS. Facilitated Tables are aimed at making the reporting process easier by automatically copying and linking information across the different sheets, guaranteeing a correct filling of the tables. The use of these Facilitated tables is optional, but they have been often used by several MS, while others produced their tables with other means (e.g. the UNFCCC CRF Reporter software). Submissions under Decision 529 sent before 15 January were checked by the JRC, providing MS with a QA/QC process, offering suggestions and highlighting possible mistakes in tables' compilation.

Every year the information submitted by MS was examined and verified by the JRC in terms of completeness and compliance to the requirements of Decision 529/2013, highlighting when submissions were incomplete or missing. A clear improvement in the carbon pools coverage and in the quality of the submitted data and methodological information was observed. However, at the end of the reporting period, a few MS still did not submit their reports, or submitted incomplete information (e.g. submitting only the latest available year, or only the data or the methodological information). For the final 2022 submission, which is the closure of the Decision 529 Reporting, the JRC is assisting these MS in producing and sending their final data, complying with the reporting obligations.

The estimations provided were extracted from the CRF tables and used within a database for display and analyses.

The analysis highlighted an increasing agreement between the yearly submissions along the reporting period, i.e. while at the beginning estimates varied significantly from year to year, in recent years Member States tend to confirm every year the previous submissions. This is probably due to an increased confidence in the estimations produced and to more solid and reliable methodologies and data collection efforts put in place by

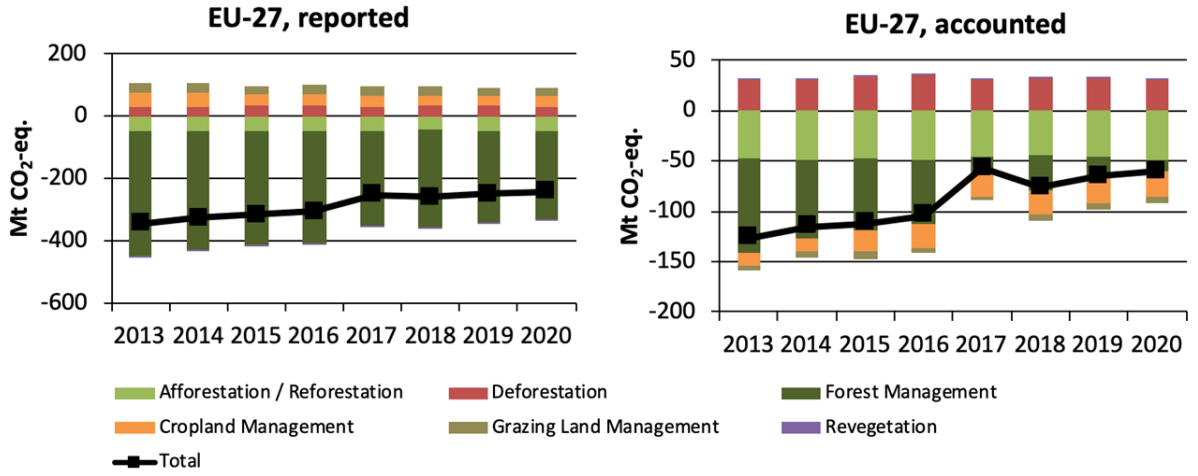
Member States as the reporting period progressed, confirming that Decision 529 was instrumental in improving methodologies for CM and GM estimations.

Decision 529 data were used to perform an accounting simulation using the KP accounting rules for CM and GM (Net-net accounting), and to complement the data submitted under KP to obtain a more complete coverage of the total accounting situation of the EU including also CM and GM.

A detailed summary overview of the submissions under Dec. 529/2013 was illustrated at the Climate Change Committee' WG5 (April 2023), and attached to this report as Annex 4 and Annex 5.

Figure 14 shows the complete accounting at the EU27 level including all the KP activities and the complementary Decision 529 CM and GM estimations.

Figure 14. The reported and accounting values at the EU27 values with a full coverage in terms of activities: the KP data were complemented by the CM and GM estimations reported under Decision 529.



2.3.2.2 Lessons learnt from the reporting era under the Kyoto protocol

The main lessons learnt from the work under 529 and the KP in the period 2013-2020 were illustrated and discussed with the MS at the Climate Change Committee' WG5 (April 2023; the presentation with country-specific values is provided in Annex 3). These can be broadly summarized as follows:

— The accounting against a FMRL projection integrated the LULUCF sector with climate commitments, but the approach was complex and final numerical result is prone to change as the inventories improve. As discussed above in section 2.3.1, the use of a projected baseline for accounting emissions from forest management is a way to distinguish human-induced impacts from natural and legacy effects impacting the forest sinks. However, the technical complexity of the approach led to some difficulties in designing effective policies.

  First, the FMRL design under the KP allowed for inclusion of expected policies in the baseline. If these policies – such as increased harvesting to rejuvenate the forests – did not take place in the commitment period, the accounting would still consider the larger-than-expected sink into favour of the country. In the FMRL accounting, there was indication of a possibility of such windfall credits, and the inclusion of policy assumptions in the baseline was therefore strictly not allowed under the FRL approach adopted in the LULUCF regulation 2018/841 (Grassi et al. 2018a).

  Second, the FMRL approach was complicated and sensitive to country-specific choices. During the first commitment period under the KP (2008-2012), only accounting of afforestation/reforestation and deforestation was mandatory for the MS, while other land management activities could be accounted for on a voluntary basis. The scope of accounting was improved for the second commitment period 2013-2020, under which also accounting of forest management against the FMRL was mandatory. In the EU, also cropland management and grazing land management were mandatory to account for in the framework of Decision 529/2013. However, accounting of revegetation was still voluntary for the MS. The inclusion of voluntary activities in the accounting makes it more complicated to compare the overall accounting results

of different MS against each other; for example, Slovenia was the only MS that chose not to account for revegetation under the KP and Decision 529/2013. This choice clearly worsened the accounting result for Slovenia under the second commitment period of the KP. Such discrepancies between the countries were no longer the case under the LULUCF regulation 2018/841, in which land accounting categories are clearly defined and the same for all MS.

Third, the accounting is made against the national GHG inventories, whose estimates improve over time. While improving completeness and accuracy of the inventories is clearly a positive thing, these improvements tend to lead to a change in the numerical values in accounting – reflected in technical corrections of the accounting baselines. As shown in Figure 12, the technical corrections (TC) to the FMRL – reflecting the recalculations of the GHG inventory time series by the MS – changed the final accounting baseline by more than 35 Mt CO_2e at the EU level. The TC is necessary to make sure that the mitigation ambition is not affected by technical changes in the inventories, such as change in methodology or improved completeness of reporting. This means that when assessing progress against the LULUCF climate targets in the EU or MS level, in addition to comparing a single year's reported value to the target for that year, it is necessary to also consider whether changes made into the GHG inventory time series are likely to lead to a TC in the accounting target. This need to ensure comparability between the MS targets and the GHG inventories will remain essential also in the future, referred to as methodological adjustments to the targets in the revised LULUCF regulation 2023/839.

— The completeness and reliability of the LULUCF inventories have increased notably over time. Over the course of the two commitment periods of the Kyoto Protocol, the LULUCF inventories in the EU MS – and consequently in the EU as a whole – were improved substantially both in terms of completeness and accuracy. This is witnessed, for example, by the more complete coverage of carbon pools over time (Figure 9) and also by the progressively fewer issues or problems in both the internal EU QA/QC process and the UN review process (Figure 8). As a result, today we are considerably more confident on LULUCF estimates than 10 years ago.

  The JRC supported the MS in this work through the GHG inventory support within QA/QC checks, various capacity building projects, the annual JRC LULUCF workshops and active participation in Working Group 1 meetings (see section 2.2), while the work on tracking progress and compliance was communicated to the MS especially in the WG 5 meetings.

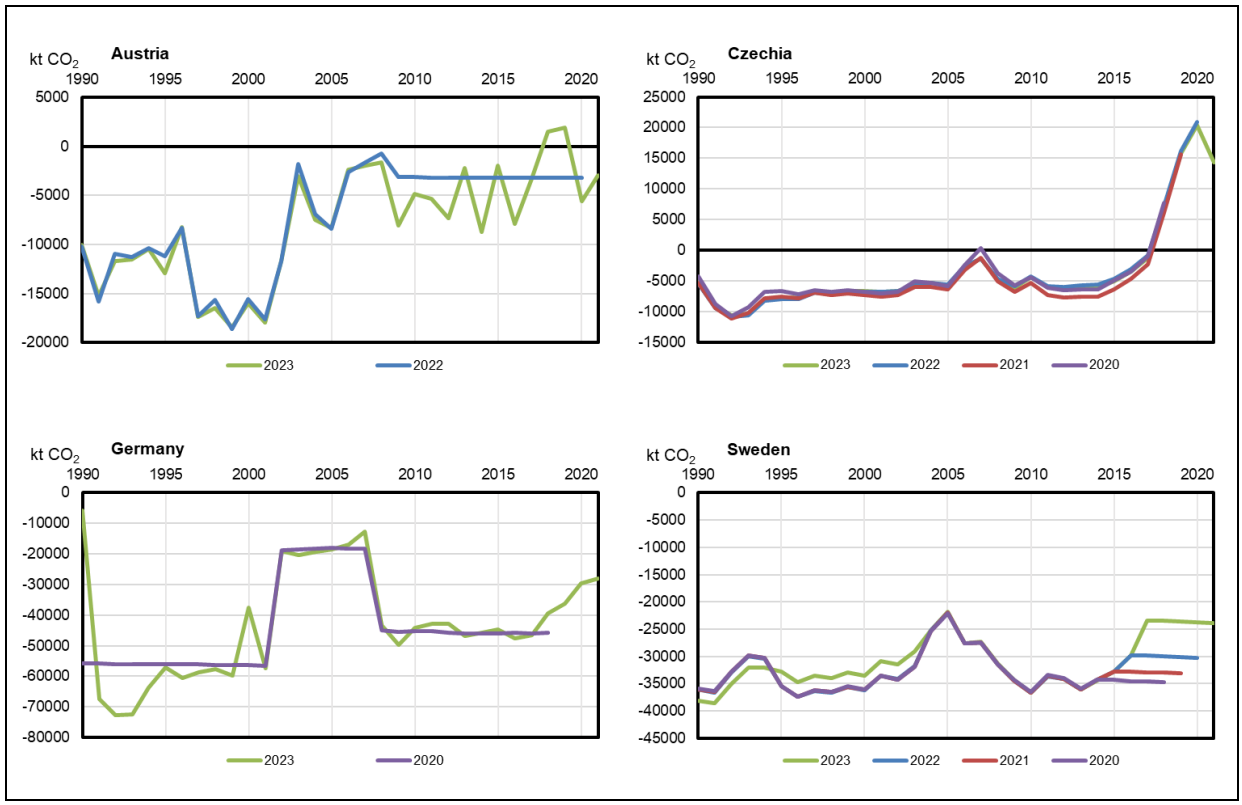
— The ambition of the EU climate policy and the role of LULUCF sector in it has increased even more. Despite the clear progress done by the inventory teams, there still remain some open issues. In particular the more stringent LULUCF targets and the associate need to improve monitoring of LULUCF fluxes make certain shortfalls of the inventories now important for climate policy. This means that even if the LULUCF reporting in the EU MS in most cases is well in line with the broad requirements of the international reporting to the UNFCCC, there may remain gaps in the compliance towards the EU regulation (see Annex 2 for the detailed analysis). By the reporting year 2022 (last GHGI reporting on LULUCF where the JRC was responsible for the EU inventory), it was clear that all MS were not fully compliant with the requirements of Regulation 2018/841 (applying from reporting year 2023 onwards), and many would have to improve substantially to comply with the revised LULUCF regulation. Specifically, the MS will need to increase the completeness of their reporting substantially, and from reporting year 2026 onwards provide estimates with at least Tier 2 for all carbon pools in all LULUCF reporting categories. Furthermore, the MS still need to improve the use of geographically explicit estimates for tracking land use changes.

  Not only the reporting of higher tiers and spatially explicit estimates will need considerable work and sharing of knowledge between the Member States, but also more timely estimates will be increasingly needed to track progresses in a meaningful manner. In many countries, timeliness of data needs to be improved substantially; this is especially important for forest land, where harvest levels and natural disturbances cause notable annual variation, but the NFI-based inventories often detect these changes with several years' delay. A striking example of such a delay is the 2023 inventory of Austria, where the estimates for living biomass were entirely recalculated from 2008 onwards. Taking the new NFI results into account changed the results for living biomass completely, especially for the years 2009-2020 that had been only extrapolated up to inventory year 2022 (Figure 15). Similar recalculations of the most recent years' estimates are observed yearly for also other MS relying on NFI data, although typically for shorter time frames; see e.g. Sweden in Figure 15. Such delays in the inventory would have made it impossible to detect e.g. the abrupt bark beetle-driven loss of sink in Czechia that started in 2017. Complementary data sources such as census or remote sensing data can be beneficial to complement the NFI data, in order to

annualize the estimates (e.g. as done by Germany after submission 2020; see also chapter 2.2.1.2 of this report).

Serious efforts to improve the timeliness and robustness of the GHGI estimates for also the most recent reporting years is now essential. This will be the case both for living biomass as well as other carbon pools. Given that compliance against the targets will be assessed already in the year of the submission of the latest reporting year (i.e. in 2027 for the first submission presenting estimates for 2025, and in 2032 for the compliance towards the 2030 target, delays in the inventory may have serious consequences. The timeliness of the MS inventories will directly affect the countries' comparability under the LULUCF regulations 2018/841 and 2023/839, and also their performance against the climate targets and their credibility.

Figure 15. Reporting for living biomass in forest land remaining forest land in different years' inventory submissions by Austria, Czechia, Germany and Sweden.



2.3.3 Enhancing tools required for simulation of the LULUCF accounting approaches

The JRC prepared simulated accounting tables for the two accounting approaches in use, i.e. the KP approach (adopted also within Decision 529/2013) and the methodology defined by Regulation 2018/841.

The KP approach considers the KP Activities, subdivided in compulsory (afforestation, reforestation and deforestation, and Forest Management), and activities which can be elected by MS for accounting (revegetation, cropland management, grazing land management and wetland drainage and rewetting). The accounting is gross-net for afforestation, reforestation and deforestation, and net-net for revegetation, cropland management, grazing land management and wetland drainage and rewetting, with a single base year (usually 1990). For Forest Management, emissions reduction are accounted against a Forest Management Reference Level (FMRL), with a Cap applied to limit the credits generated by forests.

Regulation 2018/841 introduced new land use-based accounting categories, directly derived from the land use categories defined by the IPCC Guidelines for the normal reporting under the Convention. These accounting

categories are Afforested Land, Deforested Land, Managed Forest Land, Managed Cropland, Managed Grassland, and Managed Wetland (as from 2026). Figure 16 shows the new accounting categories and how they are directly derived from the IPCC land use categories. Accounting rules are similar to KP rules, but a Reference period (2005-2009) is used in place of a single base year. Managed Forest Land is accounted against a Forest Reference Level (FRL).

Figure 16. The new land use-based accounting categories defined by Regulation 841/2018.

To: / From:	Forest Land FL	Cropland CL	Grassland GL	Wetlands WL	Settlements SL	Other land OL
Forest Land FL	**FL-FL**	FL-CL	FL-GL	FL-WL	FL-SL	FL-OL
Cropland CL	CL-FL	CL-CL	CL-GL	CL-WL	CL-SL	CL-OL
Grassland GL	GL-FL	GL-CL	**GL-GL**	GL-WL	GL-SL	GL-OL
Wetlands WL	WL-FL	WL-CL	WL-GL	**WL-WL**	WL-SL	WL-OL
Settlements SL	SL-FL	SL-CL	SL-GL	SL-WL	**SL-SL**	SL-OL
Other land OL	OL-FL	OL-CL	OL-GL	OL-WL	OL-SL	**OL-OL**

Deforested Land
Afforested Land
Managed Forest Land
Managed Cropland
Managed Grassland
Managed Wetland
Other categories, excluded

In this framework, as a support activity for the Climate Action Progress Reports, during the second Commitment Period (2nd CP, 2013-2020) the JRC contributed to a simulated KP yearly accounting, based on the years available.

Since the UNFCCC KP accounting approach defines a methodology to perform the accounting at the end of the 8-year accounting period, and in fact some of the necessary parameters (e.g. the CAP value) are expressed as a single value for the 8-year period, a methodology was therefore developed to produce yearly accounting numbers. This allowed providing indications of the general performance of each MS, and of the Union as a whole, towards the Climate objectives already during the CP. From the calculations, a series of charts were also produced displaying the emissions/removals and the accounting results.

Results and charts were included in the Climate Action Progress report, with a page dedicated to each Member State, describing the reporting and the accounting data and outlining possible explanations for particular observed trends (e.g. reduction in CO_2 absorption due to fires, etc.).

The Climate Action Progress Report 2022 (EC 2022), covered the full accounting period 2013-2020 and reflects the overall JRC work done for LULUCF accounting in the 2nd CP of the KP.

3 Conclusions

This final report outlines the activities conducted by the JRC under the Administrative Arrangement (AA) "ForMonPol" (Forest Monitoring for Policies), specifically within Lot 1 "InFoPol" (Improved GHG Inventories for better Forest Policies) from 2020 to 2023. The JRC's role in Lot 1 encompassed three main tasks: (i) thematic policy action development, (ii) greenhouse gas (GHG) inventory development, and (iii) tracking progress and compliance for the LULUCF commitments under the Kyoto Protocol and EU Decision 2013/529.

Regarding the thematic policy actions development, the JRC focused on various aspects. Firstly, it explained and clarified the complex connections between LULUCF accounting and other sectors, considering the trade-offs and synergies among different climate change mitigation options such as the forest sink, carbon stored in harvested wood products, and the use of wood for material and energy substitution. Secondly, it highlighted that the EU forest sink is rapidly deviating from the EU climate targets, emphasizing the need for swift implementation of climate-smart forest management. Improved and timely monitoring of GHG fluxes was identified as crucial in reversing this trend. Lastly, the JRC made significant enhancements to the Carbon Budget Model (CBM), which simulates forest carbon dynamics at the Member State level. These improvements included the incorporation of climate effects in projections, making CBM more flexible, faster, and comprehensive, and also moving towards near real-time proxy estimates for forest carbon fluxes.

In terms of GHG inventory development, the JRC engaged in extensive work on the annual EU LULUCF GHG inventory until 2022. Additionally, it conducted ad-hoc GHG inventory gap analyses for each Member State under the AA. The JRC also coordinated technical support and capacity building activities in collaboration with external experts, organizing roundtable discussions and expert presentations with Member States. The outcomes of these efforts were discussed during the JRC workshop in 2023 and will be condensed into three technical-scientific reports to be published as External JRC study reports in September 2023. These reports, structured as "Frequently Asked Questions," aim to provide independent scientific advice and reflections on areas where Member States need to enhance their inventories to comply with regulations and better understand the requirements arising from climate action policies like carbon farming. Since 2023, the responsibility for checking the EU LULUCF GHG inventory lies with the EEA. Nonetheless, the JRC will continue to actively contribute to the science-policy interface of LULUCF, particularly in forest carbon modelling, collaborating with Member States to improve inventory quality, organizing the annual LULUCF workshops and supporting for DG CLIMA in designing and monitoring forest-related climate mitigation policies.

Regarding tracking progress and compliance, the JRC played a pivotal role in the adoption of Forest Reference Levels (FRL) for 2021-2025 (Regulation 2018/841) and supported the implementation of reporting and accounting requirements under the Kyoto Protocol and Decision 529/2013. This work was presented at the Climate Change Committee's Working Group 5 in April 2023, along with key lessons learned. Notably, reporting on LULUCF has consistently improved across all countries, with enhanced completeness and fewer findings over time from both the internal EU quality assurance and quality control process and the UN review process. Thanks to the efforts of GHG inventory compilers, the EU/UN review process, new data, and knowledge-sharing initiatives like the JRC LULUCF workshops and capacity building activities, confidence in LULUCF estimates has significantly increased compared to a decade ago.

Overall, the extensive work carried out under the AA ForMonPol Lot 1 (InFoPol) has highlighted several key points:

- The LULUCF sector is inherently complex, making it challenging to understand and communicate its GHG fluxes and interactions with other sectors. The JRC's work over the years, including regular checks and compilation of the EU LULUCF GHG inventory until 2022, scientific publications, annual JRC LULUCF workshops, and activities under the AA, has been instrumental in fostering a common understanding among Member States and policymakers.
- This has resulted in significant improvements in the quality and completeness of GHG inventories over the past decade, accompanied by a greater awareness of the policy needs and the role of LULUCF in the broader context of climate change mitigation.
- The EU legislation (Regulation 2018/841 and 2023/839) has progressively included the entire LULUCF sector in the EU climate targets, aligning it with other GHG sectors. Simultaneously, there is a growing recognition of its crucial and increasing role in achieving EU climate neutrality. While this presents opportunities, it also poses challenges.
- Ambitious climate goals necessitate greater confidence in estimates, which can be achieved through enhanced monitoring efforts. The JRC's analysis reveals that despite observed improvements, several

Member States are not fully prepared for the new requirements under Regulations 2018/841 and 2023/839. In this context, efforts should be directed towards transitioning to higher tiers for specific areas and generating spatially explicit estimates.

— Moreover, the work conducted under this AA has highlighted a concerning decline in the EU forest sink, which could jeopardize the achievement of EU LULUCF targets and the broader climate targets by 2030. Reversing this trend requires the rapid implementation of climate-smart forest management, supported by improved and timely monitoring of GHG fluxes. This enhancement is crucial for tracking progress towards the EU's climate targets, where forests play an increasingly prominent role.

— Notably, substantial improvements to the forest Carbon Budget Model enhance the JRC's and the European Commission's ability to monitor recent carbon fluxes in EU forests and simulate future policy and climate change scenarios.

References

Achard, F., Bourgoin C., Vancutsem, C. ForMonPol Project – Final Report of Lot 2- TroFoMo Lot 2 (Tropical moist Forest Monitoring) Key Outcomes. Upcoming JRC technical report.

Avitabile V, Pilli R, Migliavacca M, Camia A, Mubareka S. Forest Biomass Production. In: Mubareka S, Migliavacca M and Sanchez Lopez J, editors. Biomass production, supply, uses and flows in the European Union. Luxembourg: Publications Office of the European Union; 2023. p. 75-85.

Avitabile V., Pilli R., Camia A., The biomass of European forests, EUR 30462 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-26100-1, doi:10.2760/758855, JRC122635.

Barbosa, A.L., Salvucci, R., Rózsai, M., Neuwahl, F., Mubareka, S., Hristov, J., Blujdea, V., Pilli, R., Hilferink, M., Witzke, H.P., Kesting, M., Grassi, G., Fiorese, G. and Perez Dominguez, I., A multi-sectoral integrated modelling framework for assessing greenhouse gas emissions and removals in the European Agriculture, Forestry and Land Use Sectors, EUR 31543 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-04193-2, doi:10.2760/254322, JRC132798.

Bellassen, V., Cienciala, E., Lehtonen, A., Moving to higher tiers for soil carbon, Korosuo, A., Blujdea, V., Rossi, S. and Grassi, G. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/056380, JRC134645. https://publications.jrc.ec.europa.eu/repository/handle/JRC134645

Blujdea, V.N.B., Rougieux, P., Sinclair, L., Morken, S., Pilli, R., Grassi, G., Mubareka, S. and Kurz, A., W., The JRC Forest Carbon Model: description of EU-CBM-HAT. Publications Office of the European Union, Luxembourg, 2022.

Buongiorno, J. 2021. GFPMX: A cobweb model of the global forest sector, with an application to the impact of the COVID-19 Pandemic. Sustainability, 2021, 13, 5507

Camia, A., Giuntoli, J., Jonsson, K., Robert, N., Cazzaniga, N., Jasinevičius, G., Avitabile, V., Grassi, G., Barredo Cano, J.I. and Mubareka, S., The use of woody biomass for energy production in the EU, EUR 30548 EN, Publications Office of the European Union, Luxembourg (2021).

Cazzaniga, N., Jasinevičius, G. and Mubareka, S., Sankey diagrams of woody biomass flows in the EU - 2021 release, European Commission, 2022, JRC127989.

Ceccherini, G., Duveiller, G., Grassi, G., Lemoine, G., Avitabile, V., Pilli, R. and Cescatti, A., 2020. Abrupt increase in harvested forest area over Europe after 2015. Nature, 583(7814), pp.72-77.

Crippa, M., Guizzardi, D., Banja, M., Solazzo, E., Muntean, M., Schaaf, E., Pagani, F., Monforti-Ferrario, F., Olivier, J., Quadrelli, R., Risquez Martin, A., Taghavi-Moharamli, P., Grassi, G., Rossi, S., Jacome Felix Oom, D., Branco, A., San-Miguel-Ayanz, J. and Vignati, E., CO2 emissions of all world countries - JRC/IEA/PBL 2022 Report, EUR 31182 EN, Publications Office of the European Union, Luxembourg, doi:10.2760/730164, JRC130363. (2022)

EEA 2023. Annual European Union greenhouse gas inventory 1990–2021 and inventory report 2023.

EEA 2019. Annual European Union greenhouse gas inventory 1990–2017 and inventory report 2019

EC 2022. European Commission, report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Accelerating the transition to climate neutrality for Europe's security and prosperity - EU Climate Action Progress Report 2022 (SWD(2022) 343 final (2022)

EC 2021a. European Commission, Commission Staff Working Document Impact Assessment Report Accompanying the document Proposal for a Regulation of the European Parliament and the Council amending Regulations (EU) 2018/841 as regards the scope, simplifying the compliance rules, setting out the targets of the Member States for 2030 and committing to the collective achievement of climate neutrality by 2035 in the land use, forestry and agriculture sector, and (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review, Directorate-General for Climate Action, SWD(2021)609 (2021)

EC 2021b. European Commission, Proposal for a Directive amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC, as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, COM (2021)557 (2021)

EC 2020a. European Commission, 2020a. Proposal for a Regulation of the European Parliament and of the Council establishing the framework for achieving climate neutrality and amending Regulation (EU) 2018/1999 (European Climate Law). COM/2020/80 final.

EC 2020b. European Commission, 2020b. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Stepping up Europe's 2030 climate ambition. Investing in a climate-neutral future for the benefit of our people. COM(2020)562 final.

EC 2019. European Commission, Communication from the Commission - The European Green Deal, COM(2019) 640 final

EU 2023. Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards the scope, simplifying the reporting and compliance rules, and setting out the targets of the Member States for 2030, and Regulation (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review (Text with EEA relevance)

EU 2018a. 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 (2018).

EU 2018b. Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) (2018)

EU 2013a. Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC Text with EEA relevance (2013).

EU 2013b. 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 (2013)

FOREST EUROPE, 2020: State of Europe's Forests 2020.

Forzieri G, Dakos V, McDowell NG, Ramdane A, Cescatti A. Emerging signals of declining forest resilience under climate change. Nature. 2022;608(7923),534-539.

Grassi, G., Schwingshackl, C., Gasser, T., Houghton, R. A., Sitch, S., Canadell, J. G., ... & Pongratz, J. (2023). Harmonising the land-use flux estimates of global models and national inventories for 2000–2020. Earth System Science Data, 15(3), 1093-1114.

Grassi, G., Conchedda, G., Federici, S., Abad Viñas, R., Korosuo, A., Melo, J., Rossi, S., Sandker, M., Somogyi, Z., Vizzarri, M. and Tubiello, F.N., 2022. Carbon fluxes from land 2000–2020: bringing clarity to countries' reporting. Earth System Science Data, 14(10), pp.4643-4666.

Grassi, G., Fiorese, G., Pilli, R., Jonsson, K., Blujdea, V., Korosuo, A. and Vizzarri, M., Brief on the role of the forest-based bioeconomy in mitigating climate change through carbon storage and material substitution, Sanchez Lopez, J., Jasinevičius, G. and Avraamides, M. editor(s), European Commission JRC124374 (2021a).

Grassi, G., Stehfest, E., Rogelj, J., Van Vuuren, D., Cescatti, A., House, J., ... & Popp, A. (2021b). Critical adjustment of land mitigation pathways for assessing countries' climate progress. *Nature Climate Change*, *11*(5), 425-434.

Grassi, G., Pilli, R., Kurz, W.A. Science-based approach for credible accounting of mitigation in managed forests. Carbon Balance Manag. 13 (8) (2018a).

Grassi, G., House, J., Kurz, W.A., Cescatti, A., Houghton, R.A., Peters, G.P., Sanz, M.J., Viñas, R.A., Alkama, R., Arneth, A. and Bondeau, A., 2018b. Reconciling global-model estimates and country reporting of anthropogenic forest CO_2 sinks. Nature Climate Change, 8(10), pp.914-920.

Grassi, G., House, J., Dentener, F., Federici, S., den Elzen, M. and Penman, J. The key role of forests in meeting climate targets requires science for credible mitigation. Nature Climate Change, 7(3), pp.220-226 (2017)

Gschwantner T., Riedela T, Henning L, Adolt R, Di Cosmo L, Freudenschuss A, Gasparini P, Kohn I, Kučera M, Marin Gh, Máslo J, Mionskowskiab M, Neagu S, Nilsson M, Pesty B, Pikula T, Schadauer K, Sroga R, Talarczyka A, Westerlunda B 2019. Specific Contract No. 21 "Use of National Forest Inventories data to harmonise and improve the current knowledge on forest increment in Europe" in the context of the "Framework contract for the provision of forest data and services in support to the JRC activities and applications on forest resources". Contract Number 934340.

Herold, M., Using Earth Observations for improving LULUCF GHG inventories in Europe, Korosuo, A., Melo, J., Rossi, S., Grassi, G. (editors). Upcoming JRC external study report.

IPCC, 2019a. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland.

IPCC, 2019b, Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]

JRC database. 2021. Salvage loggings. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/2100b612-a4b0-4897-829b-72b7b1e5782c

Korosuo, A., Pilli, R., Abad Viñas, R., Blujdea, V. N., Colditz, R. R., Fiorese, G., Rossi, S., Vizzarri, M. & Grassi, G. (2023). The role of forests in the EU climate policy: are we on the right track?. Carbon Balance and Management, 18(1), 15.

Korosuo, A., Vizzarri, M., Pilli, R., Fiorese, G., Colditz, R., Abad Viñas, R., Rossi, S. and Grassi, G., Forest reference levels under Regulation (EU) 2018/841 for the period 2021-2025, EUR 30403 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-32258-0, doi:10.2760/0521, JRC121803.

Kurz WA, Dymond CC, White TM, Stinson G, Shaw CH, Rampley GJ, et al. CBM-CFS3: a model of carbon-dynamics in forestry and land-use change implementing IPCC standards. Ecol Modell. 2009;220(4),480-504.

Mauser, H. (ed). 2021. Key questions on forests in the EU. Knowledge to Action 4, European Forest Institute. https://doi.org/10.36333/k2a04.

Olesen, A.S., Linking public and private greenhouse gas inventories in the land use sector, Korosuo, A., Roman Cuesta, R.M. and Grassi, G. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/113045, JRC135025. https://publications.jrc.ec.europa.eu/repository/handle/JRC135025

Pilli R., Blujdea V.N.B., Rougieux P., Grassi G., Mubareka S. B. The calibration of the JRC EU Forest Carbon Model within the historical period 2010 – 2020. Upcoming JRC technical report.

Pilli R, Alkama R, Cescatti A, Kurz WA, Grassi G. The European forest Carbon budget under future climate conditions and current management practices. Biogeosciences. 2022;19(13),3263-3284.

Pilli, R., Grassi, G., Kurz, W.A., Viñas, R.A. and Guerrero, N.H., 2016a. Modelling forest carbon stock changes as affected by harvest and natural disturbances. I. Comparison with countries' estimates for forest management. Carbon balance and management, 11, pp.1-18.

Pilli, R., Grassi, G., Kurz, W.A., Moris, J.V. and Viñas, R.A., 2016b. Modelling forest carbon stock changes as affected by harvest and natural disturbances. II. EU-level analysis. Carbon balance and management, 11, pp.1-19.

Pilli R, Fiorese G, Abad Viñas R, Rossi S, Priwitzer T, Hiederer R, Baranzelli C, Lavalle C, Grassi G.; LULUCF contribution to the 2030 EU climate and energy policy; EUR 28025; Luxemburg (Luxemburg): Publications Office of the European Union, 2016c; JRC102498; doi:10.2788/01911.

Pilli, R., Grassi, G., Kurz, W.A., Smyth, C.E., Blujdea, V. Application of the CBM-CFS3 model to estimate Italy's forest carbon budget, 1995–2020, Ecol. Model., 266 (1) (2013), pp. 144-171

Urrutia C, Herold A, Gores S. 2030 climate target plan: review of Land Use, Land Use Change and Forestry (LULUCF) Regulation. Policy Department for Economic, Scientific and Quality of Life Policies for the Committee on the Environment, Public Health and Food Safety (ENVI). 2021.

Vizzarri, M., Pilli, R., Korosuo, A., Blujdea, V. N., Rossi, S., Fiorese, G., Abad-Vinas, R., Colditz, R.R. and Grassi, G. (2021). Setting the forest reference levels in the European Union: overview and challenges. Carbon Balance and Management, 16(1), 1-16. https://doi.org/10.1186/s13021-021-00185-4

List of abbreviations and definitions

AA	Administrative Arrangement
CBM	Carbon Budget Model
CFS	Canadian Forest Service
CP	Commitment period of the Kyoto Protocol
CRF	Common Reporting Format
DG CLIMA	DG Climate Action
DG ENER	DG Energy
DG ENV	DG Environment
EC	European Commission
EEA	European Environment Agency
EFFIS	European Forest Fire Information System
EFI	European Forest Institute
EU	European Union
FAWS	Forest Area Available for Wood Supply
FMRL	Forest Management Reference Level
FNAWS	Forest Area not Available for Wood Supply
FRL	Forest Reference Level
GHG	Greenhouse Gas(es)
GHGI	Greenhouse Gas Inventory
HWP	Harvested Wood Products
IIASA	International Institute for Applied System Analysis
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre of the European Commission
KP	Kyoto Protocol
LULUCF	Land Use, Land Use Change, and Forestry
MRV	Monitoring Reporting and Verification process
MS	Member State(s) of the European Union
NFAP	National Forestry Accounting Plan
NFI	National Forest Inventory
QA/QC	Quality Assessment/Quality Control
RED	Renewable Energy Directive
RS	Reference Scenario
SWD	Staff Working Document
TC	Technical Correction
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WG1	Working Group 1 of the Climate Change Committee

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Annex 1

Task 2.A: Inventory development (2021)

Subreport by R. Abad Viñas

FOREST MONITORING FOR POLICES

FORMONPOL

TASK 2.A : Inventory development

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European Commission, Joint Research Centre,

Directorate D – Sustainable Resources - Bio-Economy Unit

February 01, 2021

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LIST OF ACRONYMS

AD	**Activity data**
AL	Afforested land
CRF	Common reporting format
DL	Deforested land
DOM	Dead organic matter
DW	Dead wood
EF	Emission factor
EU	European union
GHGI	Greenhouse gas inventory
HWP	Harvested wood products
IPCC	Intergovernmental panel on climate change
KC	Key category
KP	Kyoto Protocol
LAC	Land accounting category
LB	Living biomass
LT	Litter
LUC	Land use category
LULUCF	Land use, Land use Change and forestry
MCL	Managed Cropland
MFL	Managed forest land
MGL	Managed Grassland
MS	Member State
MWL	Managed Wetland
NIR	National inventory report
QAQC	Quality assurance & Quality control
SOC	Soil organic carbon
UNFCCC	United Nation Framework Convention on Climate Change

INTRODUCTION

The European Commission laid out long term policy and strategies to ensure that carbon sinks and reservoirs, including forests, are conserved, or enhanced, to meet the ambitious greenhouse gas (GHG) emissions reduction targets of the European Union by 2030, and to reduce emissions to net zero by 2050, in line with the Paris Agreement.

To help achieve these goals, Regulation 2018/841 sets out a robust accounting system and binding commitments for each Member State to ensure that GHG emissions accounted from land use are at least compensated by an equivalent removal of CO_2 from the atmosphere through action in the sector. The Regulation builds on Decision 529/2013/EU, which broadened the coverage of LULUCF accounting, and sets up a plan for improving the Monitoring Reporting and Verification (MRV) process of GHG emission and removals.

In implementing this framework, considerable follow-up work is still needed to enhance transparency, accuracy, completeness, consistency, and comparability of the pledges and of the associated mitigation actions, , especially in relation to the land use sector.

The GHG inventories are the foundation of the accounting and of the compliance systems. Inventories need to comply with Reg 2018/841 (LULUCF) and 2018/1999 (Energy Union Governance) requirements. Without this, it will be not only difficult for Member States to work towards compliance but also to implement policies that enhance action under the LULUCF and Agriculture sectors.

To support the Commission on the development of policies, the so-called administrative arrangement “Forest Monitoring for Policies” (AA FORMONPOL) was signed with the Joint Research Centre, Directorate D – Sustainable Resources - Bio-Economy Unit.

This document aims to fulfil the task 2.a of the Lot 1 of this AA FORMONPOL. It includes four different notes that address specific issues. It includes also some annexes containing relevant information to track the progress of Members States inventories towards the Regulation´s requirements.

The ultimate objective of this work is to support the quality improvement of Member States’ LULUCF inventories considering the new requirements under Reg. 2018/841. Issues addressed in this document include an assessment of the compliance of Member States inventories with requirements of the regulation and gap analysis with respect to Land Accounting Categories looking mainly, but not exclusively to article 18 of the regulation.

NOTE 1:

IMPACT ON THE RESULT OF THE KEY CATEGORY ANALYSIS WHEN IT IS PERFORMED USING LAND ACCOUNTING CATEGORIES OF REGULATION (EU) 2018/841

– ANALYSIS ON FIVE CASE STUDIES –

1. OBJECTIVE

This note aims to assess the differences in the result of the key category analysis when it is performed using different level of land use aggregation as provided by the IPCC land use categories (LUCs), reported to the UNFCCC, and by the land accounting categories used within Regulation (EU) 2018/841 (LACs), which are derived from the LUCs.

2. LEGISLATIVE FRAMEWORK: REGULATION (EU) 2018/841

According to Article 18 (4) of Regulation (EU) 2018/841, "*For emissions and removals for a carbon pool that accounts for at least 25-30 % of emissions or removals in a source or sink category which is prioritized within a Member State's national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or the uncertainty in emissions and removals in the land-use categories, at least Tier 2 methodology in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (GHGIs)*."

In the context of GHGIs, a prioritized category means a key category (KC). These categories are identified through an analysis performed in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Therefore, an avoidable question is whether under Regulation (EU) 2018/841 the KC analysis should be performed based on land use categories (LUCs), as it is done under the UNFCCC, or based on the land accounting categories (LACs) defined in Regulation (EU) 2018/841.

Regulation (EU) 2018/841 requests the accounting of emissions and removals that occur in any of the LACs included under its Article 2 (see Table 1).

Table 1: *Land accounting categories included in Regulation (EU) 2018/841*.

Deforested Land
Afforested Land
Managed Forest Land
Managed Cropland
Managed Grassland
Managed Wetland
Other categories, excluded

The same Article 2 clarifies how these LACs relate with the LUCs for which emissions and removals are to be reported in the LULUCF sector to the UNFCCC.

Table 2: *Mapping land accounting categories within the land use transition matrix reported to the UNFCCC.*

To: / From:	Forest Land FL	Cropland CL	Grassland GL	Wetlands WL	Settlements SL	Other land OL
Forest Land FL	**FL-FL**	FL-CL	FL-GL	FL-WL	FL-SL	FL-OL
Cropland CL	CL-FL	CL-CL	CL-GL	CL-WL	CL-SL	CL-OL
Grassland GL	GL-FL	GL-CL	**GL-GL**	GL-WL	GL-SL	GL-OL
Wetlands WL	WL-FL	WL-CL	WL-GL	**WL-WL**	WL-SL	WL-OL
Settlements SL	SL-FL	SL-CL	SL-GL	SL-WL	**SL-SL**	SL-OL
Other land OL	OL-FL	OL-CL	OL-GL	OL-WL	OL-SL	**OL-OL**

3. METHODOLOGICAL FRAMEWORK

2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES

Currently, GHGIs report emissions and removals at different level of aggregation. For the LULUCF sector, MSs can decide to break down further their estimates, but the software used to compile the inventories (i.e., the CRF Reporter) requests to provide information at least at the level of the following categories:

- **Sector**: LULUCF
- **Land use category** : e.g., Forest Land
- **Land use sub-category**: e.g., Land converted to Forest land
- **Land use sub-sub-category:** e.g., Cropland converted to Forest land
- **Other tables:** e.g., HWP, Direct N_2O emissions from N inputs to managed soils; GHG emissions and removals from drainage and rewetting and other management of organic and mineral soils; Direct N_2O emissions from N mineralization/immobilization associated with loss/gain of soil organic matter; Indirect N_2O emissions from managed soils; GHG emissions from biomass burning; Other.

The IPCC 2006 Guidelines (IPCC 2006 GL) provide the definition and methodological approaches for the identification of KCs. In its Volume 1, Chapter 4 KC is defined as "*the one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of GHGs in terms of the absolute level, the trend, or the uncertainty in emissions and removals*."

Performing a KC analysis is an important part of a GHGI compilation because it enables compilers to prioritize the limited resources available, focusing efforts on the improvement of those categories that are identified as key. Indeed, the guidelines include as a good practice the implementation of higher tier methods for estimating emissions and removals from KCs. Moreover, during the QA/QC procedures the KC analysis should also serve to devote particular attention to those categories identified as key. With the ultimate goal of ensuring the quality of their estimates.

IPCC 2006 GL includes two main approaches for implementing the KC analysis. Both approaches identify KCs in terms of their contribution to the absolute level of emissions and removals, and to the trend of emissions and removals. A third approach, based on qualitative criteria, can be also implemented if for any reasons some important category was not included in the quantitative analyses.

In Approach 1, KCs are identified using a pre-determined cumulative emissions threshold. KCs are identified as the categories that, when summed together in descending order of magnitude, add up to 95% of the total level. This step requires to work with absolute values, so that emissions and removals from LULUCF do not cancel out. The method is described in more detail in Section 4.3.1 of the above-mentioned IPCC chapter. Approach 2 can be used if values for category uncertainties or parameter uncertainties are available. In this case, categories are sorted according to their contribution to the uncertainty.

The IPCC 2006 GL suggests an aggregation level of the categories for performing the KC analysis using Approach 1 and lists the source and sink categories to consider in the analysis. However, it is also stated that the results of the KC identification will be most useful if the analysis is done at the appropriate level of disaggregation, and therefore countries may adapt the recommended level of analysis to their national circumstances.

Currently, within a GHGI, several KC analyses are included:

1. A KC analysis automatically generated by the UNFCCC CRF Reporter Software, showed in CRF table 7, which allows the comparison of its result among Parties by using the same aggregation level and Approach 1.
2. A possible (not automatized) more detailed KC analysis implemented using a greater level of disaggregation of the categories, adapted to national circumstances, often using approach 1 and 2 methods. This is generally done by most MSs but not all yet.
3. A mandatory not automatized KC analysis that includes information on KP-LULUCF activities that are considered “key”.

In this note, we use the KC analysis automatically generated by the CRF Reporter software, done at the level of land use sub-categories (i.e. for LULUCF this means the disaggregation of emissions and removals at the “land remaining in” and “land converted to” detail level), to which the categories called “other tables” (see above) are also included.

An important consideration provided by the IPCC 2006 GL on LULUCF disaggregation relates to the fact that inventory compilers should determine which pools and sub-sub-categories are significant within each KC. In particular, since the conversion of forests is spread out under different land-use change categories, countries should identify and sum up the emission estimates associated with the conversion of forests to any other land category (i.e. deforestation) and compare its magnitude to the smallest category identified as key. If the deforestation emissions total is larger than the smallest category identified as key, then deforestation should also be considered as key.

To better understand the implementation of the KC analysis in the GHGIs it is important to bear in mind that, although in this assessment we focus only on CO_2 (by large the major GHG in LULUCF) using the level criteria, the KC analysis included in CRF table 7 provides information also on CH_4 and N_2O using both the level and trend criteria, and repeatedly for an inventory excluding and including LULUCF categories.

In this sense, it is also important to bear in mind that the IPCC 2019 Methodological Refinement does not introduce major modifications to the IPCC 2006 GL methodology for KC analysis. However, a simplification is proposed for the equation used for the trend assessment, and some updates on the approaches used to identify KCs. A relevant addition is the suggestion that when possible (i.e. when the gain-loss method is used to estimate carbon stock changes) the analysis should be performed separately for emissions and removals within a given category or within different pools, Doing it so, it is avoided to cancel out their quantities.

APPROACH USED IN THIS ASSESSMENT

The KC analysis based on LACs requires that original land use data is disaggregated at the level showed in Table 2 (i.e., at the level of land use sub-sub-categories). However, under the current CRF tables, not all emissions and removals are unequivocally allocated to a specific land use sub-sub-category. In particular, when emissions are reported in CRF tables[1] 4(I) - 4(V) they are in most cases aggregated at the level of sub-categories "land remaining in" and generically "land converted to" without further information on which land use category land is converted. Likewise, in CRF table 4.D, which include information on Wetlands, not all the MSs report information on which land use category is converted to wetlands.

To overcome the lack of sufficient disaggregation of the information on CRF tables 4(I) – 4(V) our assessment followed the approach used by the CRF Reporter and added those tables as any other sub-category on top of the data in the other tables. Nevertheless, we selected for our assessment MS that do not report CO_2 emissions in those CRF tables, therefore no impact is expected.

On the other hand, to overcome the lack of disaggregated information in the CRF table 4.D, we selected five case studies which report in CRF table 4.D information on CO_2 disaggregated at the level required for the analysis: Austria, Belgium, Bulgaria Germany, and Sweden. This allowed an easy re-aggregation of emissions and removals to build the new LACs without making further assumptions.

For the purpose of this note, to reproduce the KC analysis based on the LACs we used information on emissions and removals for the year 2018 as included in the 2020 GHGI submissions.

Specifically, the following steps were followed:

- **Step 1**: for each MS, the KC analysis showed in CRF table 7 for the GHG CO_2 was transferred in an Excel sheet.
- **Step 2**: for each category included in the CRF table 7, the corresponding CO_2 emissions and removals were assigned. This information was gathered from the background CRF tables of the sectors concerned (i.e., energy, industrial processes, and product use (IPPU), Agriculture, LULUCF and Waste).
- **Step 3**: a percentage (%) value was calculated by dividing the sum of emissions and removals of the KC identified in the table by the total sum of all emissions and removals of the categories in the table. In this step, all the numbers were converted to absolute terms. And, only those KCs under the "level assessment"[2] and "including LULUCF" categories were considered as KC for this purpose.
- **Step 4**: using the mapping showed in table 2 above, information on emissions and removals reported in CRF tables 4.A – 4.F was then used to re-aggregate in LACs the emissions and removals of the land use sub-categories. The result is a table with information on emissions and removals for each LACs.

[1] CRF table 4(I): direct N_2O emissions from N inputs to managed soils, 4(II): GHG emissions and removals from drainage and rewetting and other management of organic and mineral soils, 4(III) direct N_2O emissions from N mineralization/immobilization associated with loss/gain of soil organic matter, 4 (IV) indirect N_2O emissions from managed soils, 4(V) GHG emissions from biomass burning.

[2] The tables show the analysis of the key categories using the level and the trend assessment criteria and including and excluding LULUCF.

***Table 3**: Example of the table described in Step 2 that was prepared for the Austrian case study.*

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification	Key category including LULUCF	Kt (CO_2)
		L		
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	X	X	2545,32
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	X	X	1367,29
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	X	X	5024,25
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CO2	X	X	1036,23
1.A.1 Fuel combustion - Energy Industries - Peat	CO2			NO
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	X	X	1582,64
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	X	X	1268,43
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	X	X	7011,72
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	X	X	925,18
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CO2			NO
1.A.3.a Domestic Aviation	CO2			45,98
1.A.3.b Road Transportation	CO2	X	X	23406,96
1.A.3.c Railways	CO2			92,46
1.A.3.d Domestic Navigation - Liquid Fuels	CO2			9,59
1.A.3.d Domestic Navigation - Gaseous Fuels	CO2			NO
1.A.3.d Domestic Navigation - Other Fossil Fuels	CO2			0,01
1.A.3.e Other Transportation	CO2	X	X	587,49
1.A.4 Other Sectors - Liquid Fuels	CO2	X	X	4327,86
1.A.4 Other Sectors - Solid Fuels	CO2		X	81,77
1.A.4 Other Sectors - Gaseous Fuels	CO2	X	X	3981,69
1.A.4 Other Sectors - Other Fossil Fuels	CO2			9,36
1.A.4 Other Sectors - Peat	CO2			NO
1.A.5 Other (Not specified elsewhere) - Liquid Fuels	CO2			50,78
1.A.5 Other (Not specified elsewhere) - Solid Fuels	CO2			0,10
1.A.5 Other (Not specified elsewhere) - Gaseous Fuels	CO2			NO
1.A.5 Other (Not specified elsewhere) - Other Fossil Fuels	CO2			0,01
1.A.5 Other (Not specified elsewhere) - Peat	CO2			NO
1.B.1 Fugitive emissions from Solid Fuels	CO2			IE
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CO2			0,00
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO2			127,24
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	CO2			IE
1.B.2.d Fugitive Emissions from Fuels - Other	CO2			NO
1.C CO2 Transport and Storage	CO2			NO
2.A.1 Cement Production	CO2	X	X	1826,66
2.A.2 Lime Production	CO2	X	X	544,16
2.A.3 Glass Production	CO2			38,29
2.A.4 Other Process Uses of Carbonates	CO2	X	X	499,11
2.B.1 Ammonia Production	CO2	X	X	356,75
2.B.3 Adipic Acid Production	CO2			NO
2.B.4 Caprolactam, Glyoxal and Glyoxylic Acid Production	CO2			NO
2.B.5 Carbide Production	CO2			48,04
2.B.6 Titanium Dioxide Production	CO2			NO
2.B.7 Soda Ash Production	CO2			NO
2.B.8 Petrochemical and Carbon Black Production	CO2			NO,IE
2.B.10 Other	CO2			136,92
2.C.1 Iron and Steel Production	CO2	X	X	9495,37
2.C.2 Ferroalloys Production	CO2			18,36
2.C.3 Aluminium Production	CO2			4,92
2.C.4 Magnesium Production	CO2			NO
2.C.5 Lead Production	CO2			4,88
2.C.6 Zinc Production	CO2			NO
2.C.7 Other	CO2			NO
2.D Non-energy Products from Fuels and Solvent Use	CO2		X	141,50
2.G Other Product Manufacture and Use	CO2			NO,NA
2.H Other	CO2			NA
3.G Liming	CO2			96,50
3.H Urea Application	CO2			23,89
3.I. Other carbon-containing fertlizers	CO2			NA
3.J. Other	CO2			NA
4.A.1 Forest Land Remaining Forest Land	CO2	X	X	-2577,10
4.A.2 Land Converted to Forest Land	CO2	X	X	-1728,79
4.B.1 Cropland Remaining Cropland	CO2			-125,60
4.B.2 Land Converted to Cropland	CO2			230,99
4.C.1 Grassland Remaining Grassland	CO2			296,65
4.C.2 Land Converted to Grassland	CO2		X	-6,12
4.D.1.1 Peat Extraction Remaining Peat Extraction	CO2			NO
4.D.1.2 Flooded Land Remaining Flooded Land	CO2			NE
4.D.1.3 Other Wetlands Remaining Other Wetlands	CO2			NE
4.D.2 Land Converted to Wetlands	CO2			66,14
4.E.1 Settlements Remaining Settlements	CO2			NO
4.E.2 Land Converted to Settlements	CO2	X	X	374,64
4.F.1 Other Land Remaining Other Land	CO2			
4.F.2 Land Converted to Other Land	CO2		X	158,66
4.G Harvested Wood Products	CO2	X	X	-2000,71
4(II). Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2			NO,IE
4(V) Biomass Burning	CO2			NO,IE
4.H Other	CO2			NO
5.A Solid Waste Disposal	CO2			NO,NA
5.C Incineration and Open Burning of Waste	CO2			2,05
5.E Other	CO2			NO
6. Other	CO2			NO

Table 4: *Example of the table described in Step 4 that was prepared for the Belgium case study.*

Deforested Land	341,94		341,94
Afforested Land	-118,77		118,77
Managed Forest Land	-1413,56	→ ABS values	1413,56
Managed Cropland	755,65		755,65
Managed Grassland	-687,33		687,33
Managed Wetlands	6,47		6,47
Other Cat (excluded)	---		---

- **Step 5:** in the table prepared in step 2 (see table 3 above), categories that concerned to LULUCF were replaced by the LAC prepared in step 4 (see table 4 above). ***Note*:** the KC analysis included in the CRF tables 7 considers harvested wood products (HWPs) as an independent category; for the purpose of this assessment, emissions and removals in HWPs were added to the LAC "Managed forest" (i.e. HWPs was considered simply as a forest carbon pool)

  Step 6: finally, all categories in the new table were sorted from largest to smallest quantities in absolute terms, and then, by using the x%[3] value calculated in the step 3, we took as KC those categories that, when summing up their quantities in descendent order, fall within that x % of the total emissions and removals in the tables.

The outputs of the assessment are two tables that we compared in order to understand the differences among the KC analysis carried out using land use and land accounting categories.

[3] It should be noted that such percentage is expected to equal 95% as correspond to the Approach 1 included in the IPCC 2006. In our analysis we ensure the comparability of the KC analysis result by using the same % values in the step 3 and 6 above. The analysis should in principle not include the last added category that surpasses the 95 percent threshold.

4. RESULTS AND DISCUSSION

In this section the result and discussion of our assessments are shown for each case study.

Austria

AUSTRIA

KC showed in CRF table 7		
N	Category	Kt (CO2)
1	2.B.1 Ammonia Production	356,75
2	**4.E.2 Land Converted to Settlements**	374,64
3	2.A.4 Other Process Uses of Carbonates	499,11
4	2.A.2 Lime Production	544,16
5	1.A.3.e Other Transportation	587,49
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fue	925,18
7	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	1036,23
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	1268,43
9	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	1367,29
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	1582,64
11	**4.A.2 Land Converted to Forest Land**	1728,79
12	2.A.1 Cement Production	1826,66
13	**4.G Harvested Wood Products**	2000,71
14	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	2545,32
15	**4.A.1 Forest Land Remaining Forest Land**	2577,10
16	1.A.4 Other Sectors - Gaseous Fuels	3981,69
17	1.A.4 Other Sectors - Liquid Fuels	4327,86
18	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	5024,25
19	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	7011,72
20	2.C.1 Iron and Steel Production	9495,37
21	1.A.3.b Road Transportation	23406,96

KC anlysis using LACs of Regulation (EU) 2018/841		
N	Category	Kt (CO2)
1	2.A.4 Other Process Uses of Carbonates	499,11
2	2.A.2 Lime Production	544,16
3	**Managed Grassland**	574,83
4	1.A.3.e Other Transportation	587,49
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fue	925,18
6	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	1036,23
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	1268,43
8	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	1367,29
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	1582,64
10	**Afforested Land**	1728,79
11	2.A.1 Cement Production	1826,66
12	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	2545,32
13	1.A.4 Other Sectors - Gaseous Fuels	3981,69
14	1.A.4 Other Sectors - Liquid Fuels	4327,86
15	**Managed Forest Land**	4577,81
16	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	5024,25
17	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	7011,72
18	2.C.1 Iron and Steel Production	9495,37
19	1.A.3.b Road Transportation	23406,96

Bearing in mind that the ultimate objective of the KC analysis is to prioritize the existing limited resources for preparing GHGIs, in the Austrian case the use of LACs for assessing LULUCF KCs has a limited impact in the result of the analysis for categories outside the LULUCF sector. Apart from the category 2.B.1 Ammonia Production, the same non-LULUCF categories that that are originally identified as key, are also included now in our KC analysis.

However, for LULUCF, both analyses show different results. While on one side, the original categories 4.A.1 and HWPs are now included in Managed forest; and 4.A.2 is included in Afforested land, the category 4.E.2 is not fully represented in Deforestation. On the other hand, Deforestation includes important sources of emissions that were not considered under 4.E.2.

More in detail, under the category 4.E.2 most of the emissions result from the conversion of Forest and Grassland to Settlements. For forest conversions, Deforestation already points out the importance in terms of emissions, although they were not explicitly highlighted in the original KC analysis but hidden behind 4.E.2. However, the new KC analysis somehow left out emissions from Grassland converted to Settlement that are potentially an important source of emissions that was intrinsically marked as key under the category 4.E.2.

Belgium

Belgium					
KC showed in CRF table 7			*KC anlysis using LACs of Regulation (EU) 2018/841*		
N	Category	Kt (CO2)	*N*	Category	Kt (CO2)
1	**4.C.2 Land Converted to Grassland**	448,96	1	**Managed Grassland**	687,33
2	**4.E.2 Land Converted to Settlements**	461,24	2	**Managed Cropland**	755,65
3	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fue	504,39	3	2.B.1 Ammonia Production	1145,72
4	**4.B.2 Land Converted to Cropland**	590,75	4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	1404,17
5	**4.A.1 Forest Land Remaining Forest Land**	1132,95	5	**Managed Forest Land**	1413,56
6	2.B.1 Ammonia Production	1145,72	6	2.A.2 Lime Production	1562,96
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	1404,17	7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	2005,24
8	2.A.2 Lime Production	1562,96	8	2.B.10 Other	2025,68
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	2005,24	9	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	2113,39
10	2.B.10 Other	2025,68	10	2.A.1 Cement Production	2534,38
11	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	2113,39	11	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	2721,60
12	2.A.1 Cement Production	2534,38	12	2.B.8 Petrochemical and Carbon Black Production	3948,69
13	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	2721,60	13	2.C.1 Iron and Steel Production	4121,43
14	2.B.8 Petrochemical and Carbon Black Production	3948,69	14	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	5098,67
15	2.C.1 Iron and Steel Production	4121,43	15	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	9679,70
16	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	5098,67	16	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	9897,25
17	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	9679,70	17	1.A.4 Other Sectors - Liquid Fuels	10601,24
18	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	9897,25	18	1.A.4 Other Sectors - Gaseous Fuels	13263,78
19	1.A.4 Other Sectors - Liquid Fuels	10601,24	19	1.A.3.b Road Transportation	25060,15
20	1.A.4 Other Sectors - Gaseous Fuels	13263,78			
21	1.A.3.b Road Transportation	25060,15			

In the case of Belgium, the use of LACs for the identification of KCs in the LULUCF sector also leads to slightly different results in non-LULUCF sectors.

In particular, the category 1.A.2., Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels - under Energy sector is left aside when we use the LACs for identifying KCs while such category was originally considered key in the analysis carried out by the CRF Reporter.

For LULUCF the results of the new analysis also highlight some differences. While the original category 4.A.1 equals to Managed Forest Land, the former 4.B.2, 4.C.2 and 4.E.2 categories can be considered only partially translated into Managed Cropland and Managed Grassland. The reason is that under these LUCs a share of the reported quantities exists that relates to deforestation (i.e., “forest converted to Cropland, Grassland and Settlements”), which is not translated in Managed Cropland and Managed Grassland and therefore not considered in the new KC analysis, since Deforested Land does not fall within the minimum threshold required for considering a category as key.

Bulgaria

Bulgaria					
KC showed in CRF table 7			*KC anlysis using LACs of Regulation (EU) 2018/841*		
N	Category	Kt (CO2)	*N*	Category	Kt (CO2)
1	1.A.3.e Other Transportation	319,40	1	1.A.3.e Other Transportation	319,40
2	1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	413,41	2	1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	413,41
3	1.A.4 Other Sectors - Gaseous Fuels	440,39	3	1.A.4 Other Sectors - Gaseous Fuels	440,39
4	1.A.4 Other Sectors - Solid Fuels	482,67	4	1.A.4 Other Sectors - Solid Fuels	482,67
5	1.A.4 Other Sectors - Liquid Fuels	522,48	5	1.A.4 Other Sectors - Liquid Fuels	522,48
6	2.B.7 Soda Ash Production	550,78	6	2.B.7 Soda Ash Production	550,78
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	567,48	7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	567,48
8	**4.B.1 Cropland Remaining Cropland**	580,78	8	2.B.1 Ammonia Production	784,00
9	**4.E.2 Land Converted to Settlements**	601,92	9	**Managed Cropland**	888,56
10	2.B.1 Ammonia Production	784,00	10	2.A.4 Other Process Uses of Carbonates	923,90
11	2.A.4 Other Process Uses of Carbonates	923,90	11	2.A.1 Cement Production	1223,50
12	**4.B.2 Land Converted to Cropland**	1166,90	12	**Afforested Land**	1355,16
13	**4.G Harvested Wood Products**	1174,82	13	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	1654,92
14	2.A.1 Cement Production	1223,50	14	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	1869,19
15	**4.A.2 Land Converted to Forest Land**	1355,16	15	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	4769,84
16	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	1654,92	16	**Managed Forest Land**	7392,92
17	**4.C.2 Land Converted to Grassland**	1775,92	17	1.A.3.b Road Transportation	9176,82
18	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	1869,19	18	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	12034,56
19	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	4769,84	19	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	21709,66
20	**4.A.1 Forest Land Remaining Forest Land**	6218,10			
21	1.A.3.b Road Transportation	9176,82			
22	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	12034,56			
23	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	21709,66			

In the case of Bulgaria, the result of the new KC analysis does not affect other non-LULUCF sectors. All the categories that were originally identified as key, have also resulted key in our analysis. However, some important changes occur within the LULUCF sector. In particular, the seven LUCs originally identified as key are now reduced to three key LACs.

When we look carefully at these results, it comes out that while the LUCs 4.A.1, 4.G, 4.A.2 and 4.B.1 are directly translated into Managed Forest Land, Afforested Land and Managed Cropland, some changes occurred in other categories. In particular, the categories 4.E.2 and 4.F.2 are considered key under the UNFCCC analysis but are only partially translated into Managed Cropland (i.e., only those quantities resulting from Cropland converted to Settlement and Other lands). On the other hand, the replacement of the category 4.E.2 by Managed Cropland leaves aside important sources of emissions that result from the conversion of Forests and Grasslands into Settlements.

Likewise, it occurs with the category 4.C.2 that provides information on land converted to Grasslands. Because neither Managed Grassland nor Deforested land are included in the new analysis, the originally considered key category 4.C.2 is not deemed key in the new analysis.

Germany

Germany					
KC showed in CRF table 7			*KC anlysis using LACs of Regulation (EU) 2018/841*		
N	Category	Kt (CO2)	*N*	Category	Kt (CO2)
1	**4.G Harvested Wood Products**	3239,37	1	2.B.1 Ammonia Production	4157,00
2	**4.E.2 Land Converted to Settlements**	3652,35	2	**Afforested Land**	4761,94
3	2.B.1 Ammonia Production	4157,00	3	2.A.2 Lime Production	4831,50
4	**4.A.2 Land Converted to Forest Land**	4761,94	4	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	6600,33
5	2.A.2 Lime Production	4831,50	5	2.A.1 Cement Production	13227,90
6	**4.C.2 Land Converted to Grassland**	5542,30	6	**Managed Cropland**	15928,57
7	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	6600,33	7	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	16825,56
8	**4.B.1 Cropland Remaining Cropland**	6716,42	8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	16825,56
9	**4.B.2 Land Converted to Cropland**	9022,11	9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	16825,56
10	2.A.1 Cement Production	13227,90	10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	16825,56
11	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	16825,56	11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fue	16825,56
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	16825,56	12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	16825,56
13	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	16825,56	13	**Managed Grassland**	17751,43
14	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	16825,56	14	2.C.1 Iron and Steel Production	20145,87
15	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fue	16825,56	15	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	48776,00
16	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	16825,56	16	1.A.4 Other Sectors - Liquid Fuels	50266,40
17	2.C.1 Iron and Steel Production	20145,87	17	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	56759,37
18	**4.C.1 Grassland Remaining Grassland**	20876,85	18	**Managed Forest Land**	65753,38
19	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	48776,00	19	1.A.4 Other Sectors - Gaseous Fuels	68277,24
20	1.A.4 Other Sectors - Liquid Fuels	50266,40	20	1.A.3.b Road Transportation	155812,70
21	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	56759,37			
22	**4.A.1 Forest Land Remaining Forest Land**	62514,01			
23	1.A.4 Other Sectors - Gaseous Fuels	68277,24			
24	1.A.3.b Road Transportation	155812,70			

In the case of Germany, the result of the new KC analysis does not affect non-LULUCF sectors. All the categories that were originally identified as key have also been included in the new analysis as key.

As regards with the LULUCF sector, there is also a good match among the categories that have resulted key considering LUCs and LACs. The categories 4.A.1, 4.G and 4.A.2 are directly included in Managed Forest land and Afforested Land. Moreover, the categories 4.B.1 and 4.B.2, on the one hand, and 4.C.1 and 4.C.2, on the other, are now included in Managed Cropland and Managed Grassland. By last, also most of the emissions and removals included in the category 4.E.2 are included in the new analysis under Managed Cropland and Managed Grassland.

Noteworthy, the exclusion of Deforested land as a KC in the new analysis seems not to have any impact since deforestation plays an important role in all the categories that involve conversions.

Sweden

Sweden						
KC showed in CRF table 7				*KC anlysis using LACs of Regulation (EU) 2018/841*		
N	Category	Kt (CO2)		*N*	Category	Kt (CO2)
1	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fue	257,87		1	**Managed Grassland**	410,79
2	1.A.4 Other Sectors - Gaseous Fuels	288,70		2	2.D Non-energy Products from Fuels and Solvent Use	442,47
3	**4.C.1 Grassland Remaining Grassland**	353,83		3	1.A.1 Fuel combustion - Energy Industries - Peat	645,01
4	2.A.2 Lime Production	388,21		4	1.A.3.d Domestic Navigation - Liquid Fuels	724,67
5	2.D Non-energy Products from Fuels and Solvent Use	442,47		5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	747,17
6	1.A.1 Fuel combustion - Energy Industries - Peat	645,01		6	1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	783,12
7	1.A.3.d Domestic Navigation - Liquid Fuels	724,67		7	2.B.10 Other	858,27
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	747,17		8	**Afforested Land**	1031,81
9	1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	783,12		9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	1545,33
10	2.B.10 Other	858,27		10	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	1583,66
11	**4.A.2 Land Converted to Forest Land**	1031,81		11	2.A.1 Cement Production	1607,18
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	1545,33		12	2.C.1 Iron and Steel Production	1977,73
13	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	1583,66		13	1.A.4 Other Sectors - Liquid Fuels	2098,35
14	2.A.1 Cement Production	1607,18		14	**Deforested Land**	2199,31
15	2.C.1 Iron and Steel Production	1977,73		15	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	2812,72
16	1.A.4 Other Sectors - Liquid Fuels	2098,35		16	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	4192,41
17	**4.E.2 Land Converted to Settlements**	2673,45		17	1.A.3.a Domestic Aviation	4200,68
18	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	2812,72		18	**Managed Cropland**	4618,76
19	**4.B.1 Cropland Remaining Cropland**	3674,53		19	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	4634,52
20	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	4192,41		20	1.A.3.b Road Transportation	14827,85
21	1.A.3.a Domestic Aviation	4200,68		21	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	25042,33
22	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	4634,52		22	**Managed Forest Land**	49475,68
23	**4.G Harvested Wood Products**	5702,33				
24	1.A.3.b Road Transportation	14827,85				
25	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	25042,33				
26	**4.A.1 Forest Land Remaining Forest Land**	43773,35				

In the case of Sweden, the result of the new KC analysis raises some differences for non-LULUCF sectors. Specifically, the categories 1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels, 1.A.4 Other Sectors - Gaseous Fuels, and 2.A.2 Lime Production identified as key by the UNFCCC analysis are excluded from the new analysis when LACs are considered.

However, for the LULUCF sector the LUCs show a good match with the resulting key LACs. Unequivocally, the categories 4.A.1 and 4.G on the one hand, and 4.A.2, 4.B.1 and 4.C.1 on the other, are directly included in Managed Forest Land, Afforested land, Managed Cropland, and Managed Grassland.

In addition, a more in-depth analysis of category 4.E.2 shows that the main drivers of this category are emissions from the conversion of forest and cropland categories into settlements. These emissions are now included under Deforested land and Managed Cropland.

5. SUMMARY AND CONCLUSIONS

Although an assessment based on more case studies might provide more insight, the results of our assessment suggest that the KC analysis based on LACs may slightly differs from the KC analysis currently done under the UNFCCC reporting scheme, which is based on LUCs.

Each analysis provides slightly different messages that can complement each other contributing to a better identification of the key sources or sinks of the LULUCF sector.

The implementation of two parallel KC analyses, while representing a small additional burden to GHGI compliers, could be used to incentive deeper analyses and to move faster towards the implementation of higher tiers on the LULUCF sector. In particular by increasing the quality of the LULUCF information with better targeting of resources. Indeed, when the two analyses are combined, in most cases a major part of LULUCF emissions and removals become key. Then, a thoroughly analysis of which are the ultimate drivers of carbon stock changes should point the areas to be improved, no matter if within LUCs or LACs.

If the KC analysis based on LACs is finally implemented, few additional decisions might need to be taken on those tables where the disaggregation of MS´s GHGIs is often not at the required level of sub-sub-categories (CRF table 4 (I) - 4 (V), and 4.D). Options include making assumptions like assigning these emissions proportionally to the emissions of “land remaining “and “land converted,” or adding them as new categories as it is now done by the analysis currently implemented by the CRF Reporter.

Nevertheless, it should be noted that:

(i) the emissions included in these CRF tables are typically small in most of the inventories, and thus are not expected to influence deeply the KC analysis.

(ii) for many MSs those emissions occur in land use categories that are directly translated into LACs, e.g., forest fires under forest land remaining forest land directly assigned to Managed forest.

(iii) many MSs have stated to have information on emissions and removals as such disaggregation level, but they do not report them at such level of disaggregation simply because is not requested by the CRF Reporter.

If the likely additional burden that results from the new KC analysis based on LACs is perceived as a problem, the analysis can be potentially automatized and circulated to the MSs for being checked. Ideally, if for some country information is not disaggregated at the level needed for the analysis, they could suggest on the most accurate attribution of the quantities to the sub-categories where not further disaggregated information is included in the CRF tables.

NOTE 2

ASSESSMENT OF TIERS METHODS USED FOR LULUCF REPORTING AND THEIR COMPLIANCE WITH REGULATION (EU) 2018/841.

- PRELIMINARY ASSESSMENT OF THE SIGNIFICANCE OF CARBON POOLS -

1. OBJECTIVE

This note has the twofold objective of (i) assessing, for each land use sub-category reported under "land remaining in the same category", the significance of its carbon pools in terms of emissions and removals, including those pools for which the IPCC 2006 GL assumes carbon stock changes to be in balance, and (ii) assessing the status of MSs submissions towards the compliance with the Article 18 of Regulation (EU) 2018/841.

In addition, several annexes have been included to this note that include information on (i) the likelihood for carbon pools by land sub-categories of being significant, (ii) Tier methods used by carbon pool, (iii) significance of carbon pools within Forest land remaining Forest land when Harvested Wood Products (HWP) are considered as an additional pool, and (iv) data sources used for land representation.

2. LEGISLATIVE FRAMEWORK: REGULATION (EU) 2018/841

Regulation (EU) 841/2018 states in its Article 18 (4) that "*for emissions and removals for a carbon pool that accounts for at least 25-30 % of emissions or removals in a source or sink category which is prioritized within a MS's national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or the uncertainty in emissions and removals in the land-use categories, at least Tier 2 methodology in accordance with the IPCC 2006 GL*[4] should be used". Moreover, MSs are encouraged to apply Tier 3 methodology, in accordance with such guidelines.

The IPCC 2006 GL defines in its Volume 1, Chapter 4, a key category (KC) as the one that is prioritized within the national inventory system because its emissions/removals have a significant influence on a country's total inventory of GHG in terms of the absolute level, the trend, or the uncertainty.

In a nutshell, MSs will have to comply with the use of, at least, Tier 2 methods for estimating emissions and removals in those carbon pools that account for at least 25-30% of emissions or removals in a key category.

3. METHODOLOGICAL FRAMEWORK

2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES

To assess the status of compliance of MSs submissions towards the Article 18 of Regulation (EU) 2018/841 we need to get a clear idea of what it is a key category, and how a KC analysis is performed. A parallel note accompanying this note addresses issues related to the KC analysis, therefore, this section focuses on describing how the Tier methods are defined in the IPCC 2006 GL, and how the separation among them is done.

[4] IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).Published: IGES, Japan.

Within the IPCC 2006 GL a Tier method represents a level of methodological complexity for estimating emissions and removals within the GHGIs. In general, moving to higher tiers improves the accuracy of the estimation and reduces its uncertainty, but the complexity and resources required for performing the inventories also increase when applying higher Tiers.

According with the guidelines, anthropogenic GHG emissions and carbon removals can be estimated through an approach that combines information on the extent to which a human activity takes place (called activity data or **AD**) with coefficients that quantify the emissions or removals per unit of activity data (called emission factors or **EF**).

The basic equation for estimating emissions and removals in a category is therefore:

$$\text{Emissions, or Removals} = \boldsymbol{AD} \times \boldsymbol{EF}$$

For most of the sources and sink categories, the IPCC 2006 GL identify three Tier methods of increasing methodological complexity, along with decision trees that help inventory compilers to select the most appropriate methodology for their circumstances. The selection should consider the result of the key categories analysis, noting that it is a good practice to use higher tier methods for key categories, unless the resources necessary to do so are prohibitive (UNFCCC Decision 24/cp.19).

Tier 1 methods are the most basic and provide a feasible option for all the countries to produce a complete national GHG inventory. In general, Tier 1 uses readily available national or international statistics in combination with default EFs and additional default parameters that are provided in the guidelines. On the contrary, Tier 2 and 3, known as higher tiers methods, involve respectively country-specific parameters at higher spatial and temporal resolution and/or more advanced modelling approaches, and are considered more accurate.

Specifically, for the LULUCF sector the IPCC 2006 GL provide at the level of carbon pool and land use category three tier methods than can be summarized as follow:

Table 1: Summary of Tier methods for estimating carbon stock changes in LULUCF sector.

1	2	3
Use default methodologies (e.g., equations) with default emissions factors, and or coefficients that are often provided at the level of climate zones, global ecological zones, and soils types. Or, in some cases it is assumed that there is no net change in the carbon stock. I.e., the pool is in equilibrium.	Use default methodologies (e.g., equations), which are often the same used in Tier 1, but involving country-specific factors, frequently in combination with some default parameters. The quality of its estimates strongly depends on the temporal and spatial scales of the data collection systems.	Use country-specific methodologies that involve highly disaggregated information that allows for fine spatial scale for estimating GHGs. Usually relates with modelling methodologies or fine temporal and spatial resolutions. (e.g., high intensity sample systems)

As showed in table 1, IPCC 2006 GL assume certain carbon pools in balance under the Tier 1. For these pools, no net emissions or removals are reported when a MS implement the Tier 1 method. The assumption of balance only applies for specified carbon pools and always under land use sub-categories “remaining”. For land use transitions the resulting carbon stock change needs to be reported even under Tier 1 methods.

Table 2: In grey, the carbon pools for which the IPCC 2006 GL assume balance under the Tier 1 method.

4.A.1. F-F					4.B.1. C-C				4.C.1. G-G				4.D.1. WL-WL				4.E.1. SL-SL				4.F.1. OL-OL			
LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg

LB-living biomass; DW-dead wood; LT- litter, DOM- dead organic matter; SOC min/org- soil organic carbon in mineral and organic soils .

Two particular cases are given in the land use sub-categories 4.F.1 -other land remaining other land-, and 4.B.1.-cropland remaining cropland-

As regards 4.F.1, the IPCC 2006 GL consider that these areas are unmanaged and lack significant carbon contents. Accordingly, there is no need to report emissions or removals from them under stable conditions, but just when they are involved in a land use conversion. Under 4.B.1, with regards to living biomass, the IPCC provides, under the Tier 1 method, default parameters only for woody crops. For annual vegetation, in the absence of country-specific parameters, the assumption of equilibrium applies.

Moreover, there are certain categories for which the IPCC 2006 GL do not provide methodologies. In these cases, inventory compilers are not required to provide estimates and the notation key NE "not estimated" can be used instead. In the LULUCF sector this lack of methodologies affects the land use sub-categories "Flooded land remaining flooded land" and "Other wetland remaining other wetlands".

As regards with the tiered approach of the IPCC 2006 GL, the IPCC 2019 Refinement does not introduce major changes. The same approach is kept for estimating GHG emissions and carbon removals in a GHGI. Nevertheless, in particular for LULUCF, most of the default factors have been updated and some new added to capture new knowledge and developments in science. For instance, new methods have been introduced for estimating carbon stock changes in soil organic carbon in mineral soils under the Tier 2.

APPROACH USED IN THIS ASSESSMENT

Article 18 in (EU) Regulation 2018/841 requires the use of, at least, Tier 2 methods for estimating emissions and removals in those carbon pools that are significant within a KC. However, the Tier 1 assumption of equilibrium (i.e., balance) is widely used for carbon pools for which MSs lack country-specific data, and IPCC 2006 GL do not provide default factors.

To assess which carbon pools must be reported with Tier 2 methods we should first know the significance of the pools within each category. However, calculating the significance for pools that are not quantitatively reported is in principle not possible. To overcome this dilemma, we offer a possible interim practical and consistent solution. **We use, as a proxy of the significance of a non-reported pool in a given land use sub-category, the average value of the significance calculated from those MSs that quantitatively estimate that pool.**

This methodology is preliminary and could be further refined in subsequent assessments[5]. However, as an interim solution, this approach allows us to get a clearer idea of which pool tends to be significant within each land use sub-category.

An important aspect to bear in mind is that the carbon behaviour within a pool is strongly dependent on the management practices and climate conditions. Thus, certain carbon pool might represent a large source of emissions in one country and a sink of carbon in other. Additionally, in specific years, other factors such as natural disturbances,

[5] For instance, the average value used as a proxy of the significance could be calculated at the level of climate region or global ecological zone that consider particular conditions reducing the variance of the average. And/or, some weighted average could be considered (e.g., using the absolute value of net emissions), and/or some iterations could be applied to reduce outliers of the sample before calculating the average.

wood market-prices could also affect the significance of the pools or even reverse its behaves from being sink to a source.

Furthermore, the lack of available estimates represents in itself an impediment for an appropriate analysis of the significance of carbon pools. The significance of each carbon pool within a given category is interlinked with that of the others, therefore when a pool is not reported the significance of those that are quantitatively estimated increase. To figure out the real significance value for a certain pool, all the carbon pools would ideally need to be reported. Moreover, for organic soils the significance is highly dependent of their area, which create a sort of artifact when pooled together with other carbon pools.

Our assessment is based on the 2020 GHGI submissions. Information on the completeness status of the reporting is based on an internal file that shows which pool is reported with quantitative estimates. The KC analysis used to know which land categories are key is taken from the CRF table 7 of MSs GHGI submissions. Information on the Tier method used is based on the analysis of the information provided by MSs to the Annex-III (i.e., methodological descriptions) of the EU GHGI, and on the National Inventory Reports (NIRs), a part of each MSs submission. The transparency of these documents was not always enough to unequivocally assign a Tier method to certain pools. Therefore, our judgement on the Tier method used should be taken with caution.

Moreover, because one of the objectives of our assessment is to highlight cases where a MS is not in line with the Regulation (EU) 2018/841 (i.e., Tier 1 methods used for significant pools in KC), our analysis focuses on the identification of Tier 1 methods and does not enter in-depth on the separation among Tier 2 and Tier 3.

Regarding gases, our analysis covers only CO_2 in land sub-categories "Land remaining in the same land" because of the complexity[6] of assigning a single Tier method to land use sub-categories "Land converted to". Usually, for reporting carbon stock changes in a category reported as "remaining ", a single data source is used that enable the categorization of the methodologies. Conversely, multiple data sources can often be used to derive emissions from sub-categories "land converted to" which often prevents an easy categorization of the methods. For instance, for estimating carbon stock changes in living biomass from forest land converted to cropland, MSs may adopt country-specific values for forest land and default factors for cropland. Besides that, the categorization of methods under a single Tier for sub-categories "land converted to" undoubtedly depends on the categories involved in the conversion (e.g., different approaches and data sources are often used for forest converted to grassland than for cropland converted to grassland).

Finally, the harvested wood products[7] (HWPs) pool has not been included in our analysis because the current CRF tables for LULUCF do not treat HWPs as an additional carbon pool associated to any land use category, but as an additional category for which estimates are provided in the sectorial CRF table 4. But the reporting of HWPs should not raise any case of non-compliance with article 18 of (EU) Regulation 2018/841 since, with the exception of Malta, which do not declare HWPs from domestic harvest, all MSs used the Production approach of the IPCC 2006 GL involving country-specific information (or international databases) on harvested quantities.

Our assessment went through the following steps:

- **Step 1**: Identification of KCs for each land use sub-category based on MS´s CRF tables 7 of GHGI submission 2020 and referring to the year 2018. Each of the KCs were considered for our assessment irrespective of whether they were derived using the level or the trend criteria.

[6] In the annex-II information on the tier methods used by carbon pool and land use sub-sub category has been included based on our expert judgement and on information included in MS´s NIRs.

[7] In the annex-III an assessment of the significance of carbon pools for the category 4.A.1 has been included assuming that all the HWPs originate from 4.A.1. Therefore, adding HWPs as an additional pool under 4.A.1

- **Step 2:** cross checking of the completeness status of MSs submissions, with a table that shows the KC analysis. The result is a table with information on the carbon pools that have been quantitatively reported and whether the concerned land use sub-category is key. On top of that we marked in grey the pools that are assumed in balance under the Tier 1 method of the IPCC 2006 GL. This allowed the separation among pools not reported based on the assumption of equilibrium and those that lack estimates based on country-specific arguments (e.g., lack of woody crops, management practices on soils applied equally across the years, lack of organic soils
- **Step 3:** For each land use sub-category "remaining' the significance of its carbon pools in terms of emissions and removals was calculated. To do so, because information at pool level in CRF table 4.A-4.F is provided only for carbon stock changes, it was necessary to convert those values into CO_2 by multiplying carbon stock change values by the ratio of molecular weights (44/12). This step was performed for the whole time series 1990-2018 and for each pool within the land use sub-categories concerned.
- **Step 4:** Once we obtained the emissions and removals values of the carbon pools, for each land use sub-category "remaining" and for the whole time series, all the values were converted to absolute terms. Then, for each year of the time series we estimated the significance of the carbon pool by dividing the absolute value of the pool by the sum of the absolute values of all the pools in the category. To obtain a single value of significance for each pool we used the average of the significance of the pool throughout the whole time series 1990-2018.
    - **N.B.:** For pools assumed in balance under the Tier 1 method of the IPCC 2006 GL we used as a proxy of the significance the average value of the significance calculated for the MSs that quantitatively reported the pool.
- **Step 5:** Once the significance value is known, we analysed the information in Annex-III of the EU GHGI or MS´s NIRs in order to give the pools a label indicating the Tier method used. Separation was only done among Tier 1 and higher Tiers, as a whole.
- **Step 6:** To conclude, we compared the information on the Tier methods used, as calculated in step 5, with the significance values of the carbon pools, as calculated in step 4. This step enables the identification of those carbon pools reported with Tier 1 methods despite of their significance being > 25- 30% (i.e., in our assessment the threshold value of 25% was used to consider a pool as significant)

4. RESULTS AND DISCUSSION

Following the approach described above, this section aims to reveal for each land use sub-category "remaining" those cases that could be in non-compliance with the requirement of the Article 18 of the Regulation (EU) 2018/841.

For each land use sub-category covered in our analysis and individual MSs, we displayed a table showing MS in which the category is key, the significance of each carbon pool, and the average value of the significance of the pools using the values of the MSs that provide estimates.

In addition, in the table we added information on the Tier method used for estimating carbon stock changes in each pool. In cases where the IPCC 2006 GL assume the pool in balance and a MS did not provide quantitative estimates the notation T1 was used.

In these tables we highlighted those pools considered (i) non-compliant or (ii) potentially non-compliant with Article 18 of the Regulation (EU) 2018/841 either:

(i) Based on the own reporting of MSs: the land use category is key and Tier 1 methods are used. I.e., implementing the assumption of equilibrium or default factors for providing estimates.

(ii) Based on the average value of the significance calculated from other Ms. I.e., irrespective of whether the category is key, the average value of significance suggests that the pool is significant, but the MS does not provide estimates and the Tier 1 assumption of balance does not apply.

All the possibilities are translated in the tables below using a colour legend as follow:

- The land use sub-category is key according with information provided in the CRF table 7.
- (i) Non-compliance based on quantitative information provided by the MS concerned.
- (ii) Potential non-compliance based on data from other MSs.
- The carbon pool is assumed in balance by the Tier 1 method of the IPCC 2006 GL.

FOREST LAND REMAINING FOREST LAND

Table 3: Reporting status of emissions and removals from forest land remaining forest land.

MS	Living biomass		Dead wood		Litter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	65%	*T2,3*	8%	*T2,3*	*IE*	*T2,3*	28%	*T2,3*		
BE	100%	*T2,3*	*T1*		*T1*		*T1*			
BG	100%	*T2,3*	0%	*T2,3*	*T1*		*T1*			
HR	100%	*T2,3*	*T1*		*T1*		*T1*			
CY	100%	*T2,3*	*T1*		*T1*		*T1*			
CZ	97%	*T2,3*	3%	*T2,3*	*T1*		*T1*			
DK	60%	*T2,3*	3%	*T2,3*	25%	*T2,3*	*T1*		12%	*T2,3*
EE	60%	*T2,3*	4%	*T2,3*	*T1*		27%	*T2,3*	9%	*T2,3*
FI	66%	*T2,3*	*IE*	*T2,3*	*IE*	*T2,3*	17%	*T2,3*	17%	*T2,3*
FR	92%	*T2,3*	8%	*T2,3*	*T1*		*T1*			
DE	65%	*T2,3*	5%	*T2,3*	1%	*T2,3*	25%	*T2,3*	4%	*T2,3*
GR	100%	*T2,3*	*T1*		*T1*		*T1*			
HU	86%	*T2,3*	11%	*T2,3*	*T1*		*T1*		3%	*T1*
IE	70%	*T2,3*	*IE*	*T2,3*	7%	*T2,3*	1%	*T2,3*	22%	*T2,3*
IT	96%	*T2,3*	1%	*T2,3*	2%	*T2,3*	*T1*			
LV	66%	*T2,3*	26%	*T2,3*	*T1*		*T1*		8%	*T2,3*
LT	87%	*T2,3*	13%	*T2,3*	*T1*		*T1*		*IE*	*T1*
LU	90%	*T2,3*	10%	*T2,3*	*T1*		*T1*			
MT	----		*T1*		*T1*		*T1*			
NL	91%	*T2,3*	5%	*T2,3*	*T1*		*T1*		4%	*T2,3*
PO	89%	*T2,3*	*T1*		*T1*		9%	*T1*	3%	*T1*
PT	98%	*T2,3*	*IE*	*T2,3*	1%	*T2,3*	2%	*T2,3*		
RO	99%	*T2,3*	*T1*		*T1*		*T1*		1%	*T1*
SK	100%	*T2,3*	*T1*		*T1*		*T1*			
SI	90%	*T2,3*	10%	*T2,3*	*T1*		*T1*			
ES	100%	*T2,3*	*T1*		*T1*		*T1*			
SE	49%	*T2,3*	1%	*T2,3*	20%	*T2,3*	6%	*T2,3*	24%	*T2,3*
IS	99%	*T2,3*	*T1*		*T1*		*T1*		1%	*T1*
Average	**86%**		**7%**		**9%**		**14%**		**9%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T - tier

The analysis shows that forest land remaining forest land is a KC for all the countries except Malta that following a recommendation from its UNFCCC Expert Review Team, does not report carbon stock change under this category. Malta confirmed that efforts are ongoing to estimate and report emissions and removals from this category in future submissions.

In terms of significance, Living biomass is by large the major contributor, accounting for an average value of 86% of the absolute level of emissions and removals in the category. The carbon pools Dead wood and Litter, for the vast majority of the countries that report the pool, do not reach the minimum significance value that would lead to the mandate of using higher tiers methods.

The estimated carbon stock changes in mineral soils exceed the significance threshold value for a number of MSs, but on average it is lower than the minimum threshold value of 25%. For organic soils, empty cells are explained by the fact that organic soils are not always present within all MS. Nevertheless, although organic soils are often considered hotspots in terms of emissions, its significance in a context of an entire category is linked with the specific area that they occupy within the entire category. Because the area of organic soils is often relatively small as

compared with mineral soils, the significance appears not as high as that of mineral soils, although their emissions per unit of area are substantially larger.

In term of Tiers methods, for living biomass we have labelled the methods applied by all MSs as “higher tiers” because MSs obtain their estimates using country-specific values taken from forest inventories or forest management plans, or in some case by modelling approaches, however a deeper analysis shows that some default parameters continue being used in the estimates. For instance, the root-to-shoots ratios for estimating below-ground biomass, or the wood densities used to convert wood volumes in tones of dry matter.

Moreover, it is remarkable the widespread use of the tier 1 assumption of equilibrium for Dead organic matter and SOC in mineral soils.

Overall, under the land use sub-category Forest land remaining forest land, only Malta seems to be in a potential non-compliance situation. While the category is not a key category for Malta, the analysis strongly suggests that living biomass is a significant pool that should in principle be reported using higher tiers methods by all MSs. On the other hand, the limited extent of forest area in Malta should also be considered to assess whether the cost of obtaining country specific data exceed the benefits.

Beyond this analysis, additional reflections are worth on Dead wood and Litter. Even if formally not “significant”, the omission of these pools from GHGI is not easily justifiable in terms of data availability or resources burden. It could be assumed that national forest inventories, which are in place for most of the MSs, collect data on these pools, at least for recent years. In addition, carbon stock changes in these pools may be estimated also from the Living biomass pool through models. Therefore, an enhanced reporting of these pools is expected in a near future. Also considering that the Regulation (EU) 2018/841 states in its article 5 that the option of not to include changes in carbon stocks in the accounts shall not apply into the case of Above-ground biomass, Dead wood and HWPs, in the land accounting category of Managed forest land.

Furthermore, the exclusion of Dead wood from the Forest Reference Level cap should represent an incentive to provide estimates for it. In these cases, a “soft” approach could be considered with MSs, i.e., guiding as many MSs as possible to report these pools based on enhanced sharing of data, methods, models, and best practices. A similar approach could be applied also to mineral soils, although less data is available.

CROPLAND REMAINING CROPLAND

Table 4: Reporting status of emissions and removals from cropland remaining cropland.

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	22%	*T2,3*	*T1*		78%	*T2,3*		
BE	2%	*T2,3*	*T1*		64%	*T2,3*	34%	*T1*
BG	8%	*T1*	*T1*		92%	*T2,3*		
HR	49%	*T1*	*T1*		8%	*T2,3*	42%	*T1*
CY	100%	*T1*	*T1*		----			
CZ	8%	*T1*	*T1*		92%	*T2,3*		
DK	1%	*T2,3*	*T1*		12%	*T2,3*	87%	*T2,3*
EE	1%	*T2,3*	*T1*		37%	*T2,3*	62%	*T2,3*
FI	0%	*T2,3*	*IE*	*T2,3*	12%	*T2,3*	88%	*T2,3*
FR	18%	*T2,3*	*T1*		82%	*T2,3*	*IE*	*T2,3*
DE	1%	*T2,3*	*T1*		1%	*T2,3*	98%	*T2,3*
GR	74%	*T2,3*	*T1*		----		26%	*T1*
HU	13%	*T2,3*	*T1*		87%	*T2,3*		
IE	41%	*T1*	*T1*		59%	*T1*		
IT	21%	*T2,3*	*T1*		62%	*T2,3*	17%	*T1*
LV	1%	*T2,3*	0%	*T2,3*	----		99%	*T1*
LT	39%	*T1*	*T1*		61%	*T2,3*	*IE*	*T1*
LU	92%	*T1*	*T1*		8%	*T2,3*		
MT	76%	*T2,3*	*T1*		24%	*T1*		
NL	----		*T1*		----		100%	*T2,3*
PO	70%	*T1*	*T1*		7%	*T1*	23%	*T1*
PT	90%	*T2,3*	*T1*		10%	*T2,3*		
RO	21%	*T2,3*	4%	*T2,3*	72%	***T1***	4%	*T1*
SK	96%	*T2,3*	*T1*		4%	*T2,3*		
SI	78%	*T1*	*T1*		1%	*T1*	21%	*T1*
ES	35%	*T2,3*	*T1*		65%	*T2,3*		
SE	5%	*T2,3*	0%	*T2,3*	18%	*T2,3*	77%	*T1*
IS	----		*T1*		3%	*T2,3*	97%	*T1*
Average	**37%**		**1%**		**40%**		**58%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T – tier.

For more than half of MSs Cropland remaining cropland appears as a key category. However, many MSs continue applying Tier 1 methods for estimating emissions and removals in its carbon pools.

Most of the MSs report on living biomass, although some of them through the use of Tier 1 methods. There are two exceptions, where MSs declared a lack of woody crops and, in line with the IPCC assumption of equilibrium for annual crops, they do not report quantitative estimate for this carbon pool. Some others have reported the pool only for the conversion among "woody" and "annual" crops, assuming that when these sub-sub categories remain stable, the living biomass is in equilibrium in terms of carbon stocks. Dead organic matter was always assumed in balance, with the exception of four MSs that implement country specific data.

Under Mineral soils, a significant number of MSs provided estimates. Many MSs have in recent years developed country-specific factors which, along with some default parameters, allowed the estimation of the pool using higher tiers methods. It should be noted that some of these country-specific parameters were then used by neighbouring countries to perform their estimates replacing the use of default factors. In both cases, the notation T2/T3 was used in our table simply to keep coherence in the tables and because the method does not involve IPCC default factors.

Under Mineral soils, empty cells are the result of MSs justifying that on the basis that management practices have not changed over time and emissions, nor removals are expected[8]. It should be noted that this assumption of "no change in management practices over time", whose implementation has decreased in recent years, is often not adequately documented.

With the purpose of highlighting potential cases of non-compliance, for empty cells in mineral soils and living biomass we used the average value of significance reported by other MSs as a proxy. Irrespective of the category being key for these MSs, if the proxy value is higher than 25%, we consider this case as being potentially in a non-compliance situation (i.e. orange cells). The reason is that more efforts and information are often needed to justify the lack of emissions or removals in cultivated mineral soils and demonstrate the lack of woody crops in the country. Nevertheless, these cases are only "potential" cases of non-compliance. A case-by-case study would be needed before judging whether leaving these cells empty complies or not with the Regulation (EU) 2018/841.

For Organic soils, empty cells generally indicate the absence of such soil type in the category. When reported, more than half of the MSs used the default factors of the IPCC 2006 GL[9] in their estimates for organic soils, which for some climate zones are larger than any country-specific value used. However, despite of the potential overestimation that could occur because of using the Tier 1method in conditions different than the ones to which the default factor applies, it is well known that cultivated organic soils are among the major sources of emissions in LULUCF sector, and therefore their significance is well demonstrated.

A similar situation occurs for Living biomass. The IPCC 2006 GL default value[10] for estimating carbon sequestration in woody crops has raised some concerns on a potential large overestimate the sink. The overestimation introduced by MSs using the Tier 1 method in this pool, is then translated into the average of the significance value calculated at EU level. However, for those MSs that report important areas of woody biomass using higher tiers, the pool appears also significant, so that higher tier methods seem needed for estimating carbon stock change in woody vegetation classified as Cropland.

Ultimately, the use of Tier 1 methods in Cropland seems to lead to an important number of non-compliance cases for MSs for which this category resulted key. Specifically, 14 MSs should increase the Tier method used in their estimates; furthermore, 6 MSs that do not report estimates for certain pool could potentially be also in non-compliance situation according with the average value of significances. Or at least, their justification for not providing estimates should be carefully scrutinized.

For living biomass, some LIFE projects like Medinet [11] have been carried out at European level in recent years that should help MSs to increase the accuracy of their estimates. Moreover, particular attention should be paid for

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[8] The IPCC methodology available for estimating carbon stock changes in mineral soils is based on the difference of carbon stock in two moments on time. The estimation of carbon stock for T1 and T2 is done on the basis of an original carbon quantity (i.e., for pristine conditions) that is then reduced, or increased, according to management practices. When these practices remain constant over time, no difference in the stocks for T1 and T2 is derived so emissions and removals are considered in equilibrium and therefore not reported.

[9] No refinement has been carried out to this value in the IPCC 2019 Refinement (although some updates are available in the 2013 Wetland supplement).

[10] A correction of the default value has been introduced in the IPCC 2019 Refinement.

[11] https://www.lifemedinet.com/

organic soils given the well-known significance of their emissions when they are cultivated. But also, for mineral soils, more science-based knowledge is needed beyond the IPCC approach. To this end, the new alternative Tier 2 method introduced in the IPCC 2019 refinement should give MSs an option to change their assumptions and assess in more detail whether cultivated mineral soils are releasing or sequestrating carbon.

GRASSLAND REMAINING GRASSLAND

*Table 5: Reporting status of emissions and removals from grassland remaining grassland.*T1

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	----		*T1*		3%	*T2,3*	97%	*T1*
BE	----		*T1*		99%	*T2,3*	1%	*T1*
BG	3%	***T1***	*T1*		97%	*T2,3*		
HR	----		*T1*		----		100%	*T1*
CY	100%	***T1***	*T1*		----			
CZ	----		*T1*		100%	*T2,3*		
DK	2%	*T2,3*	*T1*		*IE*	*T2,3*	98%	*T2,3*
EE	3%	*T2,3*	*T1*		----		97%	*T2,3*
FI	21%	*T2,3*	*T1*		----		79%	*T2,3*
FR	85%	*T2,3*	*T1*		15%	*T2,3*	*IE*	*T1*
DE	2%	*T2,3*	*T1*		1%	*T2,3*	97%	*T2,3*
GR	100%	*T2,3*	*T1*		----			
HU	----		*T1*		100%	*T2,3*		
IE	----		*T1*		12%	*T1*	88%	*T1*
IT	46%	*T2,3*	6%	*T2,3*	47%	*T2/3*	1%	*T1*
LV	5%	*T2,3*	1%	*T2,3*	----		95%	*T1*
LT	----		*T1*		----		*IE*	*T1*
LU	----		*T1*		----			
MT	----		*T1*		100%	*T1*		
NL	1%	*T2,3*	*T1*		0%	*T2,3*	99%	*T2,3*
PO	----		*T1*		40%	*T1*	60%	*T1*
PT	----		*T1*		100%	*T2,3*		
RO	100%	***T1***	*T1*		----		0%	*T1*
SK	----		*T1*		----			
SI	66%	*T2,3*	31%	*T2,3*	3%	*T1*		
ES	----		*T1*		----			
SE	33%	*T2,3*	33%	*T2,3*	7%	*T2,3*	26%	*T1*
IS	0%	*T2,3*	0%	*T2,3*	0%	*T1*	100%	*T1*
Average	**38%**		**14%**		**45%**		**69%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T – tier.

The land use category Grassland remaining grassland is a key category for 12 MSs and Iceland.

With regards to the reporting of carbon pools, with the exception of Dead organic matter, all the other pools show high significance, on average above the minimum value and thus requiring the use of higher Tier methods. Nonetheless, Tier 1 methods are widely used for estimating emissions and removals in this land use category.

As in previous categories, empty cells mostly relate to the IPCC assumptions that grasslands do not accumulate carbon in living biomass nor in dead organic matter. Furthermore, many MSs consider, as a potential conservative approach, that soils in grasslands are not subject to any management practice and, although they could result in carbon sequestration over time, the magnitude of the sink is unknown and therefore not estimated. Empty cells for organic soil areas are explained by the lack of this soils type in the category.

For this category, with the exception of Organic soils, the table highlights empty cells as potential non-compliance situations in case the carbon pool is on average significant, irrespective of whether the category is key or not, which is the case for Living biomass and Mineral soils. Or a non-compliant situation when the category is key, the country used a Tier 1 method and the result of the estimated for the pool is higher than 25%.

Overall, it appears that more efforts are needed to adequately justify the lack of emissions or removals in grassland Mineral soils, and to demonstrate the lack of woody vegetation in grassland areas. A case-by-case study involving bilateral contacts with the MSs concerned will be needed before any judgement on whether they comply or not with the Regulation (EU) 2018/841.

For MSs reporting large areas of woody vegetation on grassland, given the vegetation variety in the category, and the wide range of managed practices to which they can be subject, it would be also necessary to develop better targeted country-specific factors for estimating carbon stock changes in this category.

As for Cropland, the IPCC 2019 Refinement and further developments should play a key role on improving the reporting of this category, including the implementation of the new method for estimating carbon stock changes in mineral soils and some refined parameters in all the pools.

More than half of the MSs reporting emissions from Organic soils rely on IPCC default factors, and this leads to several non-compliance cases. Particular attention should be paid to organic soils when grasslands are managed for cultivation of grass or grazing because they release important quantities of carbon through the oxidation of the organic matter.

Moreover, in order to get a clearer and more comprehensive picture on carbon fluxes in LULUCF, future science developments should look at the estimation of potential removals on grassland organic soils, and wetlands restoration, which are often not clearly separated within land information systems (e.g., grasslands in mountain areas or bogs). These ecosystems may act as important carbon reservoir in some countries.

Overall, the analysis shows that nine countries should adopt higher tiers for estimating emissions and removals from Organic soils and Living biomass in Grassland. Also 24 MSs could potentially fall into a non-compliant situation since they do not estimate pools that are likely to be significant. Or at least, the justification for not providing estimates should be carefully scrutinized.

WETLANDS REMAINING WETLANDS

Table 6: Reporting status of emissions and removals from wetlands remaining wetlands.

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT								
BE								
BG								
HR								
CY								
CZ								
DK							100%	*T1*
EE							100%	*T2/3*
FI	0%	*T2/3*					100%	*T2/3*
FR								
DE	0%	*T2/3*			0%	*T2/3*	100%	*T2/3*
GR								
HU								
IE	1%	*T2/3*					99%	*T2/3*
IT								
LV	18%	*T2/3*	6%	*T2/3*			76%	*T1*
LT							100%	*T1*
LU								
MT								
NL					100%	*T2/3*		
PO			98%	*T2,3*			2%	*T1*
PT								
RO								
SK								
SI								
ES							100%	*T1*
SE							100%	*T1*
IS							100%	*T1*

T – tier.

Wetlands remaining wetlands is a key category for eight MSs.

With the exception of Poland, which justifies the significance of dead organic matter on peat extraction areas, the vast majority of the emissions in this category results from organic soils and more precisely, from peat extraction activities that occur in northern countries.

As regards carbon pool estimation, most of the MSs adopt a Tier 2 approach for estimating emissions and removals from Living biomass and Dead organic matter. Tier 1 is widely used for Organic soils, and default factors are taken

either from the IPCC 2006 GL, or from the IPCC Wetlands supplement,[12] which approaches the drainage of soils, and in general wetlands related issues, with more science-based knowledge and refined methods and parameters.

The reporting of "Wetlands remaining" is subdivided in three sub-categories: (i) "Peat extraction remaining peat extraction", (ii) "Flooded land remaining flooded land", and (iii) "Other wetlands remaining other wetlands." The IPCC 2006 GL only provide methods for estimating carbon stock changes in peat extraction areas. As a result, when a MS justifies the absence of peat extraction activities in its territory no emissions or removals are reported under "Wetlands remaining wetlands". This is well reflected in our tables by plenty of empty cells across MSs.

In reality, the current lack of IPCC methods used for estimating emissions and removals from wetlands, and the variety of wetlands areas and climate conditions in which they take place, prevent a clear understanding of the carbon fluxes in these ecosystems. A gap in the LULUCF reporting that will have to be progressively closed with future science developments. Addressing also the need to define what means management on "other wetlands", (i.e. water level control, etc)

Given the low number of MSs reporting carbon pools in Wetlands, in our analysis the use of an average value of significance as a proxy of the significance of the pool is not fully meaningful. Therefore, in this category we have just highlighted non-compliant cases where quantitative estimates suggest the need to move to higher tiers and the category is key. In line with this approach four MSs would need to move to higher Tier methods for the estimating carbon stock changes in organic soils in order to comply with Regulation's requirements.

[12] IPCC 2014, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands,Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.

SETTLEMENTS REMAINING SETTLEMENTS

Table 7 : Reporting status of emissions and removals from other land remaining other land.

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	*T1*		*T1*		*T1*			
BE	*T1*		*T1*		*T1*			
BG	*T1*		*T1*		*T1*			
HR	*T1*		*T1*		*T1*			
CY	*T1*		*T1*		*T1*			
CZ	*T1*		*T1*		*T1*			
DK	*T1*		*T1*		*T1*			
EE	*T1*		*T1*		*T1*			
FI	*T1*		*T1*		*T1*			
FR	100%	*T2/3*	*T1*		*T1*			
DE	*T1*		*T1*		*T1*		100%	*T2/3*
GR	*T1*		*T1*		*T1*			
HU	*T1*		*T1*		*T1*			
IE	*T1*		*T1*		*T1*			
IT	*T1*		*T1*		*T1*			
LV	90%	*T2/3*	7%	*T2/3*	*T1*		3%	*T1*
LT	*T1*		*T1*		*T1*			
LU	*T1*		*T1*		*T1*			
MT	*T1*		*T1*		*T1*			
NL	*T1*		*T1*		*T1*		100%	*T2/3*
PO	69%	*T2/3*	*T1*		*T1*		31%	*T2/3*
PT	*T1*		*T1*		*T1*			
RO	*T1*		*T1*		*T1*			
SK	*T1*		*T1*		*T1*			
SI	100%	*T2/3*	*T1*		*T1*			
ES	*T1*		*T1*		*T1*			
SE	100%	*T2/3*	*T1*		*T1*			
IS	*T1*		*T1*		*T1*			

T – tier.

Settlements remaining settlements is a key category only in one MS.

Overall, most of the MSs apply the assumption of equilibrium for carbon pools for which the IPCC 2006 GL assume no net carbon stock changes. Moreover, in most countries Settlements are not located on organic soils. As a result, estimates for most of the pools are not available for this category.

Given the low number of MSs reporting carbon pools in Wetlands, the use of an average value of significance as a proxy of the significance of the pool is not fully meaningful. Moreover, the IPCC 2006 GL do not provide default methods but just the default assumption of equilibrium for pools different than organic soils, thus, no cases of non-compliance due to the use Tier 1 methods for significant pool in key categories were identified.

5. SUMMARY AND CONCLUSIONS

In general, we observed a rather widespread use of Tier 1 methods for estimating carbon stock changes in LULUCF. The implementation of Tier1 is associated with lack of estimates or estimates with low level of accuracy and large uncertainty.

To assess to which extent current reporting represents a non-compliance problem towards the requirements of Article 18 (4) of Regulation (EU) 2018/841 (i.e. mandate to use higher tiers methods for pools considered significant because they account for at least 25-30% of emissions or removals in a key category), we combined information from MS's GHGIs on KCs, we calculated the significance of each carbon pool, and we assessed the tiers method used to report carbon pools. Furthermore, we used the average value of the significance calculated from those MSs that quantitatively estimate a pool as a proxy of the significance of that non-reported pool in a given land use sub-category. We therefore came up with a list of carbon pools, where MSs appear as non-compliant (i.e., based on their own reporting) or potentially non-compliant (i.e. based on average value from MSs reporting for that pool).

Our assessment shows that results vary considerably between land use sub-categories. Forest remaining forest has apparently few problems of non-compliance. The only significant carbon pool, Living biomass, is reported with higher tiers by all MSs, except Malta. However, beyond this analysis, additional reflections are worth especially on Dead wood and Litter. Even if formally not significant, their omission from GHGIs is not easily justifiable in terms of data availability or resources needed. Efforts should be devoted to work with MSs in order to progressively obtain country-specific data. e.g., based on enhanced sharing data platforms, or models and best practices.

For Cropland remaining cropland, all carbon pools appeared to be significant, except dead organic matter. The assessment found many cases of non-compliance, mostly for Living biomass, and Organic soils, and of potential non-compliance, mostly on Mineral soils. In the latter case, many MSs still do not report estimates for mineral soils under the assumption of "no change in management practices over time". However, this assumption is hardly realistic and often not well documented, and therefore it may jeopardize the compliance of MSs with the Regulation (EU) 2018/841. Also, for Grassland remaining grassland all carbon pools appeared to be significant, except Dead organic matter. And, also in this case, we found many cases of non-compliance, mostly for Living biomass, Organic soils, and of potential non-compliance, mostly on Living biomass and Mineral soils.

The limited reporting of GHGs for Wetlands remaining wetlands and Settlements remaining settlements did not allow a complete application of our method.

The results of this analysis should be seen as preliminary, both for the limits of the methodology used and for the difficulty of assigning a specific tier to the method used by MSs, but still, they are useful to give an idea of where the problems of non-compliance are likely to be, and where future capacity building efforts should focus.

To this regard, it should be noted that the IPCC 2019 Refinement introduces some new methods and refined default parameters. For instance, it offers a new alternative Tier 2 method for estimating carbon stock changes in agricultural mineral soils that may help to check and challenge the assumption of constant management practices over the time.

To conclude, it is clear that a number of MSs will need to move to higher Tier methods to comply with Regulation (EU) 2018/841, mainly MSs using Tier 1 methods for estimating carbon stock changes in Living biomass, Mineral soils and Organic soils in Cropland and Grassland, but also those that use Tier 1 for Organic soils in Wetlands. Moreover, Dead wood and Litter in Forest remaining forests are pools that should be considered realistically reportable by almost all MSs.

ANNEX-I: CARBON POOL´S LIKELIHOOD OF BEING SIGNIFICANT BY LAND SUBCATEGORIES

The table below shows carbon pools that are likely to be significant for a large number of MSs, therefore candidate for Tier 2/3 (Yes); or, depending on specific conditions (?); or, likely not significant (-) in most MSs.

To complete this table, we used the result of the analysis presented in this note , the estimates reported by the MSs in their GHGIs, and where necessary, expert judgement.

Category	Pools						
	Living biomass		Dead organic matter		Soil Organic Carbon in mineral soils (SOC min)	Soils Organic carbon in organic soils (only when this soil is present) (SOC org)	Harvested Wood Products (HWP)
	Above-ground biomass (AGB)	Below-ground biomass (BGB)	Dead wood (DW)	Litter (LT)			
FL-FL	Yes	Yes	-[3]	-[3]	-[3]	-	Yes
Land-FL	Yes	Yes	-[3]	-[3]	-[3]	Yes	-[4]
CL-CL	?[2]	-	-	-	Yes	Yes	-
Land-CL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
GL-GL	?[2]	-	-	-	Yes	Yes	-
Land-GL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
WL-WL	-	-	-	-	-	Yes	-
Land-WL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
SL-SL	-	-	-	-	-	-	-
Land-SL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
Land-OL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-

1: depending on whether the conversion involves forest land or woody vegetation.

2: depending on whether there is presence of woody vegetation.

3: It is likely that, although these pools could represent an important pool of carbon in the forest, they probably do not reach in most MSs the minimum threshold value of significance (25-30% of the sub-category) that leads to the use of Tier 2/3.

4: except in few MSs (e.g., PT, IE, ES) with quantitatively relevant species with short-term rotations.

ANNEX- II: INFORMATION ON TIER METHOD BY CARBON POOL AND LAND USE CATEGORY

This annex aims to provide information on which Tier approaches are used for estimating emissions and removals in each carbon pool and land category, including land use changes categories. The information provided in the tables is based on expert judgement based on the information included by MS in their national inventory reports. Whenever available, the categorization of the Tier approaches has been directly taken from information provided by the MSs in their NIRs. In most cases due to the lack of this information, the categorization is based on expert judgment and given the lack of transparency in some national reports it should be considered with caution.

AUSTRIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	Tier 3	NO	Tier3	Tier3	NO	NO	Tier2	Tier2	Tier2	NO	Tier 3	Tier 2	Tier2	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO	Tier2	NO	Tier2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier2	NO	NO	NO	Tier2	NO	Tier2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

BELGIUM

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 1	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

BULGARIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
CL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
GL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	NO	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO				

CROATIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	NO	Tier 1	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

CYPRUS

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier2	Tier 1	Tier 1	Tier 1	NO	Tier2	NO	Tier 1	NO	NO	NO	NO	NO					Tier2	NO	Tier 1	NO	Tier2	Tier 1	Tier 1	NO
CL	NO	NO	NO	NO	NO	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO					Tier 1	Tier 1	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO
GL	Tier2	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier1	Tier 1	NO	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO
SL	Tier 2	NO	Tier 1	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO					Tier 1	Tier 1	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO
OL	Tier 2	NO	Tier 1	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO					Tier 1	NO	Tier 1	NO				

CZECH REPUBLIC

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

DENMARK

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 1	Tier 3	Tier 3	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 2	Tier 1	Tier 3	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	NO	NO	Tier 1	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

ESTONIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 2					Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2					NO	NO	Tier 2	Tier 2	NO	NO	Tier 2	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	NO	Tier 2					Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO
WL	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	NO	NO	NO	Tier 2	Tier 2	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO					Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO					NO	NO		NO				

FINLAND

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	NO	Tier 3	Tier 2	Tier 3	Tier 2	NO	Tier 3	Tier 3	Tier 2	NO	NO	NO	NO	NO	NO
CL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	NO	Tier 3	Tier 2	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO
GL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	NO	Tier 3	Tier 2	Tier 2	Tier 1	NO	Tier 2	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO
WL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	Tier 3	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

FRANCE

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO					Tier 2	NO	NO	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO					Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 1					Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO					Tier 2	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

GERMANY

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2				

GREECE

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO	Tier 2	Tier 2	Tier 1	NO	NO	NO	Tier 1	NO	Tier 2	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 1	NO
CL	Tier 2	NO	NO	NO	NO	Tier 2	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO
GL	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 1	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

HUNGARY

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO					Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	NO					NO	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO					NO	NO	Tier 2	NO	NO	NO	Tier 2	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

IRELAND

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	NO	Tier 1	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	Tier 2	Tier 1
CL	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO

ITALY

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO
CL	NO	NO	NO	NO	NO	Tier 2	Tier 1	Tier 2	Tier 1	NO	NO	NO	NO					NO	NO	NO	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 2	Tier 2	Tier 1					Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

LATVIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2					Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 1	Tier 2	Tier 2	NO	Tier 1					Tier 2	Tier 2	NO	Tier 1	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 1					Tier 2	Tier 2	NO	Tier 1	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 1	Tier 2	Tier 2	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

LITHUANIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO
CL	Tier 2	NO	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	NO	NO	NO	NO	Tier 1	NO	Tier 2	Tier 1	NO	NO	NO	NO
GL	Tier 2	NO	Tier 2	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 1	NO	NO	NO	NO	Tier 1	Tier 1	Tier 2	Tier 1	NO	NO	Tier 2	Tier 1
WL	Tier 2	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	NO	Tier 2	Tier 1	NO	Tier 1	Tier 2	Tier 1	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO	Tier 1	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO				

LUXEMBOURG

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO
GL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO
WL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO
OL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO				

MALTA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CL	NO	NO	NO	NO	NO	Tier 2	Tier 1	Tier 1	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO
GL	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

NETHERLANDS

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	Tier 2					Tier 2	Tier 2	Tier 2	Tier 2					Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 2	NO	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 2	NO	Tier 2	Tier 2					Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2
GL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2					Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	Tier 2	Tier 2
WL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	Tier 2	NO	Tier 2	Tier 2
SL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2					Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	Tier 2	Tier 2
OL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2					NO	NO	Tier 2	Tier 2				

POLAND

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO					Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO
CL	Tier 2	NO	NO	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1					Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
GL	Tier 2	NO	NO	Tier 1	Tier 1	Tier 1	NO	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1					Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1					Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	Tier 1					NO	NO	NO	NO				

PORTUGAL

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 1	Tier 1	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	NO	NO
SL	Tier 2	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 2	NO	NO
OL	Tier 2	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO				

ROMANIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	Tiert 1	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO
CL	Tier 3	NO	NO	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 2	NO	NO
GL	Tier 3	NO	NO	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	Tier 1	Tier 1	NO	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO
WL	Tier 3	NO	NO	Tier 2	NO	Tier 2	NO	Tier 1	NO	No	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO
SL	Tier 3	NO	NO	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO
OL	Tier 3	NO	NO	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO				

SLOVAKIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO
CL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO
GL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	NO	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO				

SLOVENIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	NO	NO	Tier 2	NO
CL	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 1	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 2	Tier1	NO	NO	NO	NO	NO	Tier 2	Tier 1	Tier 2	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO
OL	Tier 2	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO				

SPAIN

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	NO	NO	NO	NO
CL	Tier 1	Tier 1	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
GL	Tier 1	Tier 1	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO
WL	Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 1	Tier 1	Tier 1	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

SWEDEN

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	NO	Tier 2	Tier 2
CL	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	Tier 3	Tier 3	Tier 3	Tier 1	Tier 3	Tier 2	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 3	Tier 2	Tier 2	Tier 2	NO	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 3	Tier 1	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 3	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	Tier 2	NO				

ICELAND

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO
CL	NO	NO	NO	NO	NO	NO	Tier 1	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
GL	Tier 2	NO	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 1	Tier 3	Tier 2	Tier 1	Tier 1	NO	NO	Tier 2	Tier 1		NO	NO	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	Tier 1	Tier 2	Tier 2	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO				

ANNEX-III: SIGNIFICANCE OF CARBON POOLS WHEN HWP IS CONSIDERED UNDER FL-FL

The table below shows the significance of the carbon pools for the category Forest land remaining Forest land when HWPs is considered as another carbon pool within the category.

Because information on HWP under the Convention is not disaggregated based on the land use category in which the wood originates, but instead it is reported as an additional category of the LULUCF sector in CRF table 4, the table below has been built assuming that the entire quantity of emissions and removals under HWPs originates from the category Forest land remaining forest land.

This assumption is well supported by information reported by MSs to the KP. Under the KP the vast majority of HWPs is reported under Forest management and only a negligible quantity under Afforestation and reforestation.

MS	Living biomass	Dead wood	Litter	SOCmin	SOCorg	HWP
AT	53%	6%	0%	21%	0%	20%
BE	73%	0%	0%	0%	0%	27%
BG	91%	0%	0%	0%	0%	8%
HR	96%	0%	0%	0%	0%	4%
CY	76%	0%	0%	0%	0%	24%
CZ	80%	2%	0%	0%	0%	19%
DK	56%	2%	23%	0%	11%	8%
EE	53%	3%	0%	24%	8%	12%
FI	61%	0%	0%	15%	16%	8%
FR	87%	7%	0%	0%	0%	6%
DE	60%	5%	1%	23%	4%	8%
GR	89%	0%	0%	0%	0%	11%
HU	83%	10%	0%	0%	3%	4%
IE	53%	0%	5%	1%	15%	26%
IT	95%	1%	2%	0%	0%	2%
LV	59%	21%	0%	0%	6%	14%
LT	73%	10%	0%	0%	0%	16%
LU	87%	9%	0%	0%	0%	4%
MT						
NL	87%	5%	0%	0%	3%	5%
PO	82%	0%	0%	8%	2%	8%
PT	89%	0%	1%	1%	0%	9%
RO	89%	0%	0%	0%	1%	10%
SK	86%	0%	0%	0%	0%	14%
SI	88%	10%	0%	0%	0%	2%
ES	93%	0%	0%	0%	0%	7%
SE	8%	0%	3%	1%	3%	85%
SI	99%	0%	0%	0%	1%	0%
Average	76%	3%	1%	3%	3%	13%

ANNEX-IV: INFORMATION ON DATA SOURCES USED FOR LAND REPRESENTATION

This annex aims to provide information on the main data sources and methods used by the MSs to obtain activity data information for the LULUCF sector. Based on expert judgment of the information included in the national inventory reports, we attempt to identify when satellite data have been used for acquiring land use category information. It should be noted that the information included in national inventory reports is not always enough to understand the full process and format of the data sources involved in the acquisition of land use and land use changes information. Therefore, our consideration of whether satellite data have been used should be carefully considered. For instance, national inventory reports often include descriptions of cartography and land use maps but they don't provide further information on which is the background data used to create such cartography and maps.

Member State	***Use satellite data***	***Description***
Austria	NO	*Difference statistical surveys used in a hierarchical order. Information taken from national forest inventories and STATISTIK AUSTRIA. Also, expert judgements are involved for certain land use changes.*
Belgium	Partly yes	*The method adopted for monitoring of the land-use is a grid of points on which a diagnosis of occupation/land use is carried out for the various dates of reference. The diagnoses are carried out following vectorial cartographic layers or raster bearing on sets of themes related to the land use*
Croatia	NO	*Several data sources are used to obtain information on lands, among other Forest management plans, Corine land cover, Bureau of Statistics and State Geodetic Administration's Register.*
Bulgaria	NO	*Several data sources used in Bulgaria for obtaining information on lands. For Forest land information is mainly taken from Forest Management Plans. For other land use categories information from the Bulgarian Survey of the Agricultural and Economic Conjuncture, LPIS, and National Statistical Institute is used.*
Cyprus	NO	*Information on total land use areas by category is obtained from three CORINE land cover data sets covering the years 2000, 2006 and 2012. Information in total and on land use change for year in between is retrieved by inter and extrapolation.*
Czech Republic	NO	*Land information is exclusively based on the cadastral land use information of the Czech Office for Surveying, Mapping and Cadastre. The Czech land-use representation and the land-use change identification system use annually updated COSMC data, elaborated at the level of about 13 thousand individual cadastral units.*
Denmark	Partly yes	*The land use matrix uses the latest official vector maps from Danish Geodata Agency and is updated annually since 2011. The information is taken from difference data sources (e.g., Danish building register, Danish Area Information System, LPIS) applied in a hierarchical order. Mapping of forest area in 1990 and 2005 was conducted in 2011 based on Landsat 5 Thematic Mapper.*
Estonia	NO	*The national forest inventory is a systematic collection information on randomly based sample plots that cover the whole country and all land-use categories. The nationally classified NFI sample plots are reclassified into IPCC land-use categories and this allows the construction of the land use matrix.*
Finland	Partly yes	*Information on land-use areas is calculated from national forest inventory (NFI) data covering the entire country. In detection of land-use changes the NFI data is supported by spatial data, e.g., aerial photographs and satellite images.*

Member State	*Use satellite data*	*Description*
France	Partly yes	*Land information on the continental territory is taken from TERUTI surveys follow an annual statistical method based on the determination of sampling points distributed throughout the territory. Each of the points is visited in the field by an investigator who determines, by observation, the nature of the land use. Observation of the same points repeated every year. For oversea territories satellite information is used.*
Germany	Partly yes	*The land use matrix is based on a sample-based system. A grid of points is used, and the land category is classified based on information from the Basic Digital Landscape Model. However, where necessary some other data sources were also used. Including Corine land Cover and land-cover model information.*
Greece	NO	*Information on land use areas is obtained from several data sources including the national forest inventory, Afforestation registries, Agricultural Statistics of Greece, Forest Management Plans Database, Corine land cover datasets, and others. For the land-use change matrices the results of two "Distribution of the Country's Area by Basic Categories of Land Use" projects been used. Both constitute complete, cadaster surveys providing information on the distribution of land areas per each land use category.*
Hungary	NO	*Information on areas and Land use changes is taken for Corine land cover, National Forest inventories and HCSO Statistical Yearbooks for Agriculture.*
Ireland	Partly yes	*Information on areas and land use changes is derived using in a hierarchical order a combination of Corine land cover, National forest inventories , LPIS, maps and aerial photography datasets and other national statistics.*
Italy	NO	*Information on land use and land use changes is based on national forest inventories (1985, 2005, 2012) and from the National Land-Use Inventory IUTI referring to years 1990, 2000 and 2008. Additional data on non-forest categories were collected for the year 2012, through the first phase survey in the framework of the III NFI that was carried out on an IUTI's sub grid.*
Latvia	Partly yes	*Information on area of the categories since 2009 comes from National forest inventories. Information on grassland, cropland, wetlands, and other lands provided by the State Land Service of Latvia are used for reference to estimate potential errors in the NFI. Until submission 2019 conversion of cropland to grassland was estimated using remote sensing method comparing vegetation index in the NFI sample plots listed as cropland or grassland.*
Lithuania	NO	*Data from NFI is used for monitoring and reporting of land use and land use changes. Dataset on all land use and land use changes is collected using NFI since 2012, NFI grid covering not only forest land but also other land use categories of the whole country territory since then. For the period of 1990-2011 results are presented using data of the studies conducted.*
Luxembourg	YES	*The base data used is the so-called OBS map data "Occupation Biophysique du Sol". This is a detailed land use / land cover map in digital format covering the entire territory of Luxembourg. There are 3 versions of the OBS. The first OBS89 was collected in the field over several years. The second the OBS99 was collected based on aerial color infra-red ortho-photos and some field surveying. The third set OBS07 uses very high-resolution satellite images (1m pixel size) of the satellite IKONOS. The latest dataset on land use in Luxembourg is the LU12 is based on satellite images from the Rapid Eye (RE) space segment.*
Malta	NO	*Data on land-use transition matrices was obtained from CLC (1990, 2000, 2006 and 2012), with additional data relating to Cropland from the National Statistics*

Member State	*Use satellite data*	*Description*
		Office such as the Agriculture Censuses and Farm Structure surveys, the latter providing more recent data for the Cropland category. CLC data was obtained from the local competent authority Planning Authority (PA) responsible for the CLC, rather than the EEA directly. The latest CLC report available for the purpose of this submission was the 2012 CLC.
Netherlands	YES	*Netherlands applies full and spatially explicit land use mapping that allows geographical stratification at 25mx25m resolution. Harmonized and validated digital topographical maps representing land use on 1 January 1990, 2004, 2009, 2013 and 2017 were used for wall-to-wall map overlays resulting in four national scale land use and land use change matrices. The information concerning the activities and land use categories, covers the entire territorial (land and water) surface area of the Netherlands. The sum of all land use categories is constant.*
Poland	NO	*Data on land and land areas is based on statistical data presented in statistical journals published by Statistics Poland. The data relating to the land area by the type of land use is based on data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land.*
Portugal	NO	*Information on areas and changes is divided into two different time periods: 1970-1995 and 1995-2018. The first period is estimated using spatially explicit land-use data, while for the second only an approach 1 is used. The most recent period uses the Cartografia de Ocupação de Solo produced using the full aerial photography coverage. For pre-1995 the information used includes NFIs, and agricultural census. And for the other categories it is assumed a constant area as in 1995. For oversea territories information is rather similar but involving also CLC.*
Romania	NO	*Information on land use areas is taken from different data sources intending to make use of any spatial explicit information existing in the country, either for land classification or for classification quality check. Improved reporting of land categories is based on multiple data sources as (i) NFI statistical sampling grid which was expanded for LULUCF purpose to cover the entire country territory and captures all land uses, 2nd cycle for 2013 – 2018; (ii) military topographic maps for 1970, 1980, and 1990, (iii) orthophoto for 2003-2005, 2007-2011, 2010-2014, and 2014-2015; (iv) statistical data from MADR; (v) statistical data from NIS.*
Slovakia	NO	*The identification of the LULUCF categories is based on the data from the Geodesy, Cartography and Cadaster Authority of the Slovak Republic (GCCA), which represents a key data source for identification of spatial extent of individual categories. The GCCA annually issues the Statistical Yearbook of the Soil Resources in the Slovak Republic. It provides updated cadastral information of the LULUCF areas.*
Slovenia	Partly yes	*A dedicated project interprets land uses based on national classification in years 2002, 2006 and 2012. Two matrices were produced accordingly. Land use estimation is based on digital orthophoto images on a systematic 1 km x 1 km grid. Other sources of spatial information, such as land cover from satellite images (Landsat), corresponding land-use maps of ALUM and LPIS and other maps were also used for verification of the problematic points. For the period until 2002 data on land use from the Statistical Yearbook of the Statistical Office of the Republic of Slovenia have been used, as well as forest data of Slovenia Forest Service as no digital orthophotos are available for this period.*
Spain	No	*The procedure used for estimating the areas and land use changes is based on different cartographic sources. Including a statistical adjustment applied with*

Member State	*Use satellite data*	*Description*
		land afforestation. The main data sources are Corine land cover, national forest maps, Nacional forest inventories, and Yearbooks of Agrarian Statistics
Sweden	Partly yes	*The NFI has monitored land-use categories since 1983. Based on permanent sample plots, it is possible to trace both gross and net land-use transfers from 1983 to 2014. After 2014, only net changes can be estimated since 2014 is currently the last year with a full sample record. All land areas are included in the field inventory except high mountains and urban land. The latter land-use categories are inventoried by remote sensing to be able to correctly determine areas. It is assumed that their relative importance is negligible.*
Iceland	Yes	*Several data sources are involved across the time series. Information on land use is taken from the Icelandic Geographical Land Use Database (IGLUD), activity data and mapping on afforestation and deforestation, maps of natural birch forest and shrubland, activity data and maps on revegetation, Afforestation and Reforestation registries. The Habitat Type Map (HMI), adopted in 2019 as the IGLUD base map, is a hybrid map applying remote sensing of RapidEye™ satellite images from 2011-2013, but also made use of other images as SPOT-5 from 2002-2010, and LANDSAT 8 from 2013-2016.*

NOTE 3

DIFFERENCES ON THE SIGNIFICANCE OF CARBON POOLS WHEN USING LAND USE SUBCATEGORIES OR LAND ACCOUNTING CATEGORIES.

- ANALYSIS OF THE SIGNIFICANCE OF CARBON POOLS OF THE REG.(EU) 2018/841 LAC -

1. OBJECTIVE

This note has the two-fold objective of assessing the significance of emissions and removals in carbon pools that must be reported under the land accounting categories of the Regulation (EU) 2018/841, and of raising differences with respect to the pools that are reported to the UNFCCC under the land use categories.

2. LEGISLATIVE FRAMEWORK: REGULATION (EU) 2018/841

Regulation (EU) 2018/841 states in its Article 18 (4) that "*for emissions and removals for a carbon pool that accounts for at least 25-30 % of emissions or removals in a source or sink category which is prioritized within a MS's national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or the uncertainty in emissions and removals in the land-use categories, at least Tier 2 methodology in accordance with the IPCC 2006 GL*[13] should be used". Moreover, MSs are encouraged to apply Tier 3 methodology, in accordance with such guidelines.

Article 5 (4) states that "*MSs shall include in their accounts for each land accounting category any change in the carbon stock of the carbon pools listed in Section B of Annex I. MSs may choose not to include in their accounts changes in carbon stocks of carbon pools provided that the carbon pool is not a source. However, that option not to include changes in carbon stocks in the accounts shall not apply in relation to the carbon pools of above-ground biomass, dead wood, and harvested wood products, in the land accounting category of managed forest land.*"

Carbon pools as referred to in Article 5(4) are:

(a) above-ground biomass;
(b) below-ground biomass;
(c) litter;
(d) dead wood;
(e) soil organic carbon;
(f) harvested wood products in the land accounting categories of afforested land and managed forest land.

3. METHODOLOGICAL FRAMEWORK

2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES

[13] IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).Published: IGES, Japan.

The reporting of information on the LULUCF sector to the UNFCCC considers six main land use categories: Forest land, Cropland, Grassland, Wetlands, Settlements, and Other lands. Each category is further subdivided into "land remaining " in the category, and "land converted to" the category. This calls for the construction of a land use matrix that MSs must fill with information on areas, and associated GHG emissions and carbon removals for each possible land use category.

As regards information on carbon pools, the reporting to the UNFCCC shows some differences with the forthcoming reporting under Regulation (EU) 2018/841. Differences are given by the level of aggregation of the information for the three main carbon pools of living biomass, dead organic matter, and soil organic carbon, and also for harvested wood products (HWPs) .

The EU Regulation requests information on Above-ground biomass, Below-ground biomass, Litter, Dead wood, and Soil organic carbon for each LAC. Also, information on HWPs for the LACs Afforested land and Managed Forest land is required. The reporting to the UNFCCC merges the information for some of these pools and disaggregates further the information for some other pools. Moreover, HWPs are treated as an additional category without information on the land where the wood originates.

Table 1: *Availability of information on LULUCF carbon pools under the UNFCCC reporting.*

<table>
<tr><th>Pools in EU Reg.
Categories</th><th>Above-ground biomass</th><th>Below-ground biomass</th><th>Dead wood</th><th>Litter</th><th>SOC mineral</th><th>SOC organic</th></tr>
<tr><td>Forest land</td><td colspan="2" rowspan="2">Merged
(Living biomass)</td><td>Yes</td><td>Yes</td><td>Yes
(Separately from organic soils)</td><td>Yes
(Separately from mineral soils)</td></tr>
<tr><td>Cropland, Grassland, Wetlands, Settlements, Other lands</td><td colspan="2">Merged
(Dead organic matter)</td></tr>
<tr><td>Harvested wood products</td><td colspan="6">YES
(additional category - no information on their origin-)</td></tr>
</table>

APPROACH USED IN THIS ASSESSMENT

The Regulation (EU) 2018/841 in its Article 5 (4) specifies the pools for which carbon stock changes have to be estimated for each LAC. However, current reporting of information on carbon pools to the UNFCCC shows an aggregation level that seems irreconcilable with the information requested by the Regulation.

Moreover, the aggregation level of subcategories in CRF table 4.D for "lands converted to wetlands" is not always enough to translate the UNFCCC information into LACs under EU Regulation. Examples are Forest converted to Wetland – Deforestation –; Cropland converted to Wetland – Management Cropland –; Grassland converted to Wetlands –; Managed Grassland – Settlements and Other land converted to Wetlands – Managed Wetlands. –

In principle, these differences in the reporting format prevent direct translation of information from the LUCs of the UNFCCC into the LACs of the EU Regulation. In practice, it is important to bear in mind that although the structure and format to be used in the future for submitting the LULUCF sector under the Paris Agreement is still under discussion, there are good reasons to believe that some of these differences will no longer represent an issue.

For Wetlands it is expected that information will be provided in correspondence with the aggregation level that is necessary to compile information for the LACs. But also, for HWPs the reporting will likely allow to know whether these products originate from Managed forest land or Afforested lands. As regards with Dead organic matter and

Soils organic carbon pools how the future reporting will display the information is still more uncertain. But it could be also assumed that SOC will be separately reported for mineral and organic soils and that for dead organic matter, at least for forest land countries will continue providing information on dead wood and litter.

To overcome differences in reporting format, our assessment included only those MSs that provided information on CRF table 4.D disaggregated by land use categories. Moreover, to follow the structure of the LACs we have merged information on carbon stock changes in mineral and organic soils under one single pool - Soil organic matter –, and whenever possible, we have worked with disaggregated information on dead wood and litter that is available under the Forest land category. Finally, the entire reported quantity of HWPs to the UNFCCC were assigned to Forest land remaining forest, but no impact is expected with this assignment as this category has direct translation into Managed Forest land. Likewise, Land converted to forest was assigned to LAC Afforested land.

Our assessment is based on the 2020 GHGI submissions using information reported for the year 2018. Information on carbon stock changes from CRF tables 4.A- 4.F was used to estimate the significance value of each pool. The calculations were duplicated to assess:

(i) Significance of carbon pools with respect to UNFCCC land use categories.
(ii) Significance of carbon pools with respect to Regulation (EU) 2018/841 land accounting categories.

Our assessment went through the following steps:

- **Step 1**: From each CRF table 4.A-4.F, and land use subcategory, we retrieved the carbon stock change value for each pool. Information on emissions and removals was obtained multiplying those values by the ratio of molecular weights of the CO_2 (i.e. 44/12).
- **Step 2:** Values of emissions and removals were then converted to absolute values and incorporated in a matrix that display the information for all possible land subcategory and carbon pool (see table 2). N.B.: information on HWPs retrieved from CRF table 4 was added as an additional pool in the category Forest land remaining forest land.
- **Step 3:** For each land use subcategory the significance of a carbon pool was estimated dividing its value in the land use matrix by the sum of the values of emissions and removals (all in absolute terms) of all the carbon pools in the land use category.
- **Step 4:** For each land accounting category the significance of a carbon pool was estimated by dividing the sum of values presented in the category for that pool by the sum of the values (all in absolute terms) of emissions and removals of all the carbon pools in the land accounting category.

Table 2: *Example of matrix, and legend used to estimate significance of carbon pools in the land use and land accounting categories. Numbers represent emissions and removals (absolute terms) of the carbon pools.*

To:	FL					CL			GL			WL			SL			OL		
From:	LB	DW	LT	SOC	HWP	LB	DOM	SOC	LB	DOM	SOC	LB	DOM	SOC	LB	DOM	SOC	LB	DOM	SOC
FL	4357	835		2615	2001	13	7	9	133	85	82	35	14		23	16	85	34	21	104
CL	47	1	54	47		11		137	6		148				122		112			
GL	333	4	348	238		9		211			297	17			152		413			
WL	43	1	27	0							0									
SL	30	0	29	64							0									
OL	206	3	214	516							0									

Manafed Forest land
Afforested land
Deforested land
Managed Cropland
Managed Grassland
Managed Wetlands
Other categories excluded

4. RESULTS AND DISCUSSION

Following the approach described above, in this section we displayed two tables that show the significance value of the pools considering UNFCCC´s land use categories, and Regulation (EU) 2018/841´s land accounting categories for each MS covered in this assessment.

An obvious outcome of our analysis is that as regards Managed Forest land and Afforested lands we do not see any difference in the significance value of the carbon pools since information on these accounting categories is directly translated in a one-to-one relation from Forest land remaining forest land and Land converted to forest land, respectively.

For the same reason, the assignation of the entire HWPs quantities to the category Forest land remaining forestland, as an interim solution in this assessment, does not lead to any different in the significance of the pools between the categories. It certainly changes the significance of the pools within each of the categories but not lead to differences when comparing LACs and LUCs.

On the contrary, when we merge carbon stock changes from mineral and organic soils in one single pool, as requested by the Regulation (EU) 2018/841, the significance of the resulting pool across categories is either enhanced, when the direction of the carbon fluxes is the same or reduced when the carbon fluxes in these soil types show opposite directions. This is often reported by MSs cultivating organic soils (i.e., losing carbon) while implementing at the same time lower intensive practices in mineral soil in recent years as compared with earlier periods (i.e., due to reporting method this would result in a sink of carbon).

For the other categories there are not clear patterns on how the significance value of the pools change when LACs are used in place of LUCs, but some trends are observed and included in this section. Nevertheless, a case-by-case study would provide more insight on this regard. Further analysis could also take into consideration data from different years of the time series with the aim of reaching more accurate results or factoring out potential effects of natural disturbances or wood-markets prices in single years.

LAC Deforested land groups together all the emissions from forest converted to other land use categories. This increases the significance of the pools as compared with the value that result when looking independently at the associated LUCs. The increase is more prominent for living biomass, the main driver of emissions from deforestation. However, because the significance of the pools within a category is interlinked, the observed increase in living biomass is counterbalanced in countries that report, associated with these conversions to forests, important quantities of carbon stock changes in other pools. For instance, countries where deforestation occurs in organic soils.

Carbon stock changes from Managed Cropland and Managed Grassland are driven by carbon fluxes in woody vegetation (e.g., woody crops and woody vegetation that fall outside forest definition), and the ratio between carbon input and output in the soils. Both processes that are hardly influenced by management practices and land use conversions. As regards Managed Cropland and Managed Grassland, once deforestation (i.e., Forest converted to Cropland and Grassland) has been excluded, all the other carbon stock changes in the land use subcategories are translated into these LACs. Where it is also added carbon stock changes from the conversions of Cropland and Grassland into Settlements, Wetlands, and Other lands. To assess differences on the significance of the carbon pools among LUCs and LACs a case-by-case study is needed since the significance of the pools within the LACs can be either enhanced when the pools behave in the same way across the LUCs or reduced when the pools offset each other.

By last, LAC “Wetlands Management” relies on information from LUCs “Wetlands remaining wetlands” and on conversions between Wetlands, Settlement, and Other lands. These conversions have exceptionally low occurrence and therefore it is assumed that for most of the MSs the same significance value will be showed for carbon pool considering the accounting category Wetlands Managed as for the land use category Wetlands remaining wetlands.

***Figure 1**: Significance of carbon pools of the UNFCCC land use categories and of Reg 2018/841 land accounting categories based on information for the year 2018 reported in GHG inventories 2020.*

% of each carbon A3:M20pools with respect to UNFCCC land use categories	% of each carbon pools with respect to Reg 2018/841 land accounting categories

Red cell = > 25%

AUSTRIA

	LB	DW	LT	SOC	HWP
FL-FL	44%	9%		27%	20%
L-FL	30%	0%	31%	39%	
CL-CL	8%			92%	
L-CL	9%	3%		88%	
GL-GL				100%	
L-GL	31%	19%		51%	
WL-WL					
L-WL	79%	21%			
SL-SL					
L-SL	32%	2%		66%	
OL-OL					
L-OL	21%	13%		66%	

	LB	DW	LT	SOC	HWP
MFL	44%	9%		27%	20%
AL	30%	0%	31%	39%	
DL	36%	22%		42%	
MCL	24%			76%	
MGL	17%			83%	
MWL					

BELGUM

	LB	DW	LT	SOC	HWP
FL-FL	80%				20%
L-FL	53%	1%	5%	41%	
CL-CL	3%			97%	
L-CL	1%	0%		99%	
GL-GL				100%	
L-GL	13%	2%		85%	
WL-WL					
L-WL	26%	3%		71%	
SL-SL					
L-SL	20%	4%		75%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	80%				20%
AL	53%	1%	5%	41%	
DL	60%	10%		31%	
MCL	1%			99%	
MGL				100%	
MWL				100%	

BULGARIA

	LB	DW	LT	SOC	HWP
FL-FL	84%	1%			16%
L-FL	57%		14%	29%	
CL-CL	8%			92%	
L-CL	2%			98%	
GL-GL	3%			97%	
L-GL	8%			92%	
WL-WL					
L-WL	14%			86%	
SL-SL					
L-SL	8%	1%		91%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	84%	1%			16%
AL	57%		14%	29%	
DL	40%	7%		53%	
MCL	4%			96%	
MGL	7%			93%	
MWL				100%	

CZECH REPUBLIC

	LB	DW	LT	SOC	HWP
FL-FL	83%	1%			16%
L-FL	70%	1%	19%	11%	
CL-CL	6%			94%	
L-CL	37%	1%		63%	
GL-GL				100%	
L-GL	20%	0%		80%	
WL-WL					
L-WL	99%	1%			
SL-SL					
L-SL	64%	1%		35%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	83%	1%			16%
AL	70%	1%	19%	11%	
DL	89%	2%		9%	
MCL	12%			88%	
MGL	10%			90%	
MWL					

% of each carbon pools with respect to UNFCCC land use categories	% of each carbon pools with respect to Reg 2018/841 land accounting categories

Red cell = > 25%

GERMANY

	LB	DW	LT	SOC	HWP
FL-FL	69%	6%	1%	20%	5%
L-FL	87%	3%	5%	5%	
CL-CL	0%			100%	
L-CL	13%			87%	
GL-GL	0%			100%	
L-GL	21%	0%		79%	
WL-WL	1%			99%	
L-WL	33%	10%		57%	
SL-SL				100%	
L-SL	29%	10%		62%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	69%	6%	1%	20%	5%
AL	87%	3%	5%	5%	
DL	54%	31%		15%	
MCL	9%			91%	
MGL	5%			95%	
MWL	3%			97%	

DENMARK

	LB	DW	LT	SOC	HWP
FL-FL	44%	3%	47%	2%	3%
L-FL	85%	0%	10%	4%	
CL-CL	1%			99%	
L-CL	57%	32%		11%	
GL-GL	8%	0%		92%	
L-GL	57%	29%		14%	
WL-WL				100%	
L-WL					
SL-SL					
L-SL	15%	8%		77%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	44%	3%	47%	2%	3%
AL	85%	0%	10%	4%	
DL	38%	45%		17%	
MCL	2%			98%	
MGL	9%			91%	
MWL	0%			100%	

SPAIN

	LB	DW	LT	SOC	HWP
FL-FL	92%				8%
L-FL	63%	3%	7%	28%	
CL-CL	54%	0%		46%	
L-CL	13%	1%		87%	
GL-GL					
L-GL	46%	5%		50%	
WL-WL					
L-WL	52%	6%		42%	
SL-SL					
L-SL	42%	3%		54%	
OL-OL					
L-OL	0%	0%		100%	

	LB	DW	LT	SOC	HWP
MFL	92%				8%
AL	63%	3%	7%	28%	
DL	70%	7%		23%	
MCL	46%	0%		54%	
MGL	16%	2%		82%	
MWL				100%	

FINLAND

	LB	DW	LT	SOC	HWP
FL-FL	62%			20%	18%
L-FL	65%			35%	
CL-CL	0%			100%	
L-CL	14%	0%		85%	
GL-GL	23%			77%	
L-GL	39%			61%	
WL-WL	0%			100%	
L-WL	26%	0%		74%	
SL-SL					
L-SL	64%	1%		35%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	62%			20%	18%
AL	65%			35%	
DL	35%	0%		64%	
MCL	0%			100%	
MGL	20%			80%	
MWL	0%			100%	

% of each carbon pools with respect to UNFCCC land use categories	% of each carbon pools with respect to Reg 2018/841 land accounting categories

Red cell = > 25%

GREECE

	LB	DW	LT	SOC	HWP
FL-FL	97%				3%
L-FL	100%				
CL-CL	22%			78%	
L-CL	1%			99%	
GL-GL	100%				
L-GL	19%	0%		81%	
WL-WL					
L-WL				100%	
SL-SL					
L-SL	38%	2%		61%	
OL-OL					
L-OL	8%	1%		91%	

	LB	DW	LT	SOC	HWP
MFL	97%				3%
AL	100%				
DL	16%	7%		78%	
MCL	25%			75%	
MGL	19%			81%	
MWL					

CROATIA

	LB	DW	LT	SOC	HWP
FL-FL	87%				13%
L-FL	68%	1%	13%	18%	
CL-CL	61%			39%	
L-CL	35%			65%	
GL-GL				100%	
L-GL	1%			99%	
WL-WL					
L-WL	13%			87%	
SL-SL					
L-SL	3%	0%		97%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	87%				13%
AL	68%	1%	13%	18%	
DL	31%	0%		69%	
MCL	33%			67%	
MGL	1%			99%	
MWL					

IRELAND

	LB	DW	LT	SOC	HWP
FL-FL	36%		8%	20%	35%
L-FL	61%		28%	10%	
CL-CL	35%			65%	
L-CL					
GL-GL				100%	
L-GL	66%	6%		28%	
WL-WL	1%			99%	
L-WL	2%	1%		97%	
SL-SL					
L-SL	23%	8%		69%	
OL-OL					
L-OL				100%	

	LB	DW	LT	SOC	HWP
MFL	36%		8%	20%	35%
AL	61%		28%	10%	
DL	42%	13%		45%	
MCL	34%			66%	
MGL	0%			100%	
MWL	1%			99%	

ISLAND

	LB	DW	LT	SOC	HWP
FL-FL	99%			1%	0%
L-FL	74%		7%	18%	
CL-CL				100%	
L-CL	14%			86%	
GL-GL	0%	0%		100%	
L-GL	10%	0%		90%	
WL-WL				100%	
L-WL				100%	
SL-SL					
L-SL	98%			2%	
OL-OL					
L-OL					

	LB	DW	LT	SOC	HWP
MFL	99%			1%	0%
AL	74%		7%	18%	
DL				100%	
MCL	1%			99%	
MGL	2%	0%		98%	
MWL				100%	

% of each carbon pools with respect to UNFCCC land use categories	% of each carbon pools with respect to Reg 2018/841 land accounting categories

Red cell = > 25%

LITHUANIA

	LB	DW	LT	SOC	HWP
FL-FL	77%	17%			7%
L-FL	52%	6%	17%	25%	
CL-CL	93%			7%	
L-CL	10%	2%		89%	
GL-GL					
L-GL	19%	3%		79%	
WL-WL					
L-WL	7%	1%		91%	
SL-SL					
L-SL	11%	2%		87%	
OL-OL					
L-OL	21%	4%		74%	

	LB	DW	LT	SOC	HWP
MFL	75%	6%			19%
AL	73%		5%	21%	
DL		17%		83%	
MCL	12%	5%		83%	
MGL	13%	7%		81%	
MWL				100%	

LUXEMBOURG

	LB	DW	LT	SOC	HWP
FL-FL	77%	17%			7%
L-FL	52%	6%	17%	25%	
CL-CL	93%			7%	
L-CL	10%	2%		89%	
GL-GL					
L-GL	19%	3%		79%	
WL-WL					
L-WL	7%	1%		91%	
SL-SL					
L-SL	11%	2%		87%	
OL-OL					
L-OL	21%	4%		74%	

	LB	DW	LT	SOC	HWP
MFL	77%	17%			7%
AL	52%	6%	17%	25%	
DL	49%	10%		41%	
MCL	6%			94%	
MGL	5%			95%	
MWL	4%			96%	

MALTA

	LB	DW	LT	SOC	HWP
FL-FL					
L-FL					
CL-CL	95%			5%	
L-CL	1%			99%	
GL-GL	0%			100%	
L-GL				100%	
WL-WL					
L-WL					
SL-SL					
L-SL	0%			100%	
OL-OL					
L-OL	0%			100%	

	LB	DW	LT	SOC	HWP
MFL					
AL					
DL					
MCL	21%			79%	
MGL	0%			100%	
MWL					

PORTUGAL

	LB	DW	LT	SOC	HWP
FL-FL	98%		0%	1%	1%
L-FL	73%		4%	24%	
CL-CL	71%	0%		29%	
L-CL	30%	3%		67%	
GL-GL				100%	
L-GL	29%	3%		68%	
WL-WL					
L-WL	5%	2%		93%	
SL-SL					
L-SL	15%	1%		83%	
OL-OL					
L-OL	27%	2%		71%	

	LB	DW	LT	SOC	HWP
MFL	98%		0%	1%	1%
AL	73%		4%	24%	
DL	24%	3%		73%	
MCL	22%	1%		77%	
MGL	16%	1%		83%	
MWL	8%	1%		91%	

% of each carbon pools with respect to UNFCCC land use categories	% of each carbon pools with respect to Reg 2018/841 land accounting categories

Red cell = > 25%

ROMANIA

	LB	DW	LT	SOC	HWP
FL-FL	70%	0%		0%	30%
L-FL	47%			53%	
CL-CL	34%	4%		62%	
L-CL	53%	0%		47%	
GL-GL	100%			0%	
L-GL	51%			49%	
WL-WL					
L-WL	49%			51%	
SL-SL					
L-SL	30%			70%	
OL-OL					
L-OL	42%	3%		55%	

	LB	DW	LT	SOC	HWP
MFL	70%	0%		0%	30%
AL	47%			53%	
DL	51%			49%	
MCL	38%	2%		59%	
MGL	57%			43%	
MWL	6%			94%	

SLOVAKIA

	LB	DW	LT	SOC	HWP
FL-FL	80%				20%
L-FL	50%		14%	36%	
CL-CL	93%			7%	
L-CL	1%			99%	
GL-GL					
L-GL	18%	2%		80%	
WL-WL					
L-WL					
SL-SL					
L-SL	33%	1%		65%	
OL-OL					
L-OL	51%	5%		44%	

	LB	DW	LT	SOC	HWP
MFL	80%				20%
AL	50%		14%	36%	
DL	72%	9%		18%	
MCL	86%			14%	
MGL	10%			90%	
MWL					

SLOVENIA

	LB	DW	LT	SOC	HWP
FL-FL	67%	28%			5%
L-FL	41%	18%	15%	26%	
CL-CL	75%	0%		25%	
L-CL	49%	10%		41%	
GL-GL	76%	21%		3%	
L-GL	38%	8%		54%	
WL-WL					
L-WL	78%			22%	
SL-SL	100%				
L-SL	30%	2%		68%	
OL-OL					
L-OL				100%	

	LB	DW	LT	SOC	HWP
MFL	67%	28%			5%
AL	41%	18%	15%	26%	
DL	52%	11%		37%	
MCL	63%	2%		36%	
MGL	51%	13%		36%	
MWL	86%			14%	

SWEDEN

	LB	DW	LT	SOC	HWP
FL-FL	53%	9%	12%	17%	9%
L-FL	47%	2%	23%	28%	
CL-CL	6%	0%		94%	
L-CL	48%	14%		38%	
GL-GL	43%	29%		27%	
L-GL	57%	31%		12%	
WL-WL				100%	
L-WL					
SL-SL	100%				
L-SL	37%	12%		51%	
OL-OL					
L-OL	93%			7%	

	LB	DW	LT	SOC	HWP
MFL	53%	9%	12%	17%	9%
AL	47%	2%	23%	28%	
DL	56%	22%		23%	
MCL	5%	0%		95%	
MGL	47%	25%		28%	
MWL				100%	

5. SUMMARY AND CONCLUSIONS

How the significance of the carbon pools changes when it is estimated considering EU Regulation´s land accounting categories or UNFCCC´s land use categories does not show a clear pattern. It depends on which category is considered. For those categories where the UNFCCC and the EU Regulation have a one-to-one relationship, the significance of the pools does not change. For the other categories, because the significance of the pools is interlinked, a case-by-case analysis is required to know the drivers of the changes in significance.

In principle, an enhanced level of disaggregation of the information would in any case allow for a better understanding of which pool contribute the most within a category. And ultimately, for a better targeting of resources towards mitigation actions.

In this regard, with some exceptions, the EU Regulation merges under the land accounting categories the information reported for several land use categories. Therefore, for the purpose of knowing the significance of the pools it may mask some information. On the contrary, the EU Regulation requests the information on carbon pools at more disaggregated level than the UNCCC reporting, which could provide insights to identify significant pools.

An exception is given by the soil organic carbon pool because the EU Regulation requests the information merged for mineral and organic soils. However, if the carbon in these pools varies in opposite directions the overall carbon stock changes are counterbalanced, which could hide important carbon fluxes. Moreover, also in when both pools vary in equal direction, it should be noted that the carbon stock changes reported for these pools to the UNFCCC refer to different areas, which are often subject to different management practices.

Another important aspect that might impact the significance of the carbon pools is the influence of external factors such as natural disturbances or wood market prices for single years. To factor out these effects future assessments of significance could consider using information for the entire length of the time series.

With regards to HWP the assignation of the emissions and removals to the accounting category Forest Management does not lead to any change in the significance value of the pools when we compare them with the land use category “Forest land remaining forest land” because these two categories relate one-to-one. Moreover, the current reporting under the KP, which provides information on HWP originating from Forest management and Afforestation and Reforestation activities shows that less than 1% of carbon stock changes from HWP are assigned to Afforestation lands.

By last, our assessment focuses on the significance of the carbon pools and therefore does not enter to discuss other sources of GHG emissions reported under the LULUCF sector. For some countries, these sources contribute notably to the overall budget of GHGs in the sector (e.g., large incidence of wildfires for certain year in Mediterranean countries). Therefore, although the EU Regulation only requests the use of higher tiers for reporting significant pools the attention from these sources should not be distracted. Efforts should be also devoted to ensuring reliable estimates for these sources.

NOTE 4

ISSUES RAISED BY THE UNFCCC CRF TABLES FOR COMPILING INFORMATION ON LAND ACCOUNTING CATEGORIES OF REGULATION (EU) 2018/841

-POSSIBLE OPTIONS TO OVERCOME MISMATCHES-

1. OBJECTIVE

This note aims to provide an overview of the areas where the current structure of the CRF tables, which are used for submitting information on LULUCF to the UNFCCC, poses challenges to the compilation of information on land accounting categories as defined by the Regulation (EU) 2018/841.

2. INTRODUCTION

According with its Article 2, Regulation (EU) 2018/841 applies to emissions and removals of GHGs listed in Section A (Annex I) that take place in six predefined land accounting categories (LACs).

Moreover, Article 5(4) specifies that "MSs shall include in their accounts for each LAC any change in carbon stocks of the carbon pools listed in Section B (Annex I[14]).

Box 1: Summary of reporting elements included in the Regulation (EU) 2018/841.

A. Greenhouse gases as referred to in Article 2: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O).

B. Carbon pools as referred to in Article 5(4): Above-ground biomass, Below-ground biomass, Litter, Dead wood, Soil organic carbon and Harvested wood products in the LACs of Afforested land and Managed Forest land.

C. Land accounting categories as referred to in Article 2: Afforested land, Deforested land, Managed Forest land, Managed Cropland, Managed Grassland; Managed Wetlands.

Currently, the structure of the Common Reporting Format (CRF) tables that are used to submit information on GHGIs to the UNFCCC, presents for the LULUCF sector, and for some pools, land use categories (LUCs) and GHGs, a level of aggregation that is, in principle, incompatible with the level requested by the Regulation (EU) 2018/841 for compiling information on LACs.

In this note we summarize areas of the CRF tables where the aggregation level of the information prevents a straightforward aggregation of data from UNFCCC´s LUCs into Regulation (EU) 2018/841´s LACs.

3. ISSUES RELATED WITH CARBON POOLS

[14] MSs may choose not to include in their accounts changes in carbon stocks of carbon pools provided that the carbon pool is not a source. However, that option not to include changes in carbon stocks in the accounts shall not apply in relation to the carbon pools of above-ground biomass, dead wood, and harvested wood products, in the land accounting category of managed forest land.

EU Regulation requests information on carbon stock changes for Above-ground biomass; Below-ground biomass; Litter; Dead wood; Soil organic carbon; and Harvested wood products in the LACs of Afforested land and Managed Forest land.

However, the reporting of LULUCF information to the UNFCCC covers carbon stock changes in three main carbon pools with different level of aggregation:

1. **Living biomass (LB):** this pool provides aggregated information for Above-ground and Below-ground biomass.
2. **Dead organic matter (DOM):** with the exception of the LUC Forest Land, for all the other LUCs the information on Dead wood and Litter is aggregated under DOM.
3. **Soil organic carbon (SOC):** this pool is further disaggregated in carbon stock changes occurring in mineral and organic soils.
4. **Harvested Wood products (HWPs):** this pool is treated in the LULUCF sector as an additional category and not as a carbon pool. Thus, there is not information on the LUCs where HWPs originate from.

The current aggregation level of information for the carbon pools seems in principle irreconcilable with the level requested by the EU Regulation. However, although the future structure of the CRF tables is still unknown, there are some indications to believe that at least for some carbon pool the current level of aggregation could change and facilitate the aggregation of the information needed for the LACs.

This is the case for the carbon pools LB, DOM and HWPs. As shown by the CRF tables under the KP, when it is about knowing the accounting quantities, the international community already claimed for information at more disaggregated level (in line with the EU Regulation) than when it is about reporting. Thus, it can somehow be assumed that because the KP reporting will no longer exist soon, the next generation of CRF tables will mirror the progress already done under the accounting framework and keep reporting the information disaggregated on Above-ground biomass; Below-ground biomass; Litter and Dead wood. And providing information on where the HWPs are taken from.

Likewise, it would be reasonable to believe that for SOC the tables will continue providing the information disaggregated by mineral and organic soils. In this sense, the aggregation in one single pool of this information as it is requested by the EU Regulation does not represent any technical challenge. However, to avoid the loss of information that may occur when carbon stock changes in these pools are counterbalanced, it will be needed to look at these pools independently.

Indeed, it is important to bear in mind that partly due to the different IPCC approaches used to estimate carbon stock changes in mineral and organic soils, and partly due to natural processes, these pools have often different behaviours and therefore they should be analysed independently. Any analysis should also bear in mind that the information provided in the CRF tables on these carbon pools refers to different areas.

4. ISSUES RELATED WITH LAND USE CATEGORIES

Regulation (EU) 2018/841 specifies in its Article 2 how information from the LUCs need to be aggregated into the different LACs. In this regard, the current structure of the CRF tables presents one constrain for retrieving information from the CRF table 4.D, which provide information on Wetlands.

In particular, while for other land use categories and CRF tables the information is provided for categories “land converted to” disaggregated by the land use category that is converted (e.g., Cropland converted forest Land) the CRF table 4.D does not request such level of disaggregation. The lack of this information hampers the compilation

of information on Deforested Land -Forest converted to wetlands, Cropland Management – Cropland converted to Wetlands-, Grassland Management – Grassland converted to wetlands-, and Managed Wetlands – Settlements and other lands converted to wetlands.

However, this issue should not represent an important challenge in the future. Nowadays, most of the MSs are given the freedom to add child notes to this CRF table and disaggregate further the information, and about 20 MSs are already displaying information on the land use category that is converted to wetland.

For other MSs, there are good reasons to believe that this issue will not represent a problem in the future:

- ✓ Despite of the lack of disaggregated information in their CRF table 4.D, these MSs should already count on this information to build up the land use matrix, both in terms of areas and carbon stock changes. Thus, the inclusion of this information in the CRF tables should not represent an important burden in terms of resources.
- ✓ Given the importance of Deforestation in terms of emissions from LULUCF it could be expected that future structure of the new tables will request information at the level of aggregation needed for the LACs.

5. ISSUES RELATED WITH GREENHOUSE GASES

In this section we underline issues that refers to the reporting of emissions of GHGs (CO2 and non-CO2) from other sources that are reported for the LULUCF sector in CRF tables 4(I) - 4(V).

The information in these tables is often provided at the level of land use subcategories "remaining" and "Land converted to" but without further differentiation on which land use is being converted to. In some case the information is even provided only at the level of the main land use category. E.g., Forest land, without further differentiation.

At the current level of aggregation, it is in principle not possible to identify the land use subcategory where the GHGs originate, and therefore this prevents their subsequent assignation on LACs.

1. **CRF table 4 (I) – *Direct N_2O emissions from N inputs to managed soils*. –** In this table information is disaggregated at the level of land use categories "remaining" and "Land converted to". Information is provided at such level for the categories Forest land, Wetlands, and Settlements. Moreover, the table provides the option to include further information under a row "Other[15]". Within each of these land use subcategories the information is further subdivided in (i) Inorganic Nitrogen fertilizers, and (ii) Organic Nitrogen Fertilizers.
   It is also important to bear in mind that information on these emissions taking place in cropland and grassland is included outside the LULUCF, in the Agriculture sector. Moreover, when a MSs is not able to separate the nitrogen inputs applied to land-use categories, other than cropland and grasslands, it may report all N_2O emissions from N inputs to managed soils in the Agriculture sector.

2. **CRF table 4 (II) – *GHGs (CO_2, N_2O, CH_4) emissions and removals from drainage and rewetting and other management of organic and mineral soils*. –** In this table information is disaggregated at the level of the

[15] If a Party is not able to separate the N inputs applied to forest land and to other land-use categories, other than cropland and grasslands, it may report all N2O emissions from N inputs to managed soils under the category H. Other. This should be explicitly indicated in the documentation box.

main LUCs for Forest land, Cropland, Grassland, Wetlands, and a row for "Others" (if it is relevant, this row is used to provide information on emissions occurring in Settlements or Other lands).
For each of these categories, emissions are reported for drainage and rewetting of soils and differentiating among organic and mineral soils. In CRF table 4 these emissions are added to the main LUCs (i.e., without the possibility of differentiating among "remaining" and "land converted". Other aspects to bear in mind when looking at this table concerns to the fact that N_2O emissions from drained cropland and grassland soils are reported in the Agriculture sector. Moreover, countries are allowed to report CO_2 emissions or removals from drainage of soils in tables 4.A to 4.F. If this is the case their assignation to the corresponding LAC does not represent any challenge.

3. **CRF Table (III) –** ***Direct N_2O emissions from N mineralization/immobilization associated with loss/gain of soil organic matter*** **–** This source of emissions, along with biomass burning, is the most important in terms of non-CO_2 gases reported under the LULUCF sector. The table requests information on N_2O emissions at the level of the land use subcategories "remaining" and "Land converted to" for each LUC, except for Cropland remaining cropland because these emissions are included in the Agriculture sector. The lack of information on the land use that is converted does not allow a proper assignation of these emissions to the appropriate LACs. However, MSs are increasingly[16] providing more detailed and disaggregated information on land categories in which these emissions occur. Moreover, for those cases where the information is not yet reported with such detail, the information should be easily obtained since these emissions are related with the loss of soil organic carbon in the LUCs that is reported under the CRF tables 4A-4F.

4. **CRF table 4(IV) –** ***Indirect N_2O emissions from managed soils*** **–** This table requests information on emissions from nitrogen volatized from managed soils that results from nitrogen inputs, and nitrogen from fertilizers, and others, and which is lost through leaching and run-off from managed soils.
The table does not allow to provide disaggregated information on LUCs. On the contrary, it specifies that if the sources of nitrogen cannot be separated other than between cropland and grassland, they should be included in the Agriculture sector. However, this table should not represent any challenge while compiling information on the LACs because this information is in principle not included in the LACs of Regulation (EU) 841/2018.

5. **CRF table 4(V) –** ***GHG emissions (CO_2, N_2O, CH_4) from biomass burning*** **–** In this table information is disaggregated at the level of land use categories "remaining" and "Land converted to" for Forest land, Cropland, Grassland, Wetlands. For Settlements and Other land information is provided only at the level of the main LUC. In addition, also in this case the table provides the option to include further information under a row "Other". For each of these categories the information is further disaggregated by controlled burning and wildfires.

   This level of disaggregation in principle does not allow for a direct translation of the information into LACs. However, with the expected increasing use of satellite information, which is also requested in the Regulation (EU) 2018/841, countries should not encounter insurmountable impediments to retrieve information on the land use subcategory where the fires occur. Also, it should be noted that satellite data

[16] During the QAQC checks implemented at EU level, and JRC´s LULUCF workshops, MSs have been requested to provide such level of disaggregation in order to allow checking the consistency with carbon losses reported in SOC in CRF tables 4.A – 4.F. On top of that, one of the conclusions during the last UNFCCC lead reviewer meeting calls for a specific check on this issue.

with information on burned areas is already available at European level[17], which should play an important role on the reporting and verification of information on this source of emissions.

6. SUMMARY AND CONCLUSIONS

The current structure of the CRF tables, which are used for reporting information on the GHGIs to the UNFCCC, poses some challenges for a direct translation of information from land use categories of the LULUCF sector into land accounting categories that are requested by the Regulation (EU) 2018/841.

In particular, there are some areas where the disaggregation level of the information on pools, land use categories, and gases does not allow a straightforward compilation of information under the land accounting categories .

These differences on the disaggregation level of the information could in principle be seen as irreconcilable, but in practice there are solutions to overcome the differences. For instance, it should be noted that most of the MSs count on the background information at further level of disaggregation than the one requested by the CRF tables. (i.e. land use matrices usually run on 8 to 15 land categories which are later aggregated to LUCs). The reason why this information is not included in the submission is simply that the current reporting rules do not request to do it.

How the next generation of the CRF tables will look like is still unknown. However, the most recent accounting framework under the UNFCCC-KP- already introduced some developments that include further disaggregation of the information, sometimes in line with the level requested by the EU Regulation. Based on this, it is reasonable to believe that in the future the reporting tables will also incorporate such developments which have proven to provide valuable information.

As regards non-CO2 gases, the allocation of this information under the land accounting categories could still present some challenges in the future. However, these emissions have in most of the cases exceptionally low occurrence in the countries. Moreover, when they occur are often unequivocally allocated to one or two land use categories. For instance, biomass burning in forest and grassland, or nitrogen emissions from agricultural soils. Therefore, facilitating their assignation to the corresponding land accounting category.

In the future, the use of satellite information for acquiring land information will also help to overcome the challenges raised by the current CRF tables. For instance, it should allow to allocate natural disturbance events to the corresponding land category with more accuracy, or a wall-to-wall tracking of land use changes as associated carbon stock changes on time and space

[17] https://effis.jrc.ec.europa.eu/

Annex 2

Task 2.A: Inventory development, Updated version of Note2 – Assessment of Tiers methods used for LULUCF reporting and their compliance with Regulation (EU) 2018/841 (2022)

Subreport by R. Abad Viñas

FOREST MONITORING FOR POLICIES [FORMONPOL]

Task 2.A- Inventory development

[Updated version of Note2]

Assessment of Tiers methods used for LULUCF reporting and their compliance with Regulation (EU) 2018/841.

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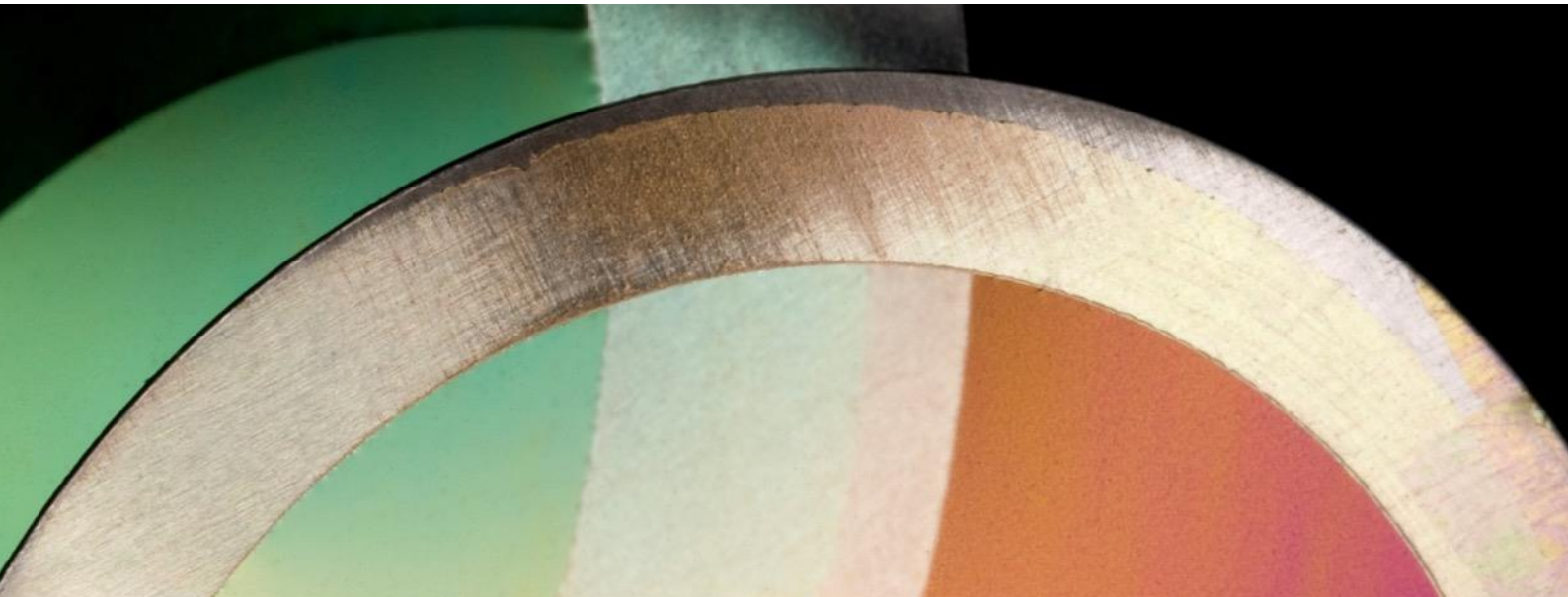
June 2022



Contents

List of acronyms

AD	Activity data
AL	Afforested land
CRF	Common reporting format
DL	Deforested land
DOM	Dead organic matter
DW	Dead wood
EF	Emission factor
EU	European union
GHGI	Greenhouse gas inventory
HWP	Harvested wood products
IPCC	Intergovernmental panel on climate change
KC	Key category
KP	Kyoto Protocol
LAC	Land accounting category
LB	Living biomass
LT	Litter
LULUCF	Land use, Land use Change and forestry
MCL	Managed Cropland
MFL	Managed forest land
MGL	Managed Grassland
MRV	Monitoring Reporting and Verification
MS	Member State
MWL	Managed Wetland
NIR	National inventory report
QAQC	Quality assurance & Quality control
SOC	Soil organic carbon
UNFCCC	United Nation Framework Convention on Climate Change

1. Introduction

The European Commission laid out long term policy and strategies to ensure that carbon sinks and reservoirs, including forests, are conserved, or enhanced to meet the ambitious greenhouse gas emissions reduction targets of the EU by 2030, and to reduce emissions to net zero by 2050, in line with the Paris Agreement.

To help achieve these goals, Regulation (EU) 2018/841 sets out a robust accounting system and binding commitments for each Member State to ensure that GHG emissions accounted from land use are at least compensated by an equivalent removal of CO_2 from the atmosphere through actions in the sector. The Regulation builds on Decision 529/2013/EU, which broadened the coverage of LULUCF accounting, and sets up a plan for improving the MRV process of GHG emissions and removals.

In implementing this framework, considerable follow-up work is still needed to enhance transparency, accuracy, completeness, consistency, and comparability of the pledges and of the associated mitigation actions, especially in relation to the land use sector.

The GHG inventories are the foundation of the accounting, and of the compliance systems. Inventories need to comply with Regulation (EU) 2018/841 (LULUCF Regulation) and 2018/1999 (Energy Union Governance Regulation) requirements. Without this, it will be difficult for MS to work towards compliance and implement mitigation policies on the AFOLU sector.

To support the Commission on the development of policies, in 2019 the so-called administrative arrangement[1] "Forest Monitoring for Policies" (AA FORMONPOL) was signed with the Joint Research Centre, Directorate D – Sustainable Resources - Bio-Economy Unit.

Based on the 2022 submission of national GHG inventories, this document updates the information on the note 2 of the report[2] submitted in 2021 to fulfil the task 2A of the Lot 1 of such AA.

However, although not included in this document, the original report submitted in 2021, included three others additional notes, and some annexes, covering important aspects for the implementation of the reporting requirements of LULUCF information under the Regulation 2018/841.

[1] N ° JRC.35608 / DG CLIMA N ° 340201/2019/815658/AA/CLIMA.C.3

[2] Registration number Ares(2021)7565298

2. Objective

This document updates, with information included in the 2022 national GHG inventory submissions, the note 2 of the report submitted as deliverable of the AA FORMONPOL TASK 2.A- *Inventory development*-.

Based on the LULUCF information included in these submissions, it assesses the reporting status of MS with the purpose of identifying cases in which the current reporting by MS appears, in principle, as non-compliance with reporting requirements included in Article 18 (4) of Regulation (EU) 2018/841. But the report does not aim to signal specific submissions because, as describe in following sections, the approach used in this assessment has limitations, and any final judgement on the compliance of national inventories with Regulation (EU) 2018/841 should involve bilateral communication with the Party.

By contrary, it aims to support the European Commission on the implementation of capacity building activities for supporting MS to increase the quality of the LULUCF information.

The ultimate objective is to identify areas of the LULUCF reporting in which countries encounter major difficulties to comply with reporting requirements.

The report includes in the main body text the assessment of Tier methods used by MS for reporting carbon stock changes in the different pools of the main land use categories, and a initial evaluation of the compliance of the LULUCF reporting with Article 18 (4) of Regulation (EU) 2018/841.

Moreover, additional information is included in four annexes addressing:

- Annex I: Likelihood of the carbon pools for being significant in the different land use subcategories.
- Annex II: information on Tier method by carbon pool and land use category.
- Annex III: Significance of carbon pools when HWP is considered under FL-FL.
- Annex IV: Information on data sources used for land representation.

3. Legislative framework

Regulation (EU) 2018/841 states in its Article 18 (4) that "*for emissions and removals for **a carbon pool** that accounts for at least **25-30 % of emissions** or removals **in a source or sink category** which is prioritized within a MS's national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or the uncertainty in emissions and removals in the land-use categories, **at least Tier 2** methodology in accordance with the IPCC 2006 GL*[3] should be used". Moreover, MS are encouraged to apply Tier 3 methodology, in accordance with such guidelines.

The IPCC 2006 GL define in its Volume 1, Chapter 4, a key category (KC) as the one that is prioritized within the national inventory system because its emissions or removals have a significant influence on the total GHG inventory of the country, in terms of the absolute level, the trend, or the uncertainty.

MS will have to comply with the use of, at least, Tier 2 methods for estimating carbon pools that account for at least 25-30% of emissions or removals in a key category

[3] IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).Published: IGES, Japan.

4. Methodological framework

2006 IPCC Guidelines for National Greenhouse Gas Inventories

To assess the status of compliance of MS inventories towards the Article 18 (4) of Regulation (EU) 2018/841 it is needed a clear view of what it is a key category, and how a key category analysis is performed.

The IPCC 2006 GL include two main approaches for implementing the KC analysis. Both approaches identify KCs in terms of their contribution to the absolute level of emissions and removals, and to the trend of emissions and removals. Beyond that, a third approach, based on qualitative criteria, can be also implemented if for any reasons some important category was not included in the quantitative analyses carried out under one of the two approaches.

In Approach 1, KCs are identified using a pre-determined cumulative emissions threshold. Key categories are identified as the categories that, when summed together in descending order of magnitude, add up to 95% of the total level of GHG emissions. This step requires to work with absolute values, so that emissions and removals from LULUCF do not cancel out. *In Approach 2*, which can be used if values for category uncertainties or parameter uncertainties are available, the categories are sorted according to their contribution to the uncertainty.

The IPCC 2006 GL suggest an aggregation level of the categories for performing the analysis using Approach 1 and lists the source and sink categories to consider in the analysis. However, it acknowledges that the KC identification will be most useful if the analysis is done at the appropriate level of disaggregation that each country may need according to national circumstances.

Up to date, national GHG inventories include information on KC in the format of:

- A KC analysis automatically generated by the UNFCCC CRF Reporter software that is included in the CRF table 7. It has the advantage of allowing the comparison of KC among Parties ensuring that the same aggregation level under the Approach 1 is used.
- A not-automatized more detailed KC analysis implemented with greater level of disaggregation of categories, and adapted to national circumstances, which often uses Approaches 1 and 2. This analysis is included by most MS, but not all.
- A mandatory and not-automatized KC analysis that includes information on KP-LULUCF activities that are considered “key”.

In this report information on key categories is taken from the CRF table 7 that is included, for the year 2020, in the 2022 submissions.

As regards methodologies for estimating GHG emissions, the IPCC 2006 GL consider three Tier methods that represent different levels of methodological complexity for estimating GHG inventories. In general, moving to higher tiers improves the accuracy of the estimation and reduces its uncertainty, but the complexity and resources required for performing the inventories also increase when applying higher Tiers.

According with the guidelines, anthropogenic GHG emissions and carbon removals can be estimated through an approach that combines information on the extent to which a human activity takes place (called activity data, **AD**) with coefficients that quantify the emissions per unit of activity data (called emission factors, **EF**).

The basic equation for estimating emissions and removals in a LULUCF inventory category is therefore:

$$Emissions, or\ Removals = AD\ x\ EF$$

For most of the sources and sink categories, the IPCC 2006 GL identify three Tier methods of increasing methodological complexity, along with decision trees that help inventory compilers to select the most appropriate methodology for their circumstances. The selection should consider the result of the key category analysis, noting that it is a good practice to use higher tier methods for key categories, unless the resources necessary to do so are prohibitive (UNFCCC Decision 24/cp.19).

Tier 1 methods are the most basic and provide a feasible option for all the countries to produce a complete national GHG inventory. In general, Tier 1 uses readily available national or international statistics in combination with default emission factors and additional default parameters that are provided in the IPCC guidelines. On the contrary, Tier 2 and 3, known as higher Tiers methods, involve respectively country-specific parameters at higher spatial and temporal resolution or more advanced modelling approaches. They are considered more accurate.

Specifically, for the LULUCF sector the IPCC 2006 GL provide at the level of carbon pool and land use category three tier methods than can be summarized as follow:

Table 1: Summary of Tier methods for estimating carbon stock changes in LULUCF sector.

Tier 1	***Tier 2***	***Tier 3***
Use default methodologies (e.g., equations) with default emissions factors, and or coefficients that are often provided at the level of climate zones, global ecological zones, and soil types. Or, in some cases it is assumed that there is no net change in the carbon stock in long term. I.e., the pool is in equilibrium.	Use default methodologies (e.g., equations), which are often the same used in Tier 1, but involving country-specific factors, frequently in combination with some default parameters. The quality of its estimates strongly depends on the temporal and spatial scales of the data collection systems and the representativeness of the factors.	Use country-specific methodologies that involve highly disaggregated information that allows for fine spatial scale for estimating GHGs. Usually relates with modelling methodologies or fine temporal and spatial resolutions. (e.g., high intensity sample systems)

As showed in table 1, IPCC 2006 GL assume certain carbon pools in balance under the Tier 1 assumption of equilibrium. For these pools, no net emissions or removals are reported when a MS implements the Tier 1 method. The assumption of balance only applies for specified carbon pools and always under land use sub-categories "remaining". For land use changes resulting carbon stock changes need to be reported even under Tier 1 methods.

Table 2: In grey, the carbon pools for which the IPCC 2006 GL assume balance under the Tier 1 method.

4.A.1. F-F					4.B.1. C-C				4.C.1. G-G				4.D.1. WL-WL				4.E.1. SL-SL				4.F.1. OL-OL			
LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg

LB-living biomass; DW-dead wood; LT- litter, DOM- dead organic matter; SOC min/org- soil organic carbon in mineral and organic soils .

Two cases special cases apply in the land use sub-categories 4.F.1, other land remaining other land, and 4.B.1, cropland remaining cropland.

As regards 4.F.1, the IPCC 2006 GL consider that these areas are unmanaged and without significant carbon stocks. Accordingly, there is no need to report emissions or removals from there areas, under stable conditions, but just when they are involved in a land use conversion. Under 4.B.1, with regards to living biomass, the IPCC provides, under the Tier 1 method, default factors only for woody crops. For annual vegetation, in the absence of country-specific parameters, the assumption of equilibrium applies.

Moreover, there are certain categories for which the IPCC 2006 GL do not provide methodologies. In these cases, inventory compilers are not required to provide estimates and the notation key NE "not estimated" can be used instead. In the LULUCF sector this lack of methodologies affects the land use sub-categories "Flooded land remaining flooded land" and "Other wetland remaining other wetlands".

As regards with the tiered approach of the IPCC 2006 GL, the IPCC 2019 Refinement does not introduce major changes. The same approach is kept for estimating GHG emissions and carbon removals in a GHG inventory. Nevertheless, for LULUCF, most of the default factors have been updated, and some new added, to capture new knowledge and developments in science. For instance, new methods have been introduced for estimating stock changes in soil organic carbon in mineral soils under the Tier 2 methods.

Approach used in this report to assess the implementation status of Art. 18 (4) of Regulation (EU) 2018/841

Article 18 (4) in Regulation(EU) 2018/841 requires the use of, at least, Tier 2 methods for estimating emissions and removals in those carbon pools that are significant within a key category. However, the Tier 1 assumption of equilibrium (i.e., no net carbon tock change in long term) is widely used for carbon pools for which MS lack country-specific data, and IPCC 2006 GL do not provide default factors.

To assess which carbon pools must be reported with, at least, Tier 2 methods we should first know the significance of the pools within each category. However, calculating the significance for pools that are not quantitatively reported is in principle not possible. To overcome this dilemma, we offer an interim practical and consistent solution.

The significance of a non-reported pool is assessed with the proxy value of the average of the significances calculated from MS that quantitatively estimate the pool.

This interim approach could be further refined in subsequent assessments[4]. As for now, this approach allows to get a clearer idea of which carbon pools tends to be significant within each land use sub-category, and to points out areas of the LULUCF reporting that will need to be enhanced to fulfil reporting requirements.

An important aspect to bear in mind is that the carbon behaviour within a pool is strongly dependent on the management practices and climate conditions. Thus, certain carbon pool might represent a large source of emissions in one country and a sink of carbon in other. Additionally, in specific years, other factors such as natural disturbances or wood market-prices could also affect the significance of the pools, or even reverse its net role in terms of carbon fluxes.

The lack of estimates for a carbon pool represents itself an impediment for an appropriate analysis of the significance of the carbon pools. The significance of each carbon pool within a given category is interlinked with that of the others, therefore when a pool is not reported the significance of those that are quantitatively estimated increase. To figure out the real significance value for a certain pool, all the carbon pools would ideally need to be reported. Moreover, for organic soils the significance is highly dependent of their area, which create a sort of artifact when pooled together with other carbon pools.

Our assessment is based on the 2022 GHG inventory submissions. Information on the completeness status of the reporting is based on an internal file that shows which pool is reported with quantitative estimates. The key category analysis is taken from the CRF table 7 of MS GHG inventory submissions. Information on the Tier method used is based on the analysis of the information provided by MS to the Annex-III (i.e., methodological descriptions) of the EU GHG inventory, and on the National Inventory Reports that are part of each MS submission.

[4] For instance, the average value used as a proxy of the significance could be calculated at the level of climate region or global ecological zone that consider particular conditions reducing the variance of the average. And/or, some weighted average could be considered (e.g., using the absolute value of net emissions), and/or some iterations could be applied to reduce outliers of the sample before calculating the average.

The categorization of a method under a single tier is not simple due to the lack of transparency of some GHG inventories, and the use in the methods of both, country-specific and default factors.

The assessment does not enter in-depth on the separation among Tier 2 and Tier 3, but just among Tier 1 versus higher Tiers because this allows to assess compliance with reporting requirements. Further details on the Tier method used by pool and land use category can be found in Annex II.

Regarding gases, it covers information on CO_2 in land sub-categories "land remaining" because of the complexity[5] of assigning a single Tier method to land use sub-categories "land converted to". Usually, for reporting carbon stock changes in a category reported as "land remaining", a single data source is used that enable the categorization of the methodologies under a Tier method. Conversely, multiple data sources are often used to derive emissions from sub-categories "land converted to", which prevents an easy categorization of the methods. For instance, for estimating carbon stock changes in living biomass from forest land converted to cropland, MS may adopt country-specific values for forest land and default factors for cropland. Besides that, the categorization of methods under a single Tier for sub-categories "land converted to" undoubtedly depends on the categories involved in the conversion (e.g., For the category Land converted to Grassland different approaches and data sources are often used for forest converted to grassland than for cropland converted to grassland).

Finally, the harvested wood products[6] (HWPs) pool has not been included in our analysis because the current CRF tables for LULUCF do not treat HWPs as an additional carbon pool associated to any land use category, but as an additional category for which estimates are provided in the sectorial CRF table 4. But the reporting of HWPs should not raise any case of non-compliance with Article 18 of (EU) Regulation 2018/841 since, except Malta, which do not declare HWPs from domestic harvest, all MS used the Production approach of the IPCC 2006 GL involving country-specific information (or international databases) on harvested quantities.

Our assessment went through the following steps:

- **Step 1**: Identification of the LULUCF key categories that are included in the CRF table 7 of the 2022 MS submission that refer to the year 2020. Each of these categories is considered in this assessment irrespective of whether they were identified as key using the level or the trend criteria.
- **Step 2:** cross-check of completeness status of MS submissions with a table that shows the result of the key category analysis. The outcome of this step is a table that displays the carbon pools that have been quantitatively reported, and which of them fall in categories identified as key. In this table, the pools that are assumed in balance under the Tier 1 method of the IPCC 2006 GL are marked in grey so that it can be differentiated among pools not reported based on the assumption of equilibrium, and those that lack estimates based on country-specific arguments (e.g., lack of woody crops, management practices on soils applied equally across the years or tendentially less intensive in the present years, or lack of organic soils).
- **Step 3:** To estimate the significance, in terms of emissions and removals, of each pool within a category, the information on carbon stock changes reported in CRF tables 4.A-4.F is converted into CO_2 using the ratio of the molecular weights (44/12). This step applies to the time series 1990-2020.

[5] In the annex-II information on the tier methods used by carbon pool and land use sub-subcategory has been included based on our expert judgement and on information included in MS´s NIRs.

[6] In the annex-III an assessment of the significance of carbon pools for the category 4.A.1 has been included assuming that all the HWPs originate from 4.A.1. Therefore, adding HWPs as an additional pool under 4.A.1

- **Step 4:** The information on CO_2 for the years 1990-2020 and for each carbon pool and category was converted to absolute values; this avoids emissions and removals counterbalancing each other. Then, for each year of the time series we estimate the significance of a carbon pool by dividing the absolute value of the pool by the total value of the category. The final value of the significance for each pool, country and category is estimated as the average of the significances estimated for that country, pool, and category throughout the years 1990-2020.
    - **N.B.:** For countries that do not report a carbon pool based on the Tier 1 IPCC assumption of "equilibrium", the assessment of compliance with Regulation (EU) 2018/841 is done using as a proxy of the significance the average value of the significances calculated for the MS that report the pool. The threshold value for considering a pool "significant" in this assessment is fixed to 25% contribution to the entire category. Regulation (EU)2018/841 considers in its article 18 (4) 25-30%.
- **Step 5:** The information included in the Annex-III of the EU GHG inventory, and in the National Inventory Reports was analysed to categorize the Tier methods used by countries to estimate carbon stocks changes within the pools. Separation was done among Tier 1 and higher Tiers (2 and 3) as a whole.
- **Step 6:** To conclude, all the information derived in the steps above was included in a table that shows for each category, country, and carbon pool (i) the Tier method used, (ii) the significance of the pool, (iii) the proxy value of the significance of the pools, (iv) whether the category is key, and (v) cases of non-compliance or potentially non-compliance with Article 18 (4) of Regulation (EU)2018/841.

The outcome of the assessment is presented below in tabular format for each category and complemented with the discussion of the results.

5. Results and discussion

Following the approach described above, this section presents preliminary results of the assessment for each land use sub-category "remaining", that shows LULUCF inventories that could be in non-compliance situation with the requirement of the Article 18 (4) of Regulation (EU) 2018/841.

For each category, the results are presented in a table that shows whether the category is key the MS, the significance of each carbon pool, the Tier method used, and the average value of the significance of the pools.

For pools where the IPCC 2006 GL assume the pool in balance, and the country does not provide quantitative estimates, the notation T1 was added.

In these tables we highlighted those pools considered (i) non-compliant or (ii) potentially non-compliant with Article 18 (4) of the Regulation (EU) 2018/841 either:

(i) Based on the own reporting of MS: the land use category is key and Tier 1 method is used for estimating carbon stock change in a significance pool.

(ii) Based on the average value of the significances calculated from other Ms. I.e., irrespective of whether the category is key, the average value of significance suggests that the pool is significant, but the MS does not provide estimates.

All the possibilities are translated in the tables below using a colour legend as follow:

- The land use sub-category is key according with information provided in the CRF table 7.
- The carbon pool is assumed in balance by the Tier 1 method of the IPCC 2006 GL.
- (i) Non-compliance based on the quantitative information reported by the MS.
- (ii) Potential non-compliance based on the average of information reported by others MS.

Forest land remaining Forest land

Table 3: Reporting status of emissions and removals under the subcategory 4.A.1.

MS	Living biomass		Dead wood		Litter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	64%	*T2,3*	4%	*T2,3*	*IE*	*T2,3*	32%	*T2,3*		
BE	100%	*T2,3*	*T1*		*T1*		*T1*			
BG	94%	*T2,3*	6%	*T2,3*	*T1*		*T1*			
HR	100%	*T2,3*	*T1*		*T1*		*T1*			
CY	100%	*T2,3*	*T1*		*T1*		*T1*			
CZ	81%	*T2,3*	5%	*T2,3*	12%	*T2,3*	2%	*T2,3*		
DK	63%	*T2,3*	3%	*T2,3*	22%	*T2,3*	*T1*		12%	*T2,3*
EE	64%	*T2,3*	3%	*T2,3*	*T1*		25%	*T2,3*	8%	*T2,3*
FI	65%	*T2,3*	*IE*	*T2,3*	*IE*	*T2,3*	18%	*T2,3*	17%	*T2,3*
FR	92%	*T2,3*	8%	*T2,3*	*T1*		*T1*			
DE	63%	*T2,3*	6%	*T2,3*	0,8%	*T2,3*	26%	*T2,3*	4%	*T2,3*
GR	100%	*T2,3*	*T1*		*T1*		*T1*			
HU	85%	*T2,3*	11%	*T2,3*	*T1*		*T1*		3%	*T1*
IE	50%	*T2,3*	*IE*	*T2,3*	7%	*T2,3*	1%	*T2,3*	42%	*T2,3*
IT	97%	*T2,3*	1%	*T2,3*	2%	*T2,3*	*T1*			
LV	66%	*T2,3*	26%	*T2,3*	*T1*		*T1*		8%	*T2,3*
LT	87%	*T2,3*	13%	*T2,3*	*T1*		*T1*		*IE*	*T1*
LU	89%	*T2,3*	11%	*T2,3*	*T1*		*T1*			
MT	100%	*T2,3*	*T1*		*T1*		*T1*			
NL	78%	*T2,3*	5%	*T2,3*	14%	*T2,3*	*T1*		3%	*T2,3*
PO	85%	*T2,3*	3%	*T2,3*	*T1*		9%	*T1*	3%	*T1*
PT	98%	*T2,3*	*IE*	*T2,3*	1%	*T2,3*	2%	*T2,3*		
RO	100%	*T2,3*	*T1*		*T1*		*T1*		0,1%	*T1*
SK	90%	*T2,3*	10%	*T2,3*	*T1*		*T1*			
SI	90%	*T2,3*	10%	*T2,3*	*T1*		*T1*			
ES	100%	*T2,3*	*T1*		*T1*		*T1*			
SE	49%	*T2,3*	11%	*T2,3*	12%	*T2,3*	19%	*T2,3*	8%	*T2,3*
IS	99%	*T2,3*	*T1*		*T1*		*T1*		1%	*T1*
Average	**84%**		**8%**		**9%**		**15%**		**9%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T – tier

The category forest land remaining forest land is reported for the year 2020 as a key category by all MS, except Malta.

In terms of significance, the carbon pool Living biomass is by large the major contributor. It accounts for an average value of 84% of the absolute level of emissions and removals in the category. The carbon pools Dead wood and Litter, for most of the countries that report their carbon stock changes, do not reach the minimum significance value that would lead to the requirement of using higher Tiers methods for estimating their emissions and removals.

Estimates of changes in Soil organic carbon of mineral soils exceed the threshold value of significance for several MS, but on average it is lower than the threshold value of 25%.

For Soil organic carbon in organic soils, empty cells indicate that the country do not report such soils in this category. Nevertheless, although organic soils, subject to management practices, are often considered hotspots in terms of emissions, its significance in a context of an entire category is linked with the specific area that they occupy within the entire category. Because the area of organic soils is often relatively small as compared with the area of mineral soils, the significance may appear not as high as that of mineral soils, although their emissions per unit of area are substantially larger.

In terms of Tier method use to estimate carbon stock changes in Living biomass, all MS are labelled as "higher tiers". This is because the main parameters involved in the estimation are country specific. Estimate are based on information from national forest inventories, or forest management plans, or in some case derived from

modelling approaches. Nevertheless, a deeper analysis shows that some IPCC default factors continue being used, increasing the final uncertainty of the estimates.

For instance, the carbon fraction of the wood, or the root-to-shoot ratios for estimating below-ground biomass, or the wood density used to convert wood volumes in tones of dry matter, are often taken from the 2006 IPCC GL, which are not able to reflect the impact that the different species, and location of the forests, have in the estimate of carbon stock in forest living biomass.

Another area where improvements seem needed, which apply equally to all land use categories, refers to the disaggregation level of the information used to derive the net final emissions or removals reported for the land categories. In this regard, the information included in the GHG inventories is frequently not enough to understand whether the net emission or removal reported for certain category in the CRF table consider in its background calculation further stratification. Further transparency on this respect, and when needed, further disaggregation to take into account the variability of the biomes within the categories would contribute to increase comparability and accuracy of the estimates.

Apart from the reporting of Living Biomass, there is a widespread use of the Tier 1 assumption of equilibrium for Dead organic matter and Soil organic carbon in mineral soils. The lack of these estimates, although, in principle, does not represent a non-compliance situation with the Article 18 (4), because these pools appear as likely not significant, prevent a comprehensive view of carbon fluxes in the category that is needed to understand the role of each reservoir and its behave under different management practices.

Beyond this analysis, additional reflections are worth on Dead wood and Litter. Even if formally, they are in most of the cases not "significant", the omission of these pools in the reporting of the Forest land category, is not easily justifiable in terms of data availability or resources burden. It is known that national forest inventories, which are for long in place for most of the MS, have started to collect data on these pools, at least for recent years. In addition, carbon stock changes in these pools may be estimated also from the Living biomass pool through models. Therefore, an enhanced reporting by MS of these pools is expected in a near future.

Furthermore, from a legal perspective, the Regulation (EU) 2018/841 states in its Article 5 that the option of not to include changes in carbon stock in the accounts shall not apply in the case of Above-ground biomass, Dead wood and HWPs in the land accounting category of Managed Forest land.

Hence, although from the table above it can be concluded that 2022 national inventory submissions for forest land remaining forest land do not raise, in principle, any non-compliance case with Article 18 (4) of Regulation (EU) 2018/841, the reporting of eight MS does not satisfy the mandate of its Article 5. In addition, Malta does not report estimates for the HWP pool since *"commercial login does not occur in its territory*".

Cropland remaining Cropland

Table 4: Reporting status of emissions and removals under the subcategory 4.B.1

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	20%	*T2,3*	*T1*		80%	*T2,3*		
BE	2%	*T2,3*	*T1*		50%	*T2,3*	48%	*T1*
BG	7%	*T1*	*T1*		88%	*T2,3*	5%	*T1*
HR	66%	*T1*	*T1*		8%	*T2,3*	27%	*T1*
CY	100%	*T1*	*T1*		----			
CZ	24%	*T1*	*T1*		76%	*T2,3*		
DK	1%	*T2,3*	*T1*		11%	*T2,3*	88%	*T2,3*
EE	1%	*T2,3*	*T1*		37%	*T2,3*	62%	*T2,3*
FI	0,04%	*T2,3*	*IE*	*T2,3*	11%	*T2,3*	89%	*T2,3*
FR	16%	*T2,3*	*T1*		84%	*T2,3*	*IE*	*T2,3*
DE	1%	*T2,3*	*T1*		1%	*T2,3*	99%	*T2,3*
GR	70%	*T2,3*	*T1*		----		30%	*T1*
HU	12%	*T2,3*	*T1*		88%	*T2,3*		
IE	35%	*T1*	*T1*		65%	*T1*		
IT	18%	*T2,3*	*T1*		64%	*T2,3*	18%	*T1*
LV	1%	*T2,3*	0,04%	*T2,3*	----		99%	*T1*
LT	35%	*T1*	*T1*		65%	*T2,3*	*IE*	*T1*
LU	79%	*T1*	*T1*		21%	*T2,3*		
MT	66%	*T2,3*	*T1*		34%	*T1*		
NL	----		*T1*		----		100%	*T2,3*
PO	63%	*T1*	*T1*		12%	*T1*	25%	*T1*
PT	85%	*T2,3*	*T1*		15%	*T2,3*		
RO	14%	*T2,3*	*T1*		79%	*T1*	8%	*T1*
SK	94%	*T2,3*	*T1*		6%	*T2,3*		
SI	8%	*T1*	2%	*T2,3*	3%	*T1*	88%	*T1*
ES	36%	*T2,3*	*T1*		64%	*T2,3*		
SE	4%	*T2,3*	0,22%	*T2,3*	18%	*T2,3*	78%	*T1*
IS	----		*T1*		2%	*T2,3*	98%	*T1*
Average	**33%**		**1%**		**41%**		**60%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T – tier.

For the year 2020 about two third of the countries reported Cropland remaining cropland as a key category. However, Tier 1 methods continue being widely used for estimating emissions and removals in its carbon pools.

Most of the MS report on Living biomass, although some of them using Tier 1 method. There are two exceptions, where MS declare to not have significant area of woody crops and, in line with the IPCC assumption of equilibrium for annual crops, they do not report quantitative estimates for this carbon pool. A deeper analysis of the submissions shows that some countries have reported the pool only for the conversion among "woody" and "annual" crops, assuming that when these categories remain stable, the living biomass is in equilibrium in terms of carbon stocks.

Dead organic matter was always assumed in balance, except by four MS that implement country-specific data. For all of them, this pool falls far below the threshold value that classify a pool as significant.

Under Mineral soils, the majority of MS provide estimates of carbon stock changes. For this pool, MS have in recent years devoted efforts to develop country-specific factors which, in some cases, along with some default parameters allowed the estimation of the pool using higher Tiers methods. It should be noted that some of these country-specific parameters were then used by neighbouring countries to perform their own estimates replacing

the use of default factors. In both cases, the notation T2/T3 was used in the table to label the method use to report the pool.

The default method of the 2006 IPCC GL for reporting annual carbon stock changes in Mineral soils is based on the comparison of default carbon stocks at two different times. The variation of the carbon stock in then driven by the management practices[7]. Bearing in mind this approach, some MS justify that on the basis that management practices have not changed over time, no emissions are expected, and that if any, the change in carbon stock across time would result in a net removal . It should be noted that this assumption of "no change in management practices over time, is often not adequately documented.

With the purpose of highlighting potential cases of non-compliance, for empty cells in Mineral soils and Living biomass the average value of significance reported by other MS is used as a proxy. Irrespective of the category being key for these MS, if the proxy value is higher than 25%, these cases are considered potentially in a non-compliance situation (i.e. orange cells). The reason is that more efforts and information are often needed to justify the lack of emissions or removals in cultivated Mineral soils and demonstrate the lack of woody crops in the country. Nevertheless, these cases are only "potential" cases of non-compliance. A case-by-case study would be needed before judging whether leaving these cells empty complies or not with the Regulation (EU) 2018/841.

For Organic soils, empty cells indicate the absence of such soil type in the category. When reported, more than half of the countries used the default factor of the IPCC 2006 GL[8] in their estimates for Organic soils, which for some climate zones are larger than any country-specific value used. However, despite of the potential overestimation that could occur because of using the Tier 1 method, it is well known that cultivated organic soils are among the major sources of emissions, by unit of activity data, in the LULUCF sector, and therefore their significance is well demonstrated.

A similar situation occurs for Living biomass. The IPCC 2006 GL default value[9] for estimating carbon sequestration in woody crops has raised some concerns about the potential large overestimate that cause in the carbon sink. The overestimation introduced by MSs using the Tier 1 method in this pool, is then translated into the average of the significance value calculated at EU level. However, for those MS that report important areas of woody cross using higher Tiers, the living biomass pool appears also significant, which indicates that higher Tier methods seem needed for estimating carbon stock change in woody vegetation classified as Cropland.

Ultimately, the use of Tier 1 methods in Cropland seems to lead to an important number of non-compliance cases for MS for which this category resulted key. Specifically, 11 MS should increase the Tier method used in their estimates. Furthermore, 6 MS that do not report estimates for some pool could potentially be also in non-compliance situation according with the proxy value of significant used in this report. Or at least, their justification for not providing estimates should be further scrutinized.

For living biomass, the LIFE projects Medinet[10] that was carried out at European level in recent years has contributed to increase the accuracy of MS estimates in this category, mainly in the Mediterranean basin.

Particular attention should still be paid for the reporting of Organic soils in this category given the well-known significance of their emissions when they are cultivated. But also, for Mineral soils, more science-based knowledge is needed beyond the approach of the 2006 IPCC GL. To this end, the Tier 2 method introduced in the IPCC 2019 refinement should give MS the option to change their assumptions and assess in more detail whether cultivated mineral soils are releasing or sequestrating carbon.

[7] The 2006 IPCC methodology for estimating carbon stock changes in mineral soils is based on the difference of carbon stock in two moments on time. The estimation of carbon stock for T1 and T2 is done on the basis of an original carbon quantity (i.e., for pristine conditions) that is then reduced, or increased, according to management practices. When these practices remain constant over time, no difference in the stocks for T1 and T2 is derived so emissions and removals are considered in equilibrium and therefore not reported.

[8] No refinement has been carried out to this value in the IPCC 2019 Refinement (although some updates are available in the 2013 Wetland supplement that few MS have already incorporated).

[9] A correction of the default value has been introduced in the IPCC 2019 Refinement.

[10] https://www.lifemedinet.com/

Grassland remaining Grassland

Table 5: Reporting status of emissions and removals under the subcategory 4.C.1

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	----		*T1*		3%	*T2,3*	97%	*T1*
BE	----		*T1*		89%	*T2,3*	11%	*T1*
BG	4%	*T1*	*T1*		72%	*T2,3*	23%	*T1*
HR	----		*T1*		----		100%	*T1*
CY	100%	***T1***	*T1*		----			
CZ	----		*T1*		100%	*T2,3*		
DK	2%	*T2,3*	*T1*		*IE*	*T2,3*	98%	*T2,3*
EE	----		*T1*		----		100%	*T2,3*
FI	13%	*T2,3*	*T1*		----		87%	*T2,3*
FR	74%	*T2,3*	*T1*		26%	*T2,3*	*IE*	*T1*
DE	4%	*T2,3*	*T1*		1%	*T2,3*	96%	*T2,3*
GR	100%	*T2,3*	*T1*		----			
HU	----		*T1*		100%	*T2,3*		
IE	----		*T1*		13%	*T1*	87%	*T1*
IT	48%	*T2,3*	5%	*T2,3*	45%	*T2/3*	1%	*T1*
LV	7%	*T2,3*	1%	*T2,3*	----		92%	*T1*
LT	----		*T1*		----		*IE*	*T1*
LU	----		*T1*		----			
MT	----		*T1*		----			
NL	1%	*T2,3*	*T1*		0%	*T2,3*	98%	*T2,3*
PO	----		*T1*		32%	*T1*	68%	*T1*
PT	----		*T1*		100%	*T2,3*		
RO	5%	*T1*	*T1*		94%	*T2,3*	1%	*T1*
SK	----		*T1*		----			
SI	63%	*T2,3*	29%	*T2,3*	8%	*T1*		
ES	----		*T1*		----			
SE	25%	*T2,3*	28%	*T2,3*	21%	*T2,3*	26%	*T1*
IS	0,1%	*T2,3*	0,02%	*T2,3*	0,04%	*T1*	100%	*T1*
Average	**32%**		**13%**		**44%**		**68%**	

Notation key "IE"- included elsewhere- carbon stock changes are estimated and reported merged with another carbon pool; T – tier.

The land use category Grassland remaining grassland is reported for the year 2022 as key by 14 MS and Iceland.

With regards to the reporting of carbon pools, except Dead organic matter, all the other pools show high significance. On average well above the minimum threshold value that led to the requirement of using higher Tier methods. Nonetheless, Tier 1 methods are still widely used for estimating emissions and removals in this category.

As in previous categories, empty cells mostly relate with the implementation of the IPCC assumption of "equilibrium" under which, at long term grasslands do not accumulate carbon in Living biomass nor in Dead organic matter. Furthermore, many MS consider, as a potential conservative approach, that soils in grasslands are not subject to any management practice and, although they could result in carbon sequestration over time the magnitude of the sink is unknown and therefore not estimated. Empty cells for Organic soil, as in previous categories, indicate that the country does not report presence of organic soils in grassland areas.

For this category, except for Organic soils, the lack of quantitative estimates is in the table highlighted as potential non-compliance situations in case the carbon pool is on average significant, irrespective of whether the category is key or not, which is the case for Living biomass and Mineral soils. Or highlighted as a non-compliant situation

when the category is key, the country used a Tier 1 method to estimate the pool and its significance within the category appears higher than 25%.

Overall, it appears that in this category more efforts are needed to adequately justify the lack of emissions or removals in Mineral soils, and to demonstrate the lack of woody vegetation in grassland areas. A case-by-case study involving bilateral contacts with the MS will be needed before any judgement on whether their reporting complies Regulation (EU) 2018/841.

For MS reporting large areas of woody vegetation on grassland, given the different vegetation types in the category, and the wide variety of management practices to which they can be subject, it would be also necessary to develop better targeted country-specific factors for estimating carbon stock changes in this category.

As for Cropland, the IPCC 2019 Refinement and further developments should play a key role on improving the reporting of this category, including the implementation of the new method for estimating carbon stock changes in Mineral soils and some refined parameters in other pools.

More than half of the MS reporting emissions from Organic soils rely on IPCC default factors, and this leads to several non-compliance cases. Particular attention should be paid to Organic soils when grasslands are managed for cultivation of grass or grazing, practice that release important quantities of CO_2 through the oxidation of the soils organic matter.

Moreover, a more comprehensive picture on carbon fluxes in LULUCF is needed and future science developments should look at grassland organic soils and wetlands restoration, which are often not clearly separated within the land information systems (e.g., grasslands in mountain areas or bogs). The carbon fluxes in these ecosystems nowadays are not well reflected in the national GHG inventories.

Overall, this analysis shows that seven countries should adopt higher Tiers methods for estimating emissions and removals from Organic soils and Living biomass in this category. But also, 24 countries could potentially fall into a non-compliant situation since they do not estimate carbon stock changes for pools that are likely to be significant. Or at least, the justification for not providing estimates should be scrutinized.

Wetlands remaining Wetlands

Table 6: Reporting status of emissions and removals under the subcategory 4.D.1.

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT								
BE								
BG								
HR								
CY								
CZ								
DK							100%	*T1*
EE							100%	*T2/3*
FI	0,2%	*T2/3*					100%	*T2/3*
FR								
DE	0,1%	*T2/3*			0,004%	*T2/3*	100%	*T2/3*
GR								
HU	12%	*T1*			88%	*T1*		
IE	1%	*T2/3*					99%	*T2/3*
IT								
LV	30%	*T2/3*	11%	*T2/3*			60%	*T1*
LT							100%	*T1*
LU								
MT	30%	*T1*			38%	*T1*		
NL					100%	*T2/3*		
PO			74%	*T2,3*			26%	*T1*
PT								
RO	100%	*T1*						
SK								
SI								
ES							100%	*T1*
SE							100%	*T1*
IS							100%	*T1*

T – tier.

Wetlands remaining wetlands is reported for the year 2020 as a key by six MS and Iceland.

Except few cases that report carbon stock changes in Living Biomass and Dead Organic Matter, most of the emissions reported in this category results from Organic soils, and more precisely, from peat extraction activities that occur in northern countries.

As regards the estimation methods, most of the MS adopt Tier 2 approaches for estimating emissions and removals from Living biomass and Dead organic matter. And Tier 1 methods are widely used for Organic soils. In this case, default factors are taken either from the IPCC 2006 GL, or from the IPCC Wetlands supplement,[11] which cover the reporting GHG inventories from the drainage of soils, and in general from wetlands areas, introducing more recent science-based knowledge and refined methods and parameters.

The reporting of Wetlands remaining wetland is further subdivided in three sub-categories: (i) Peat extraction remaining peat extraction, (ii) Flooded land remaining flooded land, and (iii) Other wetlands remaining other wetlands. The IPCC 2006 GL only provide methods for estimating carbon stock changes in peat extraction areas. As a result, when a MS justifies the absence of peat extraction activities in its territory no emissions or removals

[11] IPCC 2014, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.

are reported under Wetlands remaining wetlands. This is well reflected in the table above showing plenty of empty.

As a result, considering the variety of biomes and climate conditions in which Wetlands areas take place, The reporting of LULUCF lacks a clear understanding of the carbon fluxes that occur in Wetlands. A gap in the LULUCF reporting that will have to be progressively closed with future science developments. Countries should also increase the transparency of the information reported under this category. Specifically, with better description of the lands included under each of the three sub-categories, and the management practices and origin of the reported carbon stock changes. In particular, when they refer to Other wetlands.

Given the low number of MS reporting carbon pools in Wetland, the use of a proxy value of significance is not fully meaningful in this category. Therefore, the table above just highlights non-compliant cases where the method used to report quantitative estimates suggest the need to move to higher Tiers, and the category is key. With this approach, three MS would need to move to higher Tier methods for the estimating carbon stock changes in Organic soils to comply with reporting requirements.

Settlements remaining Settlements

Table 7 : Reporting status of emissions and removals under the subcategory 4.E.1 .

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	*T1*		*T1*		*T1*			
BE	*T1*		*T1*		*T1*			
BG	*T1*		*T1*		*T1*			
HR	*T1*		*T1*		*T1*			
CY	*T1*		*T1*		*T1*			
CZ	*T1*		*T1*		*T1*			
DK	*T1*		*T1*		*T1*			
EE	*T1*		*T1*		*T1*			
FI	*T1*		*T1*		*T1*			
FR	100%	*T2/3*	*T1*		*T1*			
DE	*T1*		*T1*		*T1*		100%	*T2/3*
GR	*T1*		*T1*		*T1*			
HU	*T1*		*T1*		*T1*			
IE	*T1*		*T1*		*T1*			
IT	*T1*		*T1*		*T1*			
LV	89%	*T2/3*	7%	*T2/3*	*T1*		3%	*T1*
LT	*T1*		*T1*		*T1*			
LU	*T1*		*T1*		*T1*			
MT	*T1*		*T1*		*T1*			
NL	*T1*		*T1*		*T1*		100%	*T2/3*
PO	82%	*T2/3*	*T1*		*T1*		18%	*T2/3*
PT	*T1*		*T1*		*T1*			
RO	*T1*		*T1*		*T1*			
SK	*T1*		*T1*		*T1*			
SI	100%	*T2/3*	*T1*		*T1*			
ES	*T1*		*T1*		*T1*			
SE	100%	*T2/3*	*T1*		*T1*			
IS	*T1*		*T1*		*T1*			

T – tier.

Settlements remaining settlements is reported for the year 2020 as a key category by three MS.

Overall, most of the MS apply the assumption of equilibrium for reporting carbon stock change in those pools for which the IPCC 2006 GL allows to assume no net carbon stock change under its Tier 1 method. Moreover, in most countries Settlements are not located on organic soils. As a result, this category, for most of the countries, lacks information on carbon fluxes.

Given the low number of MS reporting information on carbon stock changes in the pools under Wetlands, the use of an average value of significance as a proxy of the significance of the pool is not fully meaningful here.

Moreover, because the IPCC 2006 GL do not provide default factors, but just the default assumption of equilibrium for pools different than Organic soils, no cases of non-compliance due to the use Tier 1 methods for significant pool in key categories were identified.

6. Summary and conclusions

To assess to which extent current reporting under the LULUCF represents is in a non-compliance situation towards requirements of Article 18 (4) of Regulation (EU) 2018/841, this assessment uses information included in the national GHG inventories to identify key categories, to calculate the significance of each reported carbon pool, and to categorize the Tier method used for the reporting of carbon stock changes in each pool.

Furthermore, it uses as a proxy of the significance of a non-reported pool the average value of the significances calculated from those MS that quantitatively estimate the pool in the category. The objective is to identify cases where the reporting of carbon pools appears as non-compliant (i.e., based on the significance reported) or potentially non-compliant (i.e., based on the proxy value of the significance) with reporting requirements of Article 18 (4).

Despite of the important efforts that have been devoted in the last decade which, undoubtedly have increased the completeness and accuracy of the information reported under the LULUCF sector, the 2022 submissions by countries show that an important number of pools continue being reported with Tier 1 method of the 2006 IPCC GL.

Tier 1 methods associate with estimates reported with low accuracy, due to the hight uncertainty of the emissions factors involved, or with the absence of estimates when the assumption of equilibrium applies. The last, although not considered "incomplete" from a reporting rules perspective, prevents a comprehensive understanding of the carbon fluxes that occur in the LULUCF sector.

The methods implemented vary considerably between land use sub-categories, pools and countries. Forest remaining forest has not any apparent situation of non-compliance with Article 18 (4) of the EU Regulation. The only significant carbon pool, Living biomass, is reported with higher Tier methods by all MS. However, beyond this analysis, additional reflections are worth, especially on Dead wood and Litter. Even if formally not significant, their omission from GHGIs is not easily justifiable in terms of data availability or resources needed. Moreover, in the case of Dead wood, Article 5 of Regulation (EU) 2018/841, requests to account always for its carbon stock change in the Managed Forest land category. Efforts should be devoted to work with MS to progressively obtain country-specific data. For instance, based on enhanced sharing data platforms, or increasing the capacity for using models and best practices.

For Cropland remaining cropland, all carbon pools appeared to be significant, except Dead organic matter. The assessment found many cases where the current reporting is non-compliance with requirements, mostly for Living biomass, and Organic soils, and of potential non-compliance, mostly on Mineral soils. In the latter case, many MS still do not report estimates for mineral soils under the assumption of "no change in management practices over time". However, this assumption is hardly realistic and often not well documented, and therefore it may jeopardize the compliance of MS with the Regulation (EU) 2018/841.

Also, for Grassland remaining grassland all carbon pools appeared to be significant, except Dead organic matter. And, also in this case, this assessment found many cases of non-compliance with reporting requirements, mostly for Organic soils, and of potential non-compliance, mostly on Living biomass and Mineral soils. In both cases, further efforts should be devoted to transparently document that the lack of woody vegetation in grassland justify the lack of quantitative estimates in Living biomass. But also, as for Cropland, to ensure that current management do not result in the release of CO_2 emissions from cultivated soils.

The limited reporting by countries of information on carbon fluxes that occur in Wetlands remaining wetlands and Settlements remaining settlements does not allow a complete application of the approach used in this assessment to raise non-compliance situations towards requirements of Article 18 (4) of Regulation (EU) 2018/841. However, among MS that report information under these categories, three MS will need to enhance the reporting of carbon fluxes from Organic soils in wetlands by using higher Tier methods.

Finally, irrespective of the land use category considered, the confidence in the reported numbers, and the comparability of the LULUCF sector would increase with the provision of transparent information on the level of

disaggregation used in the background information. For most of the MS the CRF table only provide only a net value of the emission or removals that occur in certain pool and category, but it is not clear if the background calculation considered different strata within the category, which is in most of the cases needed to estimate carbon stock changes with methods and factors that consider the variability of biomes within the land use category.

The results of this assessment should be seen as preliminary, both for the limits of the methodology used and for the difficulties on labelling under a single Tier the methodologies used by MS. But still, the outcomes are considered useful to give an idea of where the problems of non-compliance are likely to be, and where future capacity building efforts should focus.

To this regard, the IPCC 2019 Refinement introduces some new methods and refined default parameters. For instance, a new Tier 2 method for estimating carbon stock changes in agricultural mineral soils that may help to enhance the reporting of this pool and to verify the current reporting and assumptions that justify the lack of estimates.

To conclude, it seems clear from this assessment that several MS will need to move to higher Tier methods for the reporting of information on LULUCF to comply with reporting requirements of Article 18 (4) of Regulation (EU) 2018/841. Mainly MS using Tier 1 methods for estimating carbon stock changes in Living biomass, Mineral soils and Organic soils in Cropland and Grassland, but also those that use Tier 1 methods for Organic soils in Wetlands.

Moreover, Dead wood and Litter in Forest remaining forests are pools, whose reporting seems realistic. However, more efforts are needed to assess the most cost-effected way to do so. But ultimately, it must be considered that the same regulation, in its Article 5, includes the mandate of account for emissions and removals from Dead wood (also above-ground biomass, and HWPs) in the land accounting category of Managed Forest land.

Annex I: Likelihood of carbon pools for being significant in the different categories.

The table below shows carbon pools that are likely to be significant, therefore candidate for being reported with Tier 2/3 (Yes); or, depending on country-specific conditions (?); or, likely not significant (-).

To complete this table, the result of the assessment previously presented, the estimates reported by the MS in their GHG inventories, and where necessary, expert judgement have been used.

Category	Pools						
	Living biomass		Dead organic matter		Soil Organic Carbon in mineral soils (SOC min)	Soils Organic carbon in organic soils) (SOC org)	Harvested Wood Products (HWP)
	Above-ground biomass (AGB)	Below-ground biomass (BGB)	Dead wood (DW)	Litter (LT)			
FL-FL	Yes	Yes	-[3]	-[3]	-[3]	-	Yes
Land-FL	Yes	Yes	-[3]	-[3]	-[3]	Yes	-[4]
CL-CL	?[2]	-	-	-	Yes	Yes	-
Land-CL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
GL-GL	?[2]	-	-	-	Yes	Yes	-
Land-GL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
WL-WL	-	-	-	-	-	Yes	-
Land-WL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
SL-SL	-	-	-	-	-	-	-
Land-SL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-
Land-OL	?[1]	?[1]	?[1]	?[1]	Yes	Yes	-

1: depending on whether the conversion involves forest land or woody vegetation.

2: depending on whether there is presence of woody vegetation.

3: It is likely that, although these pools could represent an important carbon pool in the forest, they probably do not reach in most MS the minimum threshold value of significance (25-30% of the sub-category) that leads to the use of Tier 2/3.

4: except in few MS (e.g., PT, IE, ES) with quantitatively relevant areas of species with short-term rotations.

Annex II: information on Tier method by carbon pool and land use category.

This annex provides information on the Tier method used for estimating emissions and removals in each carbon pool and land use category, including the information for categories that involve land use changes. The information provided in the tables below is based on expert judgement, which is built on the understanding of the information included in individual national inventory reports.

Whenever available in the GHG inventories, the categorization of the Tier methods in this annex has used the same category provided by the MS in their inventories. However, in most cases due to the lack of this information, the categorization below is based on the understanding of the methodological descriptions included in the inventories. The lack of transparency in some national inventory reports hamper the categorization of the method under a single Tier. Therefore, the information from the tables below should be considered with caution. A double-check, that involve bilateral contact with the country who can provide further information on the methods implemented should serve to verify the information in the tables.

By last, the information in this file considers the inventory submitted in 2022 that refers to the year 2020. In few cases, a country reports certain pool only for a period of years of the time series but not for the year 2020. If this is the case, the notation key NO is included in the tables below for the pool concerned. This is also the case when countries report certain pool across the time series, but if in 2020 the land use conversion does not take place, the notation key NO is used for pools for which the reporting of carbon stock change is based on the concept of "instantaneous oxidation".

AUSTRIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	Tier 3	NO	Tier3	Tier3	NO	NO	Tier2	Tier2	Tier2	NO	Tier 3	Tier 2	Tier2	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO	Tier2	NO	Tier2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier2	NO	NO	NO	Tier2	NO	Tier2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

BELGIUM

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 1	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

BULGARIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
CL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
GL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	NO	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO				

CROATIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	NO	Tier 1	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

CYPRUS

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier2	Tier 1	Tier 1	Tier 1	NO	Tier2	NO	Tier 1	NO	NO	NO	NO	NO					Tier2	NO	Tier 1	NO	Tier2	Tier 1	Tier 1	NO
CL	NO	NO	NO	NO	NO	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO					Tier 1	Tier 1	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO
GL	Tier2	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier1	Tier 1	NO	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO
SL	Tier 2	NO	Tier 1	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO					Tier 1	Tier 1	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO
OL	Tier 2	NO	Tier 1	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO					Tier 1	NO	Tier 1	NO				

CZECHIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 3	NO	NO	Tier 3	Tier 3	Tier 3	NO	NO	NO	NO	NO
CL	Tier 3	Tier 3	Tier 3	Tier 3	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 3	Tier 3	Tier 3	Tier 3	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 3	Tier 3	Tier 3	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 3	Tier 3	Tier 3	Tier 3	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

DENMARK

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 1	Tier 3	Tier 3	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 2	Tier 1	Tier 3	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 3	Tier 3	Tier 3	NO	Tier 3	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	NO	NO	Tier 1	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

ESTONIA

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 2					Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2					NO	NO	Tier 2	Tier 2	NO	NO	Tier 2	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2					Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO
WL	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	NO	NO	NO	Tier 2	Tier 2	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO					Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO					NO	NO		NO				

FINLAND

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	NO	Tier 3	Tier 2	Tier 3	Tier 2	NO	Tier 3	Tier 3	Tier 2	NO	NO	NO	NO	NO	NO
CL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	NO	Tier 3	Tier 2	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO
GL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	NO	Tier 3	Tier 2	Tier 2	Tier 1	NO	Tier 2	NO	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO
WL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	Tier 3	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 3	NO	Tier 3	Tier 3	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

FRANCE

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO					Tier 2	NO	NO	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO					Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	Tier 1	Tier 2	Tier 1					Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO					Tier 2	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

GERMANY

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2				

GREECE

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO	Tier 2	Tier 2	Tier 1	NO	NO	NO	Tier 1	NO	Tier 2	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 1	NO
CL	Tier 2	NO	NO	NO	NO	Tier 2	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO
GL	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 1	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

HUNGARY

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO					Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	NO					NO	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO					NO	NO	Tier 2	NO	NO	NO	Tier 2	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

IRELAND

To:	FL					CL				GL				WL				SL				OL			
From:	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	NO	Tier 1	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	Tier 2	Tier 1
CL	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO				

ITALY

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO
CL	NO	NO	NO	NO	NO	Tier 2	Tier 1	Tier 2	Tier 1	NO	NO	NO	NO					NO	NO	NO	NO	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 2	Tier 2	Tier 1					Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

LATVIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2					Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO
CL	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 1	Tier 2	Tier 2	NO	Tier 1					Tier 2	Tier 2	NO	Tier 1	NO	NO	NO	NO
GL	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 1					Tier 2	Tier 2	NO	Tier 1	NO	NO	NO	NO
WL	Tier 2	Tier 2	Tier 2	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 1	Tier 2	Tier 2	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO
SL	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 2	Tier 2	Tier 1	Tier 1	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

LITHUANIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO
CL	Tier 2	NO	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	NO	NO	NO	NO	Tier 1	NO	Tier 2	Tier 1	NO	NO	NO	NO
GL	Tier 2	NO	Tier 2	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 1	NO	NO	NO	NO	Tier 1	Tier 1	Tier 2	Tier 1	NO	NO	Tier 2	Tier 1
WL	Tier 2	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	NO	Tier 2	Tier 1	NO	Tier 1	Tier 2	Tier 1	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO	Tier 1	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO				

LUXEMBOURG

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO
GL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO
WL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	NO	NO	NO	NO
SL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO
OL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO				

MALTA

From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier2	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO	NO	NO	NO	NO
CL	Tier2	NO	Tier 1	NO	NO	Tier 2	Tier 1	Tier 1	NO	Tier 2	NO	Tier 1	NO					NO	NO	Tier 1	NO	NO	NO	Tier 1	NO
GL	Tier2	NO	Tier 1	NO	NO	Tier 2	NO	Tier 1	NO	Tier 1	Tier 1	NO	NO					NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier1	NO	Tier1	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO					NO	NO	NO	NO				

NETHERLANDS

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2					Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 2	NO	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 2	NO	Tier 2	Tier 2					Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2
GL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	Tier 1	Tier 2	Tier 2					Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	Tier 2	Tier 2
WL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	NO	NO	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2
SL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2					Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	Tier 2	Tier 2
OL	Tier 2	Tier 2	NO	NO	Tier 2	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2					NO	NO	Tier 2	Tier 2				

POLAND

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO					Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO
CL	Tier 2	NO	NO	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1					Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
GL	Tier 2	NO	NO	Tier 1	Tier 1	Tier 1	NO	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1					Tier 1	NO	Tier 1	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1					Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO
OL	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	Tier 1					NO	NO	NO	NO				

PORTUGAL

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
GL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 1	Tier 1	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
WL	Tier 2	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	NO	NO
SL	Tier 2	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 2	NO	NO
OL	Tier 2	Tier 2	Tier 2	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO				

ROMANIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	Tier 2	Tiier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO
CL	Tier 3	Tier 2	NO	Tier 2	NO	Tier 2	Tier 1	Tier 1	Tier 1	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	NO	Tier 1	NO	Tier 2	Tier 2	NO	NO
GL	Tier 3	Tier 2	NO	Tier 2	NO	Tier 2	Tier 2	Tier 1	NO	Tier 1	Tier 1	Tier 2	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO
WL	Tier 3	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO
SL	Tier 3	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	Tier1	Tier 1	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO
OL	NO	NO	NO	NO	NO	Tier 2	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	Tier 1	NO	NO	NO	Tier 1	NO				

SLOVAKIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 2	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO
CL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO
GL	Tier 2	NO	Tier 2	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO	Tier 2	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	NO	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO				

SLOVENIA

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	NO	NO	Tier 2	NO
CL	NO	NO	NO	NO	NO	Tier 1	Tier 2	Tier 1	Tier 1	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 2	Tier 1	Tier 1	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier1	NO	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 1	Tier 2	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	Tier 1	Tier 2	Tier 2	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO
OL	Tier 2	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO				

SPAIN

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	NO	Tier 2	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	NO	NO	NO	NO
CL	Tier 1	Tier 1	Tier 2	Tier 2	NO	Tier 2	Tier 1	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
GL	Tier 1	Tier 1	Tier 2	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	Tier 1	Tier 1	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 2	NO
WL	Tier 1	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 1	Tier 1	Tier 1	Tier 2	NO	Tier 1	Tier 1	Tier 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				

SWEDEN

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 3	Tier 3	Tier 3	Tier 3	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	NO	Tier 2	Tier 2
CL	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	Tier 3	Tier 3	Tier 3	Tier 1	Tier 3	Tier 2	NO	NO	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
GL	Tier 3	Tier 2	Tier 2	Tier 2	NO	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 3	Tier 1	NO	NO	NO	NO	Tier 2	NO	Tier 2	NO	NO	NO	NO	NO
WL	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	Tier 3	Tier 2	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	Tier 2	Tier 3	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 3	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 3	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	NO	Tier 2	NO				

ICELAND

To: / From:	FL					CL				GL				WL				SL				OL			
	LB	DW	LT	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
FL	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO
CL	NO	NO	NO	NO	NO	NO	Tier 1	Tier 2	Tier 1	Tier 2	Tier 2	Tier 2	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
GL	Tier 2	NO	Tier 2	Tier 2	Tier 1	Tier 1	NO	Tier 2	Tier 1	Tier 3	Tier 2	Tier 1	Tier 1	NO	NO	Tier 2	Tier 1		NO	NO	NO	NO	NO	NO	NO
WL	NO	NO	NO	NO	NO	Tier 1	Tier 2	Tier 2	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	Tier 1	NO	NO	NO	NO	NO	NO	NO	NO
SL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Tier 1	Tier 1	Tier 1	NO	NO	NO	NO	NO
OL	Tier 2	Tier 2	Tier 2	Tier 2	NO	NO	NO	NO	NO	Tier 2	Tier 2	Tier 2	NO	NO	NO	Tier 2	NO	NO	NO	NO	NO				

Annex III: Significance of carbon pools when HWP is considered a pool in 4.A.1

The table below shows the significance of the carbon pools for the category Forest land remaining Forest land when HWPs is considered as another carbon pool within the category.

Because information on HWPs, currently reported under the Convention, does not distinguish the land use category in which the wood originates, but instead it is reported as an additional category of the LULUCF sector, the table below assumes that the entire quantity of HWPs originates from the category Forest land remaining forest land. This assumption is well supported by information reported by MS under the KP-LULUCF where the entire HWP information is reported under the Forest management activity with the only exception of a negligible quantity reported under Afforestation and reforestation.

MS	Living biomass	Dead wood	Litter	SOC mineral	SOC organic	HWP
AT	52%	3%	0%	24%	0%	21%
BE	77%	0%	0%	0%	0%	23%
BG	87%	5%	0%	0%	0%	8%
HR	95%	0%	0%	0%	0%	5%
CY	78%	0%	0%	0%	0%	22%
CZ	71%	4%	9%	2%	0%	14%
DK	58%	3%	20%	0%	10%	8%
EE	56%	3%	0%	21%	7%	13%
FI	60%	0%	0%	16%	16%	8%
FR	87%	8%	0%	0%	0%	6%
DE	58%	5%	1%	24%	4%	9%
GR	90%	0%	0%	0%	0%	10%
HU	81%	11%	0%	0%	3%	4%
IE	42%	0%	6%	1%	34%	18%
IT	95%	1%	2%	0%	0%	2%
LV	58%	21%	0%	0%	6%	14%
LT	74%	11%	0%	0%	0%	15%
LU	86%	10%	0%	0%	0%	4%
MT	100%	0%	0%	0%	0%	0%
NL	75%	5%	13%	0%	3%	5%
PO	79%	3%	0%	8%	2%	8%
PT	90%	0%	1%	1%	0%	9%
RO	93%	0%	0%	0%	0%	7%
SK	79%	8%	0%	0%	0%	12%
SI	88%	9%	0%	0%	0%	2%
ES	93%	0%	0%	0%	0%	7%
SE	45%	10%	11%	18%	8%	10%
SI	99%	0%	0%	0%	1%	0%
Average	**77%**	**4%**	**2%**	**4%**	**3%**	**9%**

Malta does not report HWPs because “commercial login does not occur in its territory”. This approach, in principle, appears as a non-compliance with Article 5 of the Regulation 841/2018

Annex IV: Summary of information on data sources used for land representation

This annex aims to provide a summary of information on the main data sources and methods used by the MS to obtain activity data information for the LULUCF sector.

Based on the expert judgment of the information included in the national inventory reports, it attempts to identifying when satellite data have been used, as the main data source and method for acquiring information on land use categories and changes. It should be noted that the information included in national inventory reports is not always enough to understand the full process and format of the data sources involved in the acquisition of this information. Therefore, our consideration of whether satellite data have been used should be carefully considered. For instance, national inventory reports often include descriptions of cartography and land use maps, but they do not provide further information on which is the background data used to create such cartography and maps.

Member State	***Use satellite data***	***Description***
Austria	Partly yes	*Difference statistical surveys used in a hierarchical order. Information taken from national forest inventories and STATISTIK AUSTRIA. Also, expert judgements are involved for certain land use changes. The land-use changes between grassland and cropland based on a grid point survey by using the INSPIRE grid to sample geographic land use information in IACS/LPIS.*
Belgium	Partly yes	*The method adopted for monitoring of the land-use is a grid of points on which a diagnosis of occupation/land use is carried out for the various dates of reference. The diagnoses are carried out following vectorial cartographic layers or raster bearing on sets of themes related to the land use*
Croatia	NO	*Several data sources are used to obtain information on lands, among other Forest management plans, Corine land cover, Bureau of Statistics and State Geodetic Administration's Register.*
Bulgaria	NO	*Several data sources used in Bulgaria for obtaining information on lands. For Forest land information is mainly taken from Forest Management Plans. For other land use categories information from the Bulgarian Survey of the Agricultural and Economic Conjuncture, LPIS, and National Statistical Institute is used.*
Cyprus	NO	*Information on total land use areas by category is obtained from three CORINE land cover data sets covering the years 2000, 2006 and 2012. Information in total and on land use change for year in between is retrieved by inter and extrapolation.*
Czechia	NO	*Land information is exclusively based on the cadastral land use information of the Czech Office for Surveying, Mapping and Cadastre. The Czech land-use representation and the land-use change identification system use annually updated COSMC data, elaborated at the level of about 13 thousand individual cadastral units.*
Denmark	Partly yes	*The land use matrix uses the latest official vector maps from Danish Geodata Agency and is updated annually since 2011. The information is taken from difference data sources (e.g., Danish building register, Danish Area Information System, LPIS) applied in a hierarchical order. Mapping of forest area in 1990 and 2005 was conducted in 2011 based on Landsat 5 Thematic Mapper.*

Member State	*Use satellite data*	*Description*
Estonia	NO	*The national forest inventory is a systematic collection information on randomly based sample plots that cover the whole country and all land-use categories. The nationally classified NFI sample plots are reclassified into IPCC land-use categories, and this allows the construction of the land use matrix.*
Finland	Partly yes	*Information on land-use areas is calculated from national forest inventory (NFI) data covering the entire country. In detection of land-use changes the NFI data is supported by spatial data, e.g., aerial photographs and satellite images.*
France	Partly yes	*Land information on the continental territory is taken from TERUTI surveys follow an annual statistical method based on the determination of sampling points distributed throughout the territory. Each of the points is visited in the field by an investigator who determines, by observation, the nature of the land use. Observation of the same points repeated every year. For oversea territories satellite information is used.*
Germany	Partly yes	*The land use matrix is based on a sample-based system. A grid of points is used, and the land category is classified based on information from the Basic Digital Landscape Model. However, where necessary some other data sources were also used. Including Corine land Cover and land-cover model information.*
Greece	NO	*Information on land use areas is obtained from several data sources including the national forest inventory, Afforestation registries, Agricultural Statistics of Greece, Forest Management Plans Database, Corine land cover datasets, and others. For the land-use change matrices the results of two "Distribution of the Country's Area by Basic Categories of Land Use" projects been used. Both constitute complete, cadaster surveys providing information on the distribution of land areas per each land use category.*
Hungary	NO	*Information on areas and Land use changes is taken for Corine land cover, National Forest inventories and HCSO Statistical Yearbooks for Agriculture.*
Ireland	Partly yes	*Information on areas and land use changes is derived using in a hierarchical order a combination of Corine land cover, National Forest inventories , LPIS, maps and aerial photography datasets and other national statistics.*
Italy	NO	*Information on land use and land use changes is based on national forest inventories (1985, 2005, 2012) and from the National Land-Use Inventory IUTI referring to years 1990, 2000 and 2008. Additional data on non-forest categories were collected for the year 2012, through the first phase survey in the framework of the III NFI that was carried out on an IUTI's sub grid.*
Latvia	Partly yes	*Information on area of the categories since 2009 comes from National Forest inventories. Information on grassland, cropland, wetlands, and other lands provided by the State Land Service of Latvia are used for reference to estimate potential errors in the NFI. Until submission 2019 conversion of cropland to grassland was estimated using remote sensing method comparing vegetation index in the NFI sample plots listed as cropland or grassland.*
Lithuania	NO	*Data from NFI is used for monitoring and reporting of land use and land use changes. Dataset on all land use and land use changes is collected using NFI since 2012, NFI grid covering not only forest land but also other land use categories of the whole country territory since then. For the period of 1990-2011 results are presented using data of the studies conducted.*

Member State	*Use satellite data*	*Description*
Luxembourg	YES	*The base data used is the so-called OBS map data "Occupation Biophysique du Sol". This is a detailed land use / land cover map in digital format covering the entire territory of Luxembourg. There are 3 versions of the OBS. The first OBS89 was collected in the field over several years. The second the OBS99 was collected based on aerial color infra-red ortho-photos and some field surveying. The third set OBS07 uses very high-resolution satellite images (1m pixel size) of the satellite IKONOS. The latest dataset on land use in Luxembourg is the LU12 is based on satellite images from the Rapid Eye (RE) space segment.*
Malta	NO	*Data on land-use transition matrices was obtained from CLC (1990, 2000, 2006 and 2012), with additional data relating to Cropland from the National Statistics Office such as the Agriculture Censuses and Farm Structure surveys, the latter providing more recent data for the Cropland category. CLC data was obtained from the local competent authority Planning Authority (PA) responsible for the CLC, rather than the EEA directly. The latest CLC report available for the purpose of this submission was the 2012 CLC.*
Netherlands	YES	*Netherlands applies full and spatially explicit land use mapping that allows geographical stratification at 25mx25m resolution. Harmonized and validated digital topographical maps representing land use on 1 January 1990, 2004, 2009, 2013 and 2017 were used for wall-to-wall map overlays resulting in four national scale land use and land use change matrices. The information concerning the activities and land use categories, covers the entire territorial (land and water) surface area of the Netherlands. The sum of all land use categories is constant.*
Poland	NO	*Data on land and land areas is based on statistical data presented in statistical journals published by Statistics Poland. The data relating to the land area by the type of land use is based on data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land.*
Portugal	NO	*Information on areas and changes is divided into two different time periods: 1970-1995 and 1995-2018. The first period is estimated using spatially explicit land-use data, while for the second only an approach 1 is used. The most recent period uses the Cartografia de Ocupação de Solo produced using the full aerial photography coverage. For pre-1995 the information used includes NFIs, and agricultural census. And for the other categories it is assumed a constant area as in 1995. For oversea territories information is rather similar but involving also CLC.*
Romania	Partly yes	*Information on land use areas is based on explicit geospatial maps that use LPIS/IACS and CLC information. This is supported by information acquired using Lidar techniques. Information from other national statistics as the national forest inventory and MADR is also used.*
Slovakia	NO	*The identification of the LULUCF categories is based on the data from the Geodesy, Cartography and Cadaster Authority of the Slovak Republic (GCCA), which represents a key data source for identification of spatial extent of individual categories. The GCCA annually issues the Statistical Yearbook of the Soil Resources in the Slovak Republic. It provides updated cadastral information of the LULUCF areas.*

Member State	*Use satellite data*	*Description*
Slovenia	Partly yes	*A dedicated project interprets land uses based on national classification in years 2002, 2006 and 2012. Two matrices were produced accordingly. Land use estimation is based on digital orthophoto images on a systematic 1 km x 1 km grid. Other sources of spatial information, such as land cover from satellite images (Landsat), corresponding land-use maps of ALUM and LPIS and other maps were also used for verification of the problematic points. For the period until 2002 data on land use from the Statistical Yearbook of the Statistical Office of the Republic of Slovenia have been used, as well as forest data of Slovenia Forest Service as no digital orthophotos are available for this period.*
Spain	No	*The procedure used for estimating the areas and land use changes is based on different cartographic sources. Including a statistical adjustment applied with land afforestation. The main data sources are Corine land cover, national forest maps, Nacional Forest Inventories, and Yearbooks of Agrarian Statistics*
Sweden	Partly yes	*The NFI has monitored land-use categories since 1983. Based on permanent sample plots, it is possible to trace both gross and net land-use transfers from 1983 to 2014. After 2014, only net changes can be estimated since 2014 is currently the last year with a full sample record. All land areas are included in the field inventory except high mountains and urban land. The latter land-use categories are inventoried by remote sensing to be able to correctly determine areas. It is assumed that their relative importance is negligible.*
Iceland	Yes	*Several data sources are involved across the time series. Information on land use is taken from the Icelandic Geographical Land Use Database (IGLUD), activity data and mapping on afforestation and deforestation, maps of natural birch forest and shrubland, activity data and maps on revegetation, Afforestation and Reforestation registries. The Habitat Type Map (HMI), adopted in 2019 as the IGLUD base map, is a hybrid map applying remote sensing of RapidEye™ satellite images from 2011-2013, but also made use of other images as SPOT-5 from 2002-2010, and LANDSAT 8 from 2013-2016.*

Annex 3

Summary of Kyoto Protocol submissions: reporting and accounting of LULUCF in the 2nd Commitment Period

JRC presentation in Working Group 5 meeting by S. Rossi et al.

Summary of Kyoto Protocol submissions: reporting and accounting of LULUCF in the 2nd Commitment Period

Simone Rossi, Anu Korosuo, Giacomo Grassi

Joint Research Centre (JRC), European Commission

WG5 – 19 April 2023

European Commission

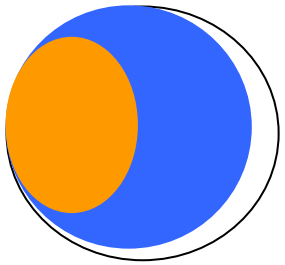
Outline

- Introduction to the LULUCF accounting in the Kyoto Protocol
- Reported and accounted quantities by Member State, 2013-2020

LULUCF world

Slide from 2011

	UNFCCC	Kyoto Protocol		
	Reporting	**Reporting**	**Accounting 2008-2012**	**Accounting 2012-2020**
AGRI CULTURE	CH_4 and N_20 from soils, livestock, manure	= UNFCCC	As other GHG sectors (relative to 1990)	
LULUCF	GHG from 6 **land uses** (all managed lands) FL Forest land CL Cropland (CO2) GL Grassland (CO2) WL Wetland S Settlements O Other	GHG only from direct human induced **activities** AR Aff/Reforestation D Deforestation FM Forest management CM Cropland manag. (CO2) GM Grazing land manag. (CO2) RV Revegetation	Incomplete, complex **Mandatory, gross-net** → **Voluntary, gross-net + cap** **Voluntary, relative to 1990 (net-net)**	More complete, very complex **Mandatory, gross-net** **Mandatory, Forest Management Reference Level** **Voluntary, relative to 1990 (net-net)**

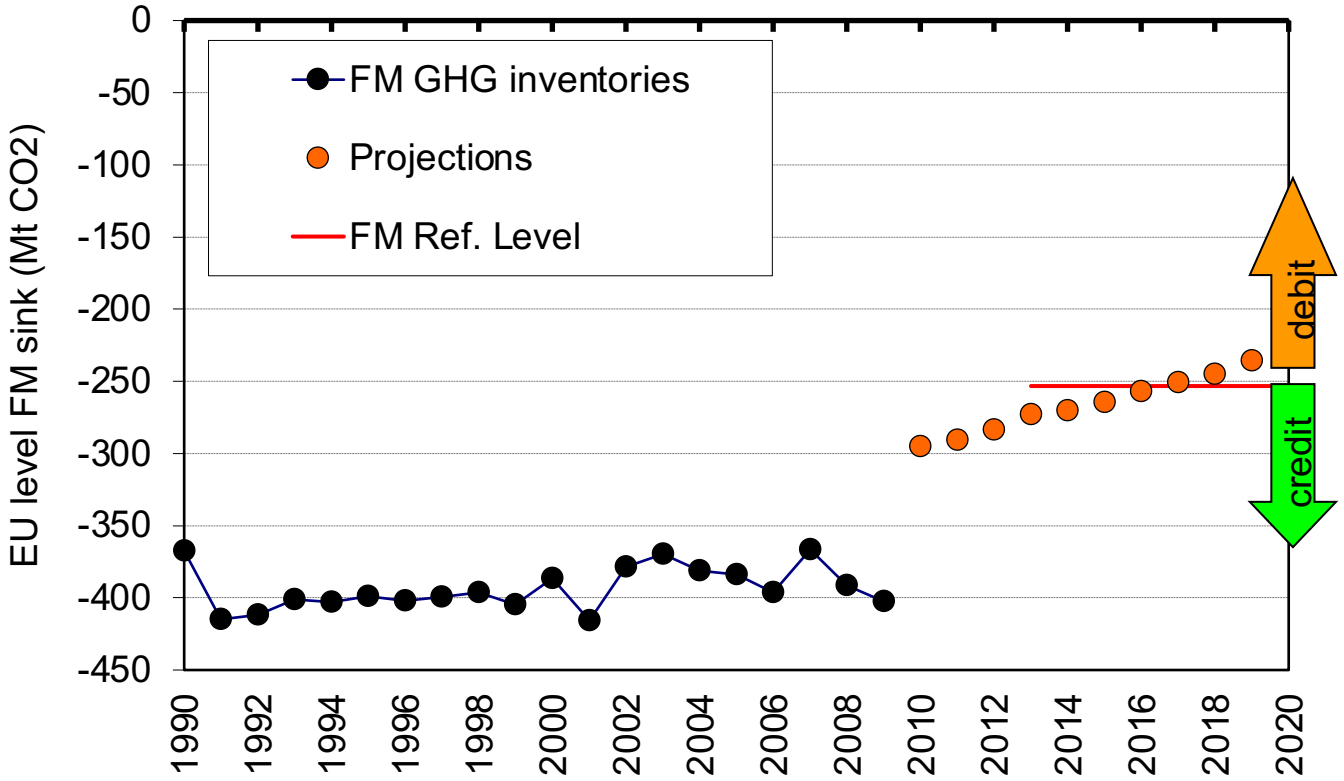


- Total GHG in a country
- GHG reported under UNFCCC
- GHG accounted for under KP

Mandatory reporting under **EU Decision 529/2013**

European Commission

The **Forest Management Reference Level** (**FMRL**) is a value of average annual net emissions and removals from FM in the 2nd Commitment Period of the Kyoto Protocol (CP2, 2013-2020) against which the net emissions and removals reported for FM during CP2 will be compared for accounting purposes.



Approaches to set FMRL in the EU:

1. Model-based projected BAU, with:
   a) country-specific methodology,
   b) common methodological approach (JRC-IIASA-EFI)
2. Projections based on the elaboration (average/extrapolation) of historical data from GHG inventories, assumed as proxy for a BAU

TECHNICAL CORRECTIONS to FMRL

If methodological inconsistency exists between the FMRL and the FM reporting during the CP (e.g. because data or methods changed), to ensure consistency, Parties are required to apply a Technical Correction.

The **Technical Correction** is a net value of emissions or removals, which is added at the time of accounting to the original FMRL to ensure that accounted emissions / removals will not reflect the impact of methodological inconsistencies

Technical Correction = $FMRL_{corr}$ - FMRL

European Commission

Annual European Union greenhouse gas inventory 1990–2020 and inventory report 2022

Submission to the UNFCCC Secretariat

European Environment Agency

11 KP-LULUCF

- General information on KP-LULUCF activities, completeness of reporting of carbon pools and GHG sources, areas reported for each activity, accounting quantities, key category analysis, forest definition.
- Information related to the land representation approach for KP-LULUCF activities.
- Activity-specific information, (i.e., methodologies for estimating carbon stock changes and other sources of GHG emissions, justification for omitting carbon pools, and other methodological issues).
- A synthesis of supplementary information required, i.e., natural disturbances, HWP, methods for constructing the FMRLs, technical corrections, conversion from natural to planted forests.

The EU will neither issue, nor cancel units based on reported emissions and removals from activities under Article 3(3) and (4).

European Commission

Elected activities

Country	Elected activities under Art 3(4) 1	Accounting frequency
Austria	---	end of CP
Belgium	---	end of CP
Bulgaria	---	end of CP
Croatia	---	end of CP
Cyprus	---	end of CP
Czechia	---	end of CP
Denmark	CM, GM	annual
Estonia	---	end of CP
Finland	---	end of CP
France	---	end of CP
Germany	CM, GM	end of CP
Greece	---	end of CP
Hungary	---	annual
Ireland	CM, GM	end of CP
Italy	CM, GM	end of CP
Latvia	---	end of CP
Lithuania	---	end of CP
Luxembourg	---	end of CP
Malta	---	end of CP
Netherlands	---	end of CP
Poland	---	end of CP
Portugal	CM, GM	end of CP
Romania	RV	end of CP
Slovakia	---	end of CP
Slovenia	---	end of CP
Spain	CM	end of CP
Sweden	---	end of CP

FM: forest management,
CM: cropland management,
GM: grazing land management,
RV: revegetation,
WDR: wetlands drainage and rewetting.

Area reported

Country	Art. 3.3 activities		Art. 3.4 activities					TOTAL Area under KP
	AR	D	FM	CM	GM	RV	WDR	
Austria	254,2	82,3	3.803,6					4.140,2
Belgium	35,0	34,0	672,8					741,8
Bulgaria	120,4	6,5	3.798,7					3.925,6
Croatia	63,7	4,8	2.321,4					2.389,9
Cyprus	0,4	0,0	157,9					158,3
Czechia	69,5	19,6	2.607,9					2.696,9
Denmark	112,3	15,5	529,0	2.857,4	181,9			3.696,2
Estonia	56,7	34,1	2.386,8					2.477,6
Finland	212,1	472,9	21.605,6					22.290,6
France	2.396,3	1.153,1	20.592,9					24.142,3
Germany	325,8	135,6	10.692,5	13.279,3	7.022,0			31.455,3
Greece	35,3	5,9	1.247,7					1.288,9
Hungary	177,9	46,5	1.879,1					2.103,6
Ireland	333,0	20,8	446,0	743,9	4.220,4			5.764,1
Italy	2.136,6	69,9	7.441,9	8.999,8	3.948,7			22.596,9
Latvia	120,6	103,3	3.120,9					3.344,8
Lithuania	57,3	5,7	2.164,9					2.228,0
Luxembourg*	0,2	0,1	88,9					89,2
Malta	0,1	NO,NA	0,1					0,1
Netherlands	48,4	79,3	305,7					433,4
Poland	797,3	29,8	8.645,5					9.472,7
Portugal	488,3	286,6	3.852,5	2.256,3	1.745,8			8.629,6
Romania	46,1	78,3	6.943,4			94,4		7.162,2
Slovakia	51,0	9,1	1.976,9					2.037,0
Slovenia	NO,NA	27,3	1.164,2					1.191,5
Spain	1.277,0	131,1	14.418,7	20.192,0				36.018,7
Sweden	334,1	350,2	27.902,2					28.586,4
EU	9.549,8	3.202,2	150.767,5	48.328,7	17.118,9	94,4		229.061,6

FMRL values, Technical correction and approach used for FMRL

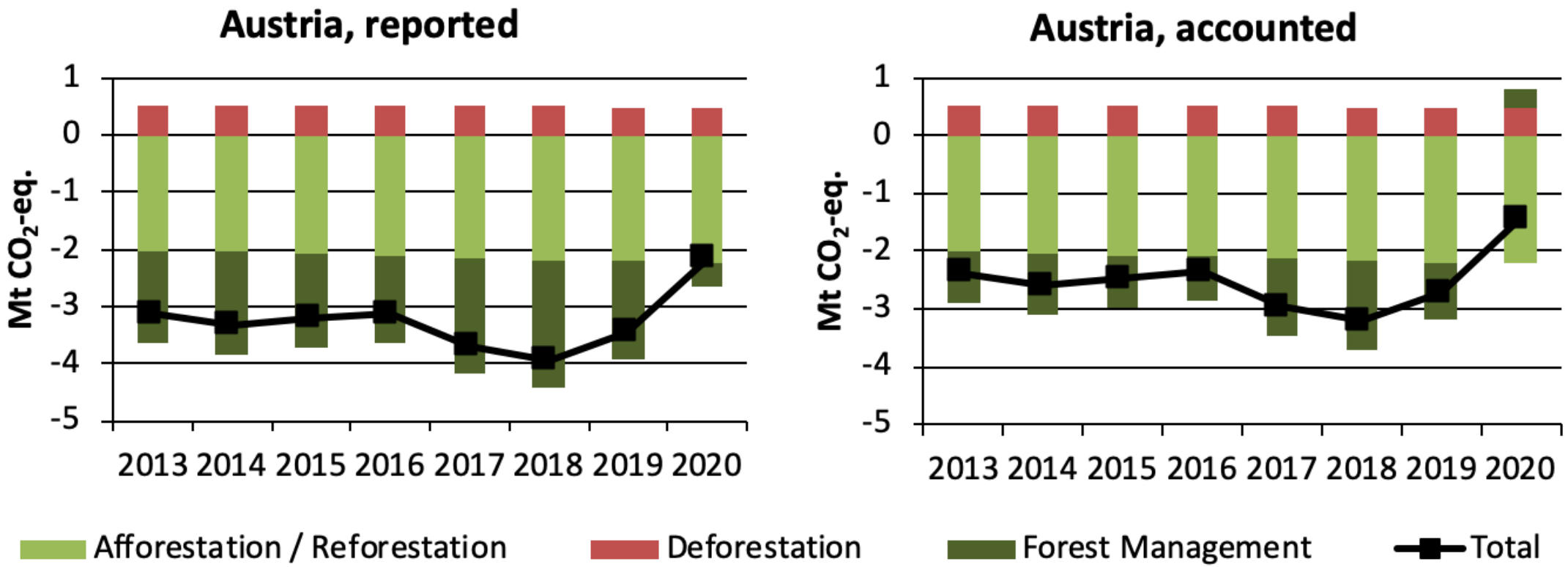
Country	Value inscribed in the Appendix to the annex to decision 2/CMP.7 (kt CO_2 eq/yr.)	Technical correction	FMRL based on projections under a "Business-as-usual" scenario		
			Model-based projections using country-specific methodology	Model-based projections using "JRC approach"	Projections based on historical data assumed as proxy for a "business-as-usual"
Austria	-6516	5774	X		
Belgium	-2499	1010		X	
Bulgaria	-7950	-2942		X	
Croatia	-6289	97	X		
Cyprus	-157	78			X
Czechia	-4686	-225		X	
Denmark	409	-83	X		
Estonia	-2741	2164		X	
Finland	-20466	-9198	X		
France	-67410	23318		X	
Germany	-22418	6331	X		
Greece	-1830	210			X
Hungary	-1000	-334		X	
Ireland	-142	170	X		
Italy	-22166	-1680		X	
Latvia	-16302	14829		X	
Lithuania	-4552	-922		X	
Luxembourg	-418	40		X	
Malta	-49	49			X
Netherlands	-1425	337		X	
Poland	-27133	-7082	X		
Portugal	-6830	6703	X		
Romania	-15793	-2578		X	
Slovakia	-1084	-3723		X	
Slovenia	-3171	-161	X		
Spain	-23100	-4261		X	
Sweden	-41336	8943	X		

Reported and accounted quantities by Member State

(updated Dec 2022)

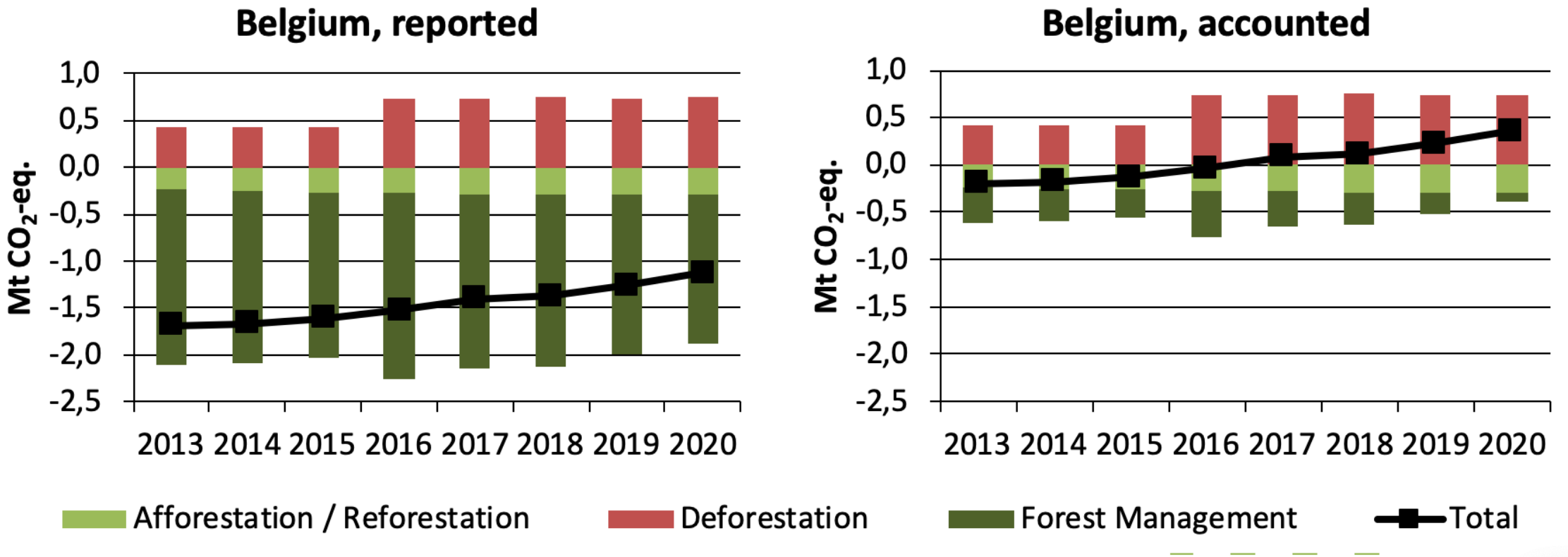
European Commission

Austria



- Average removals 3.25 Mt CO_2eq/year (1% of EU27 removals), average credits 2.51 Mt CO_2eq/year (3% of EU27 credits).
- Reported net removals and accounted net credits increase moderately until 2018 and then show a decline.
- FM shows credits in all years except 2020. Austria is one of 14 EU Member States with debits by FM for at least one year.
- Main causes of Forest sink reduction can be identified in increased harvest and natural disturbances.

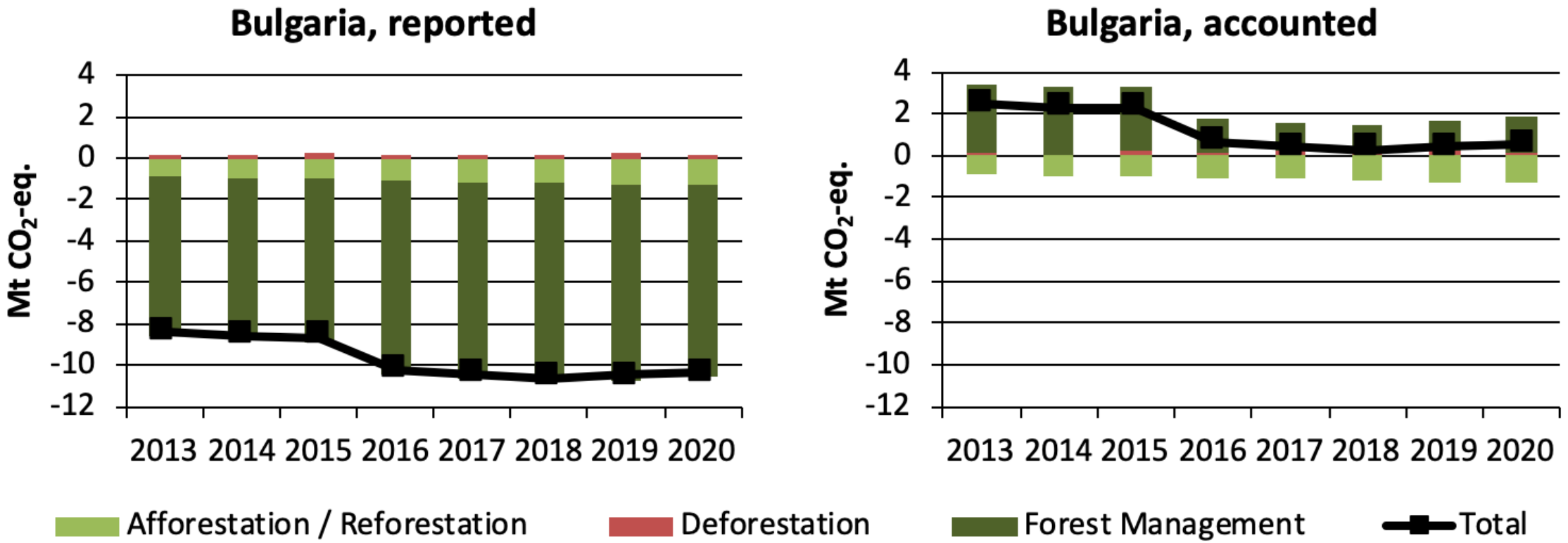
Belgium



- **Average removals 1.46 Mt CO_2eq/year (0.5% of EU27 removals), average debit 0.03 Mt CO_2eq/year (1.86% of EU27 debits).**
- **Reported sinks show an overall decreasing trend that turns into net accounting debits from 2017 onwards. Belgium is one of eight EU Member States with average net debits over the 2013-2020 period.**
- **Debits by D dominate the accounting. Credits by FM vary and decrease in recent years**

European Commission

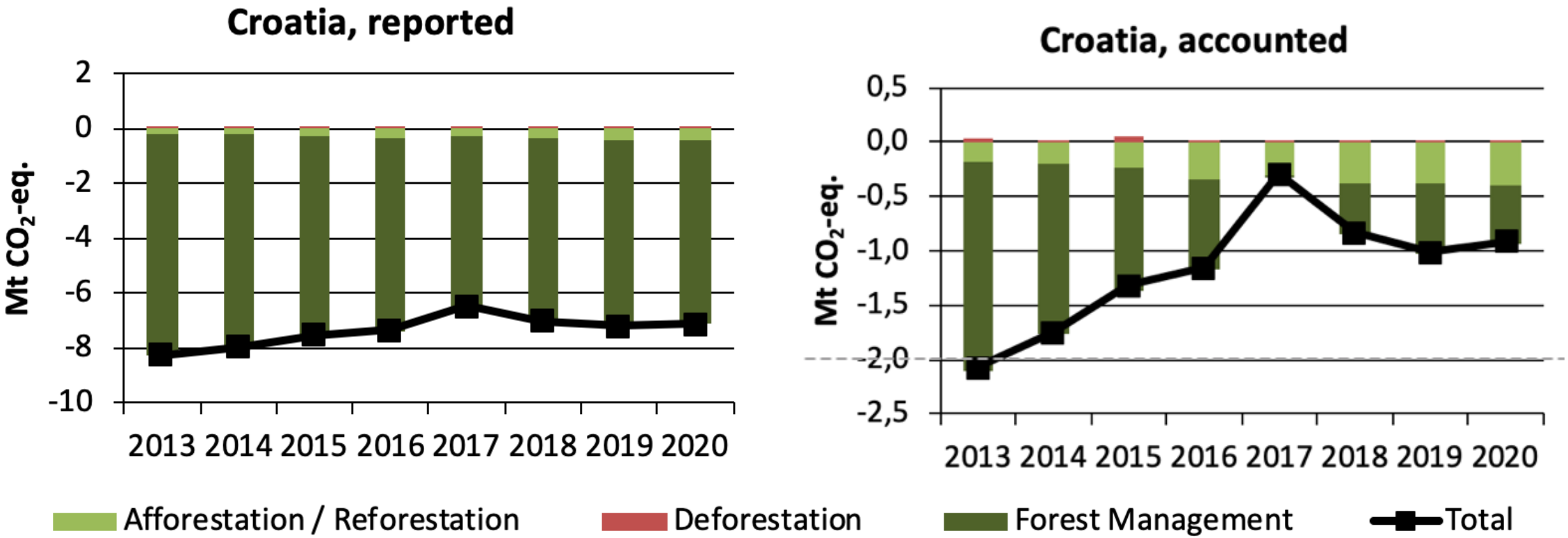
Bulgaria



- Average removals 9.7 Mt CO_2eq/year (3% of EU27 removals), average debit 1.2 Mt CO_2eq/year (6.8% of EU27 debits).
- Reported net removals show minor variations with a slightly increasing trend overall.
- In terms of accounting, FM is a net debit.
- The dominating reported activity is FM, followed by AR, while emissions by D are small.
- LULUCF is a net debit, substantailly decreasing after 2015.

European Commission

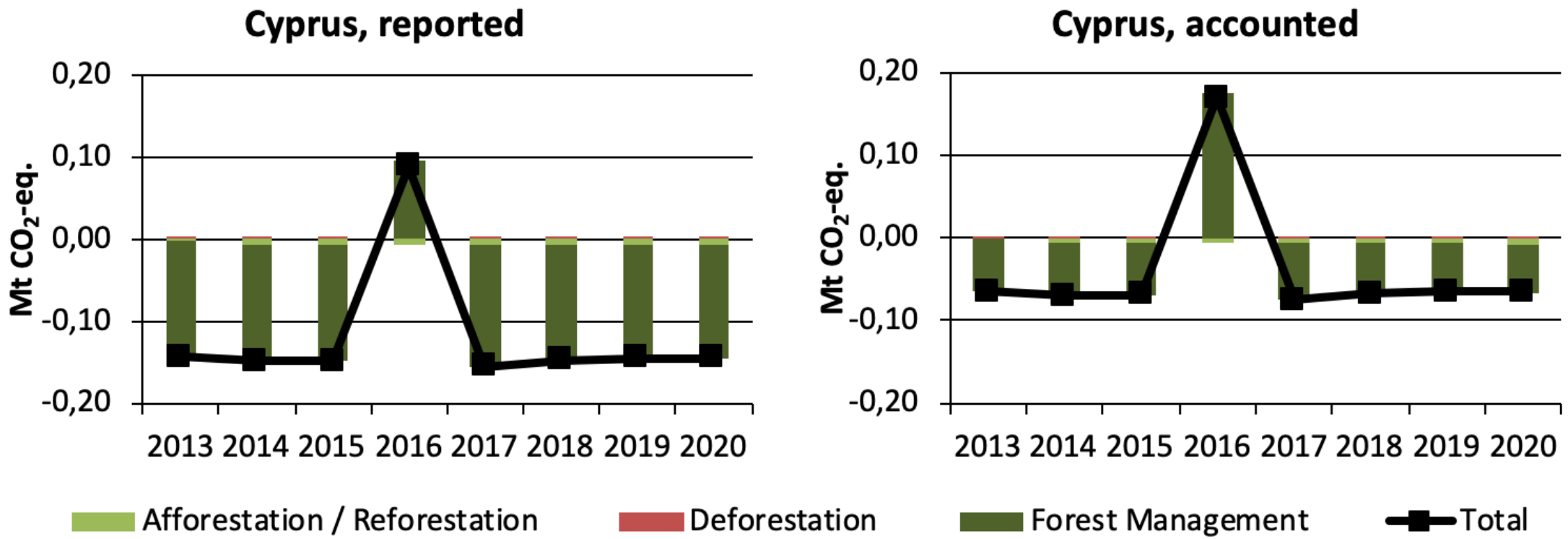
Croatia



- Average net removals 7.4 Mt CO_2eq/year (2.4% of EU27 removals), average credit 1.2 Mt CO_2eq/year (1.4% of EU27 net credits).
- Reported net removals show a slightly decreasing trend. This pattern is more pronounced for accounted net credits.
- FM dominates the reporting and the accounting, with an overall reduction in removals and credits and a noticeable drop in 2017, possibly caused by extensive fires in the Split region.
- Croatia performed substantial recalculations among its submissions from May 2022 to October 2022.

European Commission

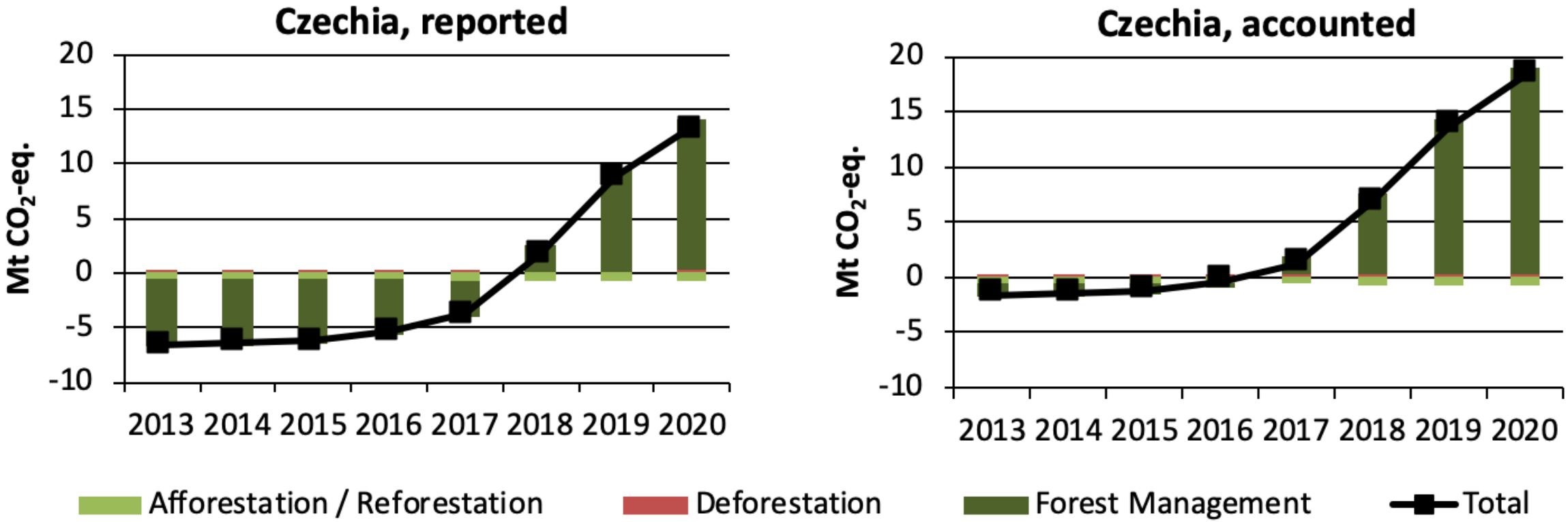
Cyprus



- **Reported net removals and accounted net credits are neraly constant for all years except 2016, when reporting turns into net emissions and accounting into net debits due to major forest fires.**
- **FM dominates the reported and accounting quantities, usually as a net sink. Emissions by D are nearly absent.**

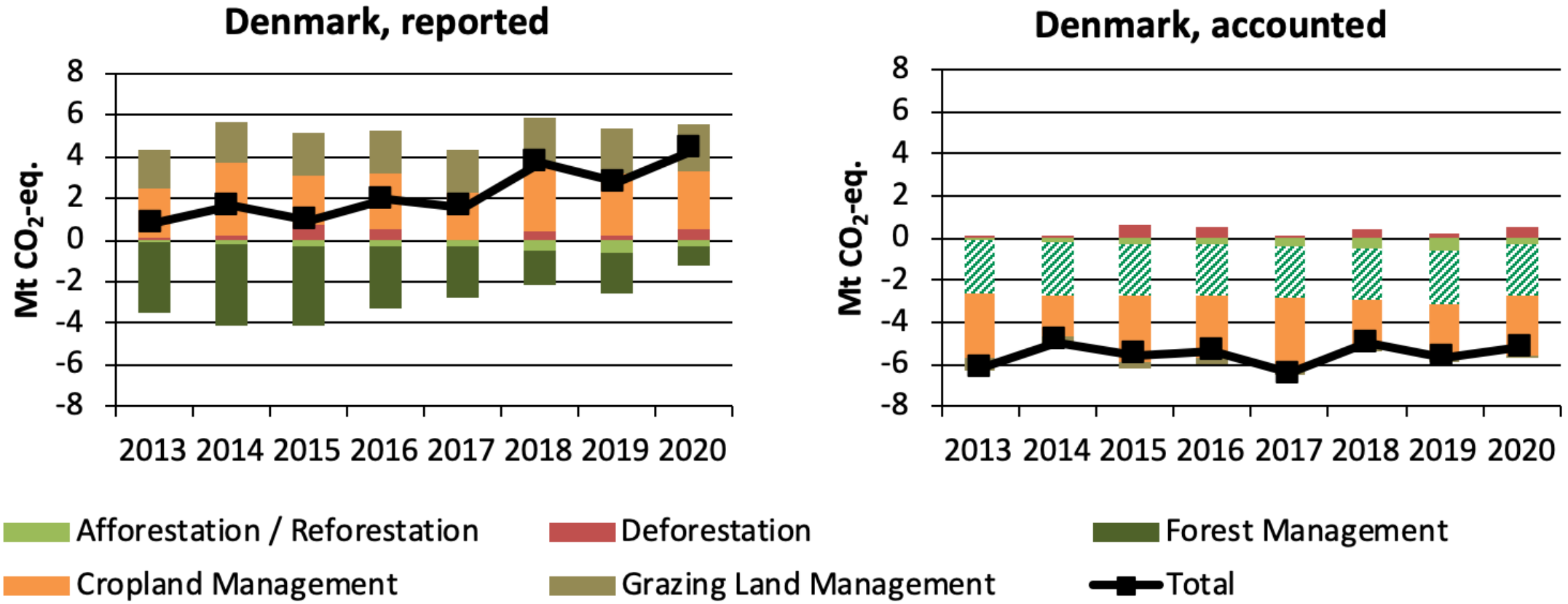
European Commission

Czechia



- **Average net removals 0.5 Mt CO_2eq/year (0.16% of EU27 removals), average net debit 4.4 Mt CO_2eq/year (16.4% of EU27 debits).**
- **Reported net removals show a strong decreasing trend that turns into net emissions in the past three years. This pattern replicates in the accounted quantities when small net credits turned into strong net debits from 2017 onwards.**
- **The main reason for this trend is a series of dry seasons since 2015, which led to bark beetle outbreaks that required necessary sanitary action including wood removal. Total harvest increased by 96% from 2015 to 2019. The share of salvage logging on the total harvest amounted to 95% in 2019 and 2020 (it was 17% in 2005 and 61% in 2017).**

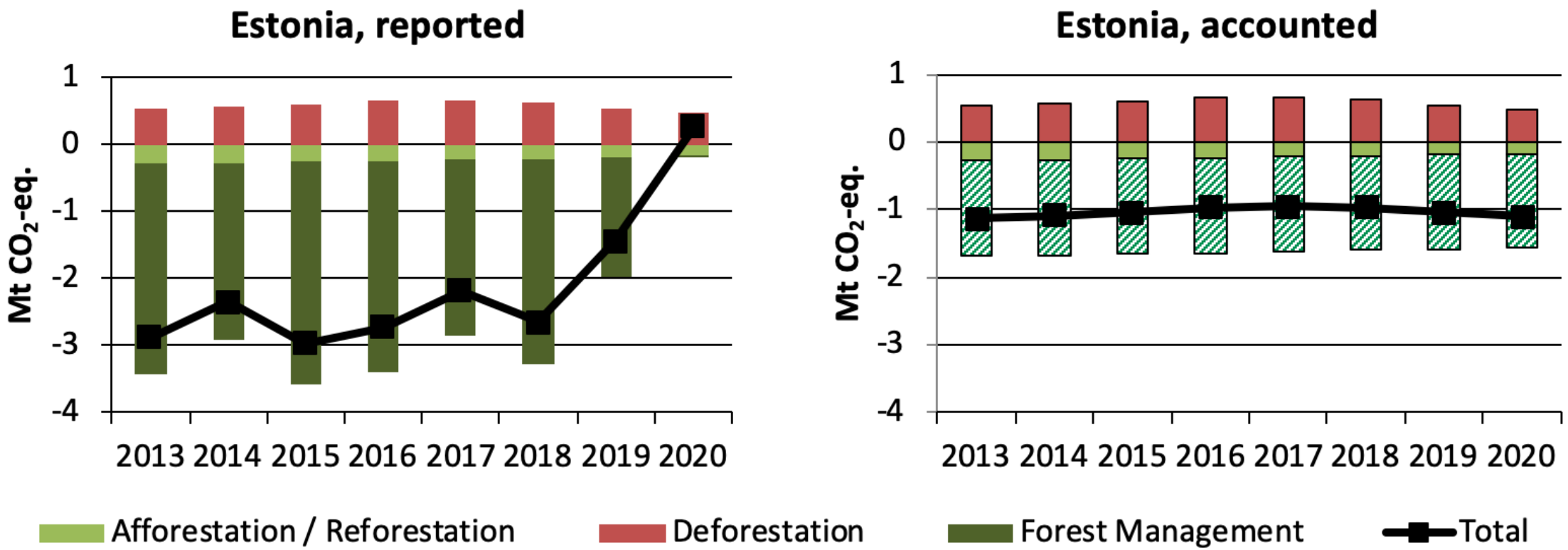
Denmark



- **Average net emissions 2.2 Mt CO_2eq/year (0.7% of EU27 removals), average net credits 5.5 Mt CO_2eq/year (6.7% of EU27 net credits).**
- **Until 2016 the dominant reported activity is FM with removals, which is superseded by emissions by CM and GM (elected) in subsequent years. CM is a source but compared to 1990 values generates a credit. Removals by Forest Management decreased since 2016 due to the aging of forests, along with increased harvest.**
- **FM credits are capped to 19.8 MtCO_2eq over the 8-years period, with a 2.48 MtCO_2eq yearly average.**

European Commission

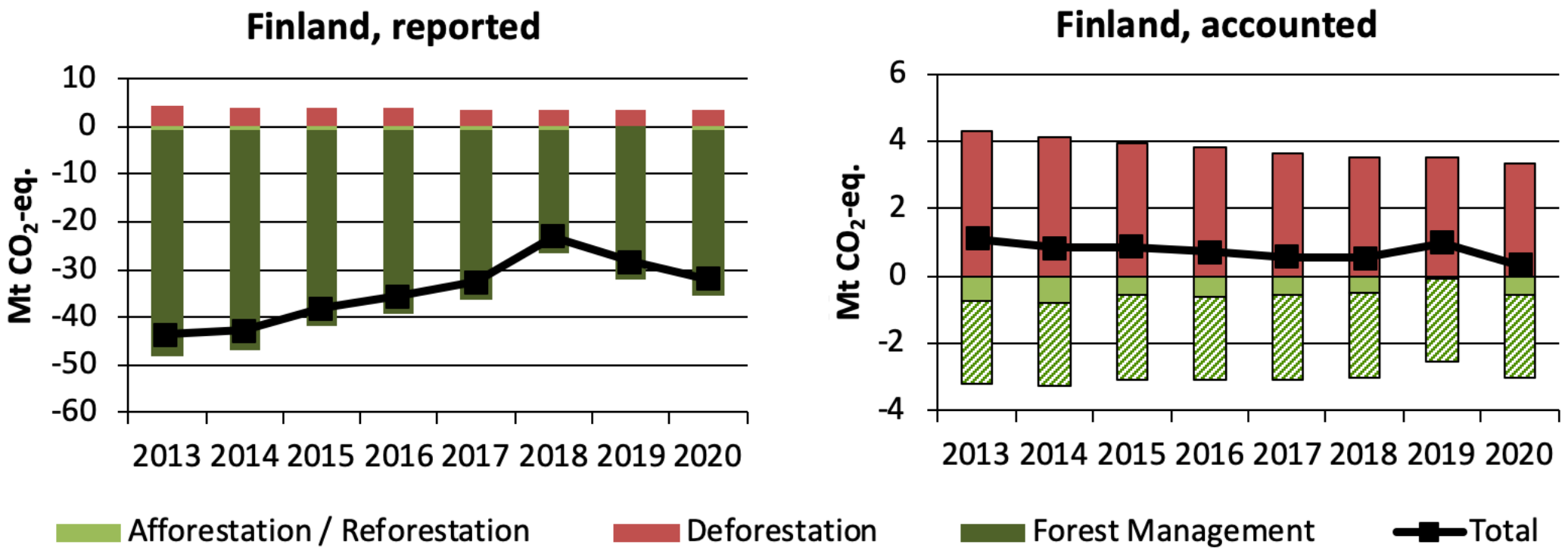
Estonia



- **Average net removals 2.1 Mt CO_2eq/year (0.7% of EU27 removals), average net credits 1 Mt CO_2eq/year (1.3% of EU27 net credits).**
- **Removals by FM dropped notably from 2013 to 2014, between 2016 and 2018 and significantly between 2019 and 2020. Wide areas of forests reaching maturity and on the other hand the very young age of recently revegetated areas are the main drivers behind this pattern. Emission by Deforestation show a slightly decreasing trend in recent years. The abrupt decrease in FM removals from 2018 to 2020 is due to increased harvest volumes.**
- **FM credits are capped to 11.2 Mt CO_2eq over the 8-years period (1.40 Mt CO_2eq yearly).**

European Commission

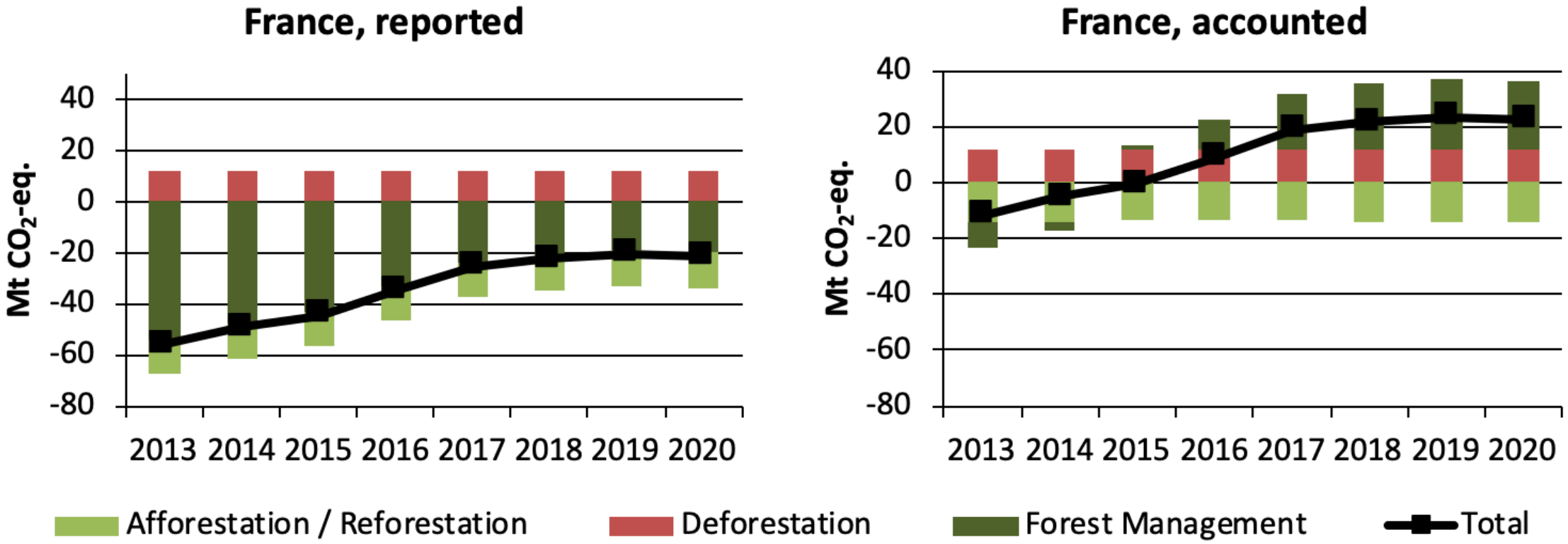
Finland



- **Average net removals 34.6 Mt CO_2eq/year (11% of EU27 net removals), average net debit 0.7 Mt CO_2eq/year (11.3% of EU27 debits).**
- **Removals by FM decrease markedly by 21.2 Mt CO2-eq between 2013 and 2018 due to increased harvest. In 2020 removals have increased again by 8.6 Mt CO2-eq, from 2018 levels, but remain lower compared to the years before 2018.**
- **The Accounting results in a net debit due to the significant contribution of D.**
- **FM credits capped to 20 Mt CO_2eq over the 8-years period (around 2.5 Mt CO_2eq per year).**

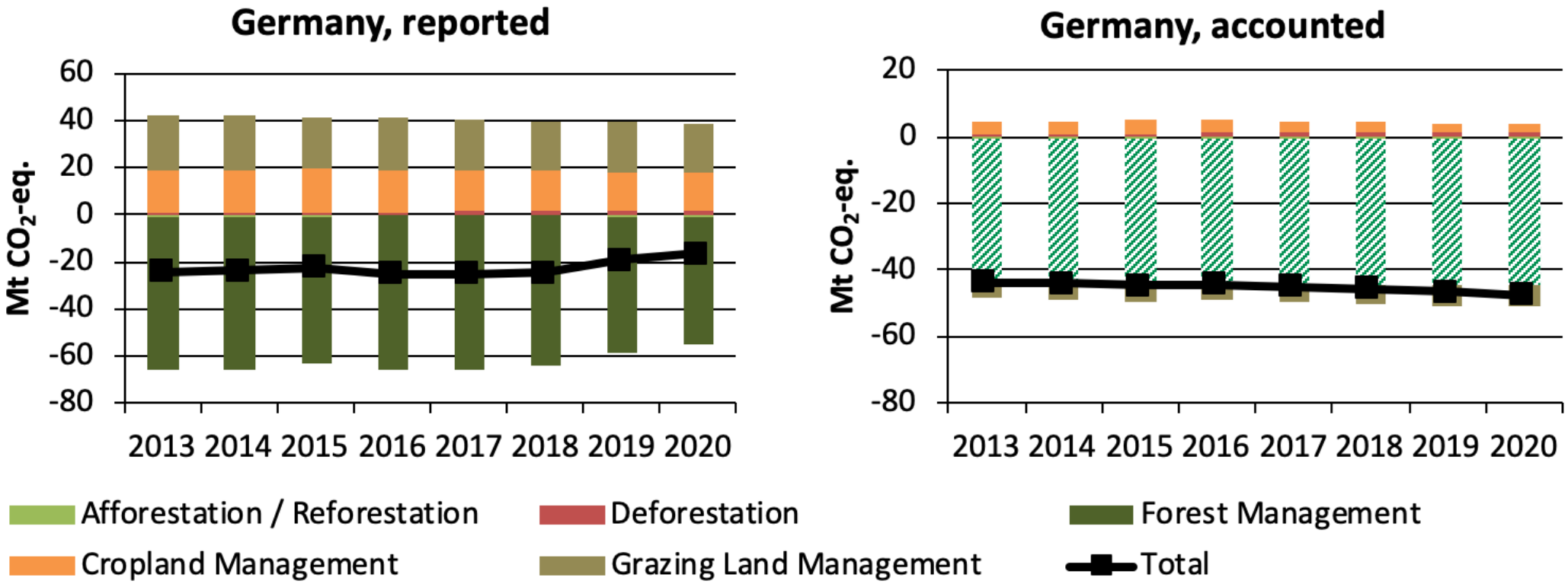
European Commission

France



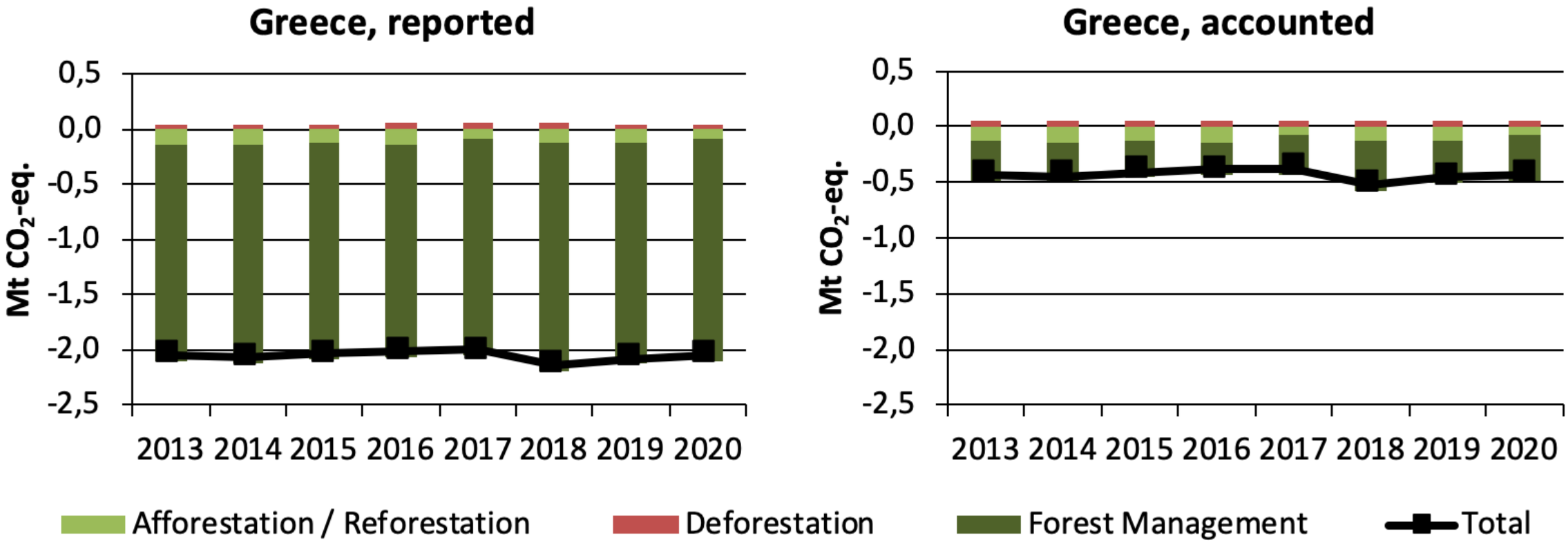
- **Average net removals 34.4 Mt CO_2eq/year (11% of EU27 net removals), average net debits 9.66 Mt CO_2eq/year (75% of EU27 debits).**
- **Net removals show a decreasing trend, with a small increase in 2020. The accounting show the same pattern more accentuated, with net credits in 2013, 2014 and 2016 and increasing net debits in all other years.**
- **Removals by Forest Management decrease markedly between 2013 and 2020. The reason for this decrease is a combination of aging forests with increased mortality and lower growth, of droughts and disturbances, and of increased harvest.**

Germany



- **Average net removals 22.7 Mt CO_2eq/year (7.3% of EU27 net removals), average net credits 45.2 Mt CO_2eq/year (54.7% of EU27 net credits).**
- **Credits by FM are the dominant accounted activity. Reported quantities are quite constant with decreasing removals in FM from 2018. The accounting results in slightly increasing removals mainly due to increasing credits in GMt and decreasing debits in CM.**
- **FM credits are capped to 351008 Ktonnes CO_2 over the 8-years period. Notably, Germany is the EU Member State with by far the highest cap threshold, more than double than the second higher cap, Poland.**

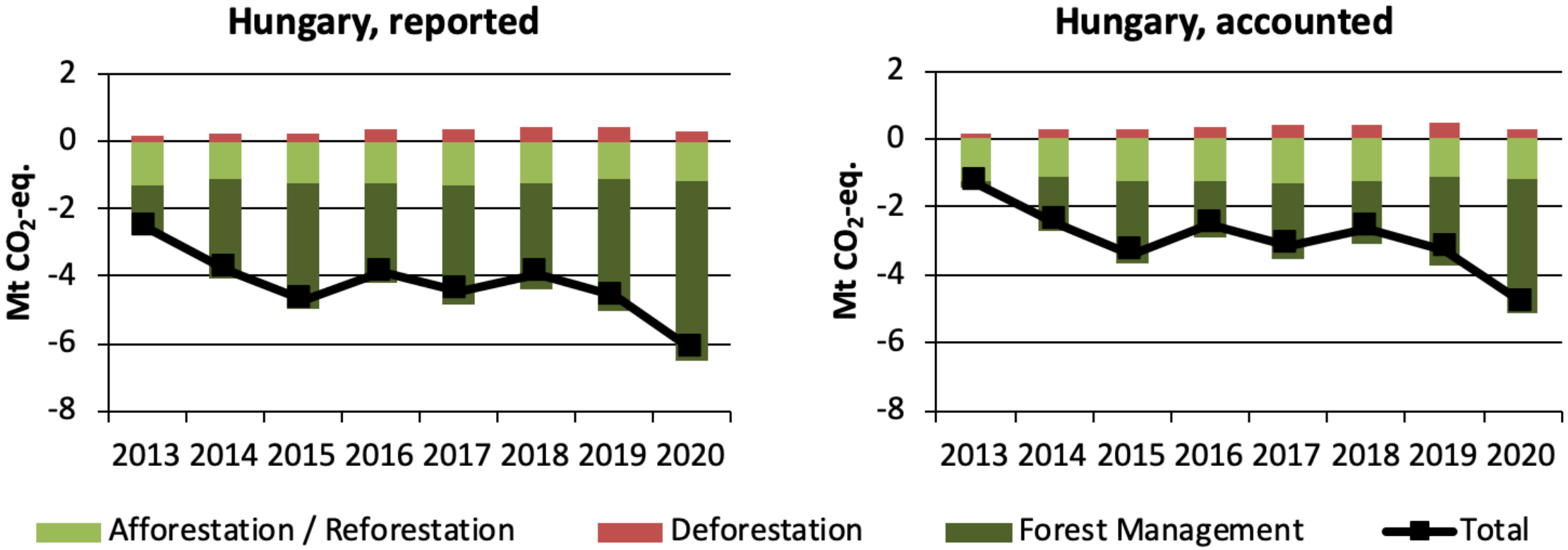
Greece



- **Average net removals 2.1 Mt CO_2eq/year (0.7% of EU27 net removals), average net credits 0.43 Mt CO_2eq/year (0.5% of EU27 net credits).**
- **FM is by far the dominant activity.**
- **Reported net removals and accounted credits are quite stable, with an increase in 2018 as a result in increasing credits removals from Afforestation/Reforestation and Forest Management.**

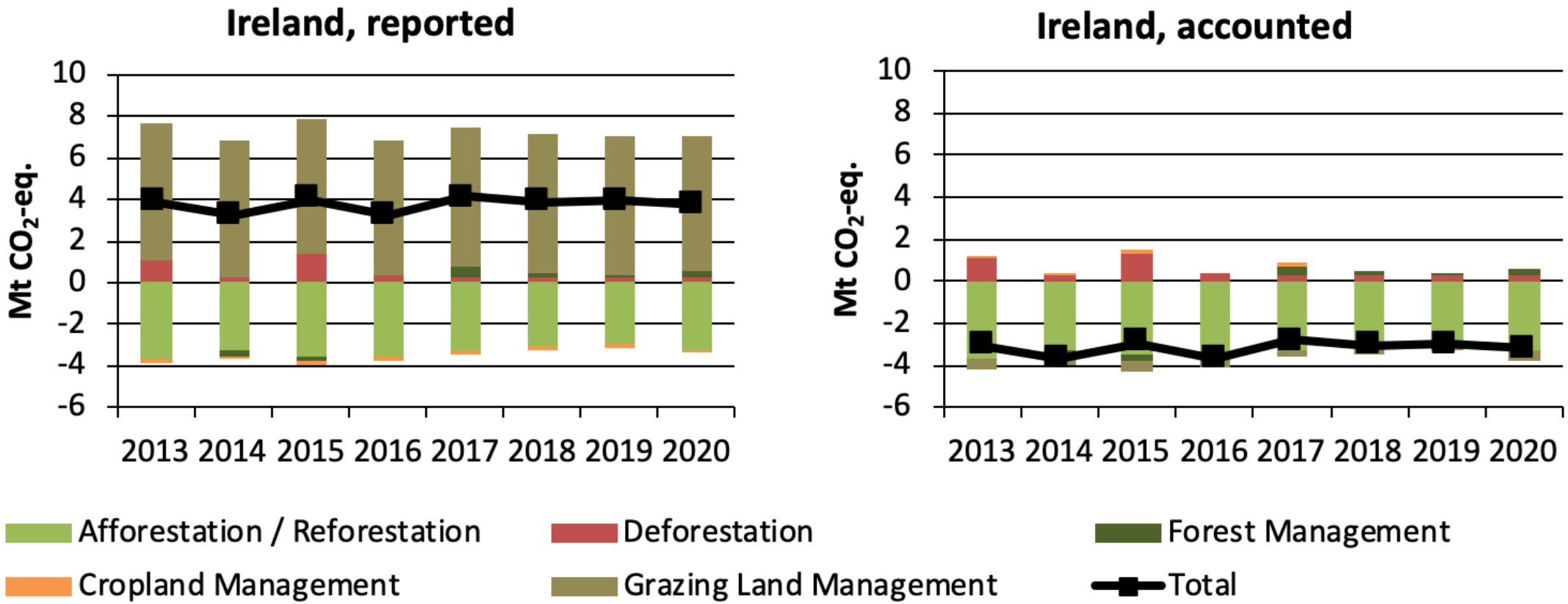
European Commission

Hungary



- **Average net removals 4.3 Mt CO_2eq/year (1.4% of EU27 net removals), average net credits 2.9 Mt CO_2eq/year (3.6% of EU27 net credits).**
- **Removals by Forest Management show an overall increasing trend especially on the latest reported years, and emissions by Deforestation increase up to 2019 with a decrease in 2020.**
- **Forest management dominates the accounting which over the 2nd CP results in credits 5 time bigger than 2013. The increase of removals and credits in 2020 is due to the lower harvest caused by the COVID pandemic.**

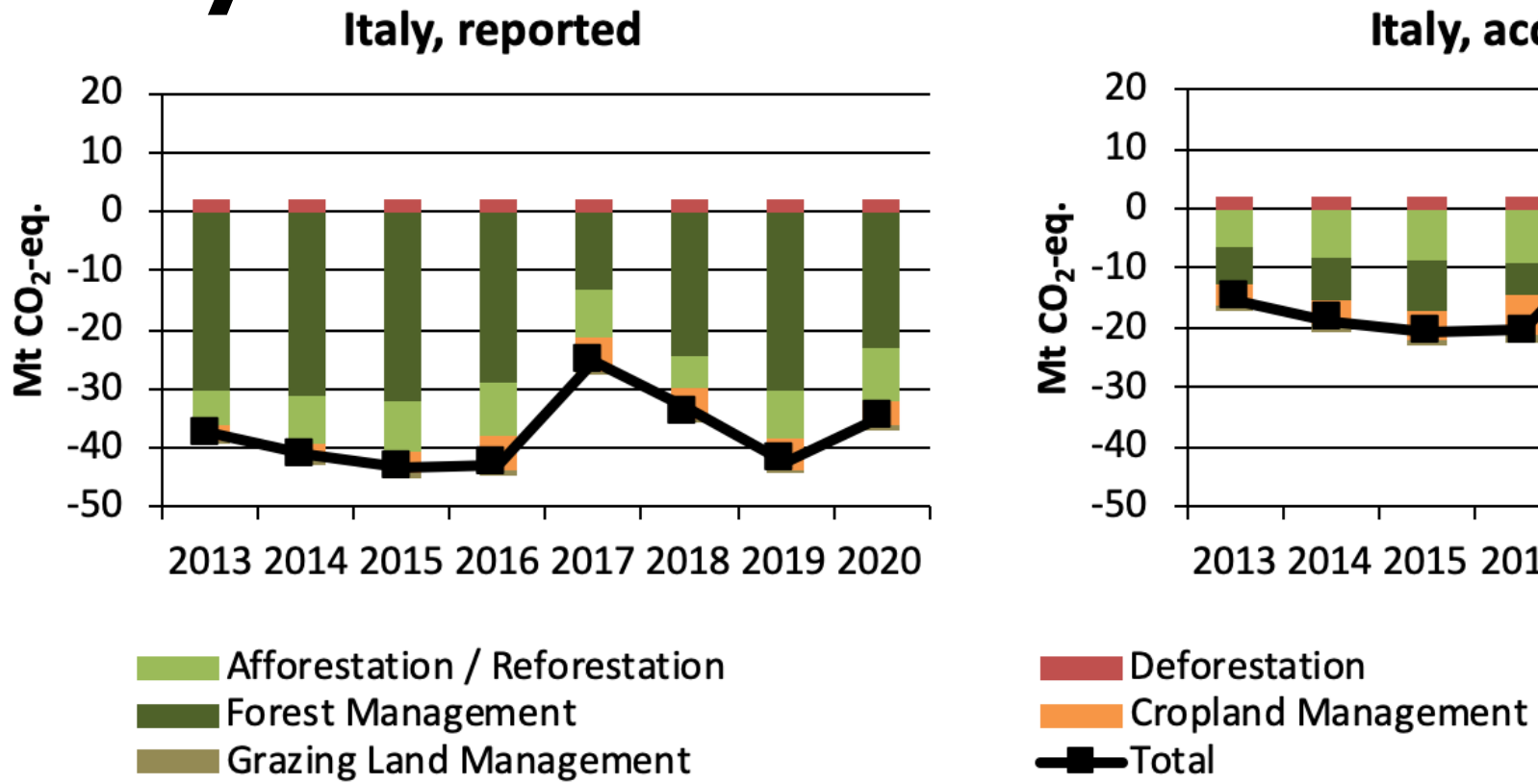
Ireland



- **Average net emissions 3.8 Mt CO_2eq/year (1.2% of EU27 net removals), average net credits 3.2 Mt CO_2eq/year (3.8% of EU27 net credits).**
- **GM is the most important activity , resulting in net emissions, followed by AR which also plays an important role as a net sink. FM fluctuates between emissions and removals with a small contribution to the overall budget.**
- **In the accounting AR is the main driver generating net credits.**

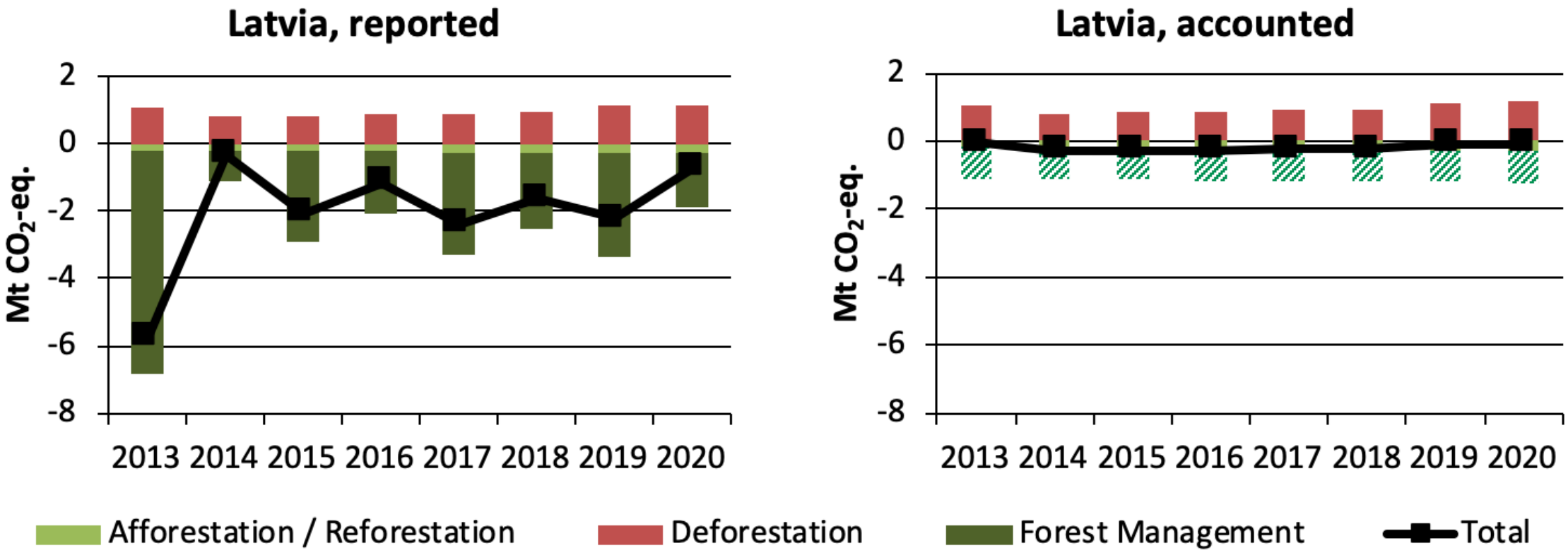
European Commission

Italy



- **Average net removals 37.7 Mt CO_2eq/year (12.1% of EU27 net removals), average net credits 15.3 Mt CO_2eq/year (18.5% of EU27 net credits).**
- **The dominating reported activity is FM with removals followed by removals by AR and CM. Removals by FM dropped by more than 50% in 2017 due to an exceptional forest fires season but return to former levels in 2019, followed by a decrease in 2020 again due to a 19% increase in areas under forest fires. Removals by Afforestation/Reforestation show the same pattern but at a lesser scale and continues to increase in 2020.**
- **An even worse 2021 is expected as burned forest areas were 3 times bigger than in 2020.**

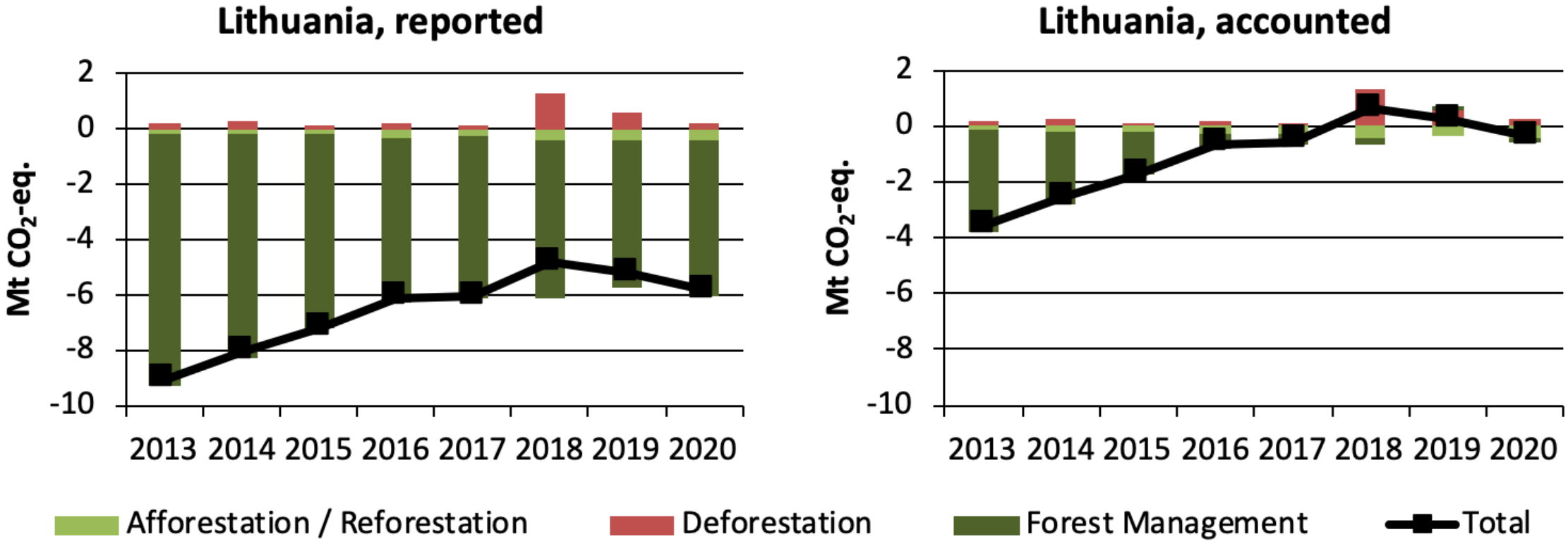
Latvia



- Average net removals 2 Mt CO_2eq/year (0.7% of EU27 net removals), average net credits 0.2 Mt CO_2eq/year (0.2% of EU27 net credits).
- Reported quantities show a remarkable decrease in 2014 due to growing harvest rates determined by demand and price of roundwood assortments in the local and export markets. Accounting quantities show a quite stable pattern.
- FM credits are capped to 7.4 Mt CO_2 eq over the 8-years period (0.92 on average).

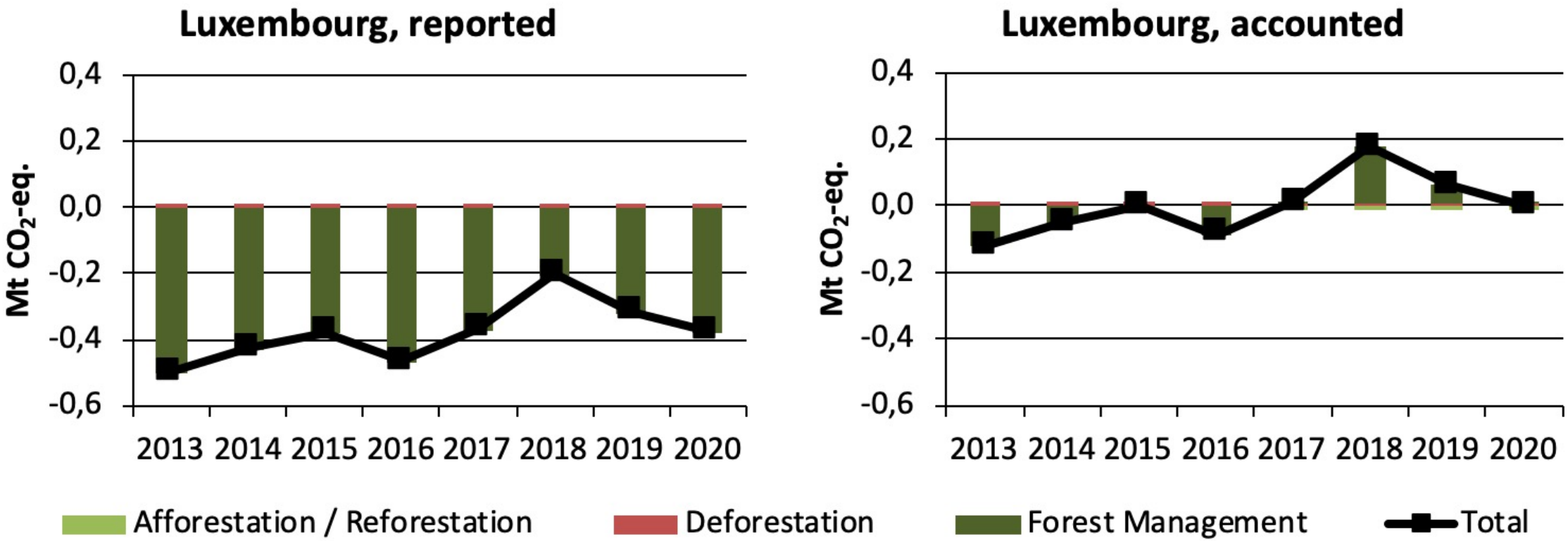
European Commission

Lithuania



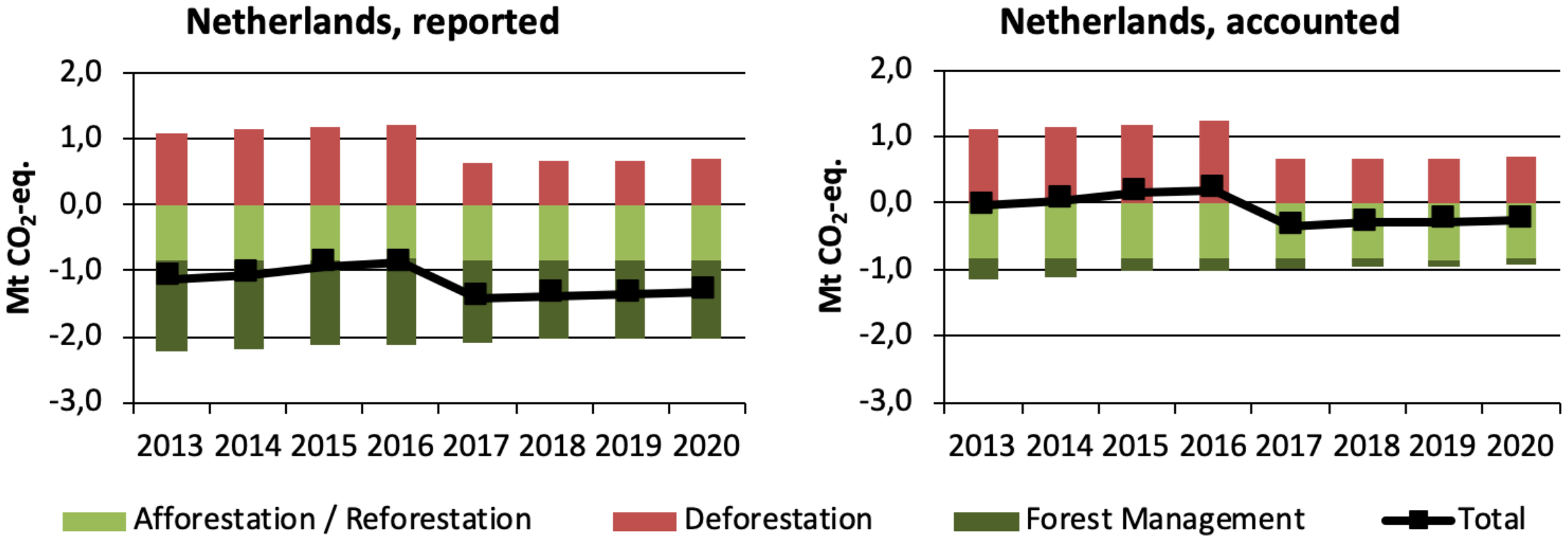
- **Average net removals 6.5 Mt CO_2eq/year (2.1% of EU27 net removals), average net credits 1.1 Mt CO_2eq/year (1.3% of EU27 net credits).**
- **Reported net removals show a sharply decreasing trend between 2013 to 2018, led by a decrease in FM removals due to growing harvest rates. The same trend is observed for accounted net credits between 2013 and 2017 turning into net debits in 2018 and 2019 due to an increase in D rates and a decrease in FM removals, and then reversing to net credits for 2020. With the exception of 2018, FM determines the accounting trajectory.**

Luxembourg



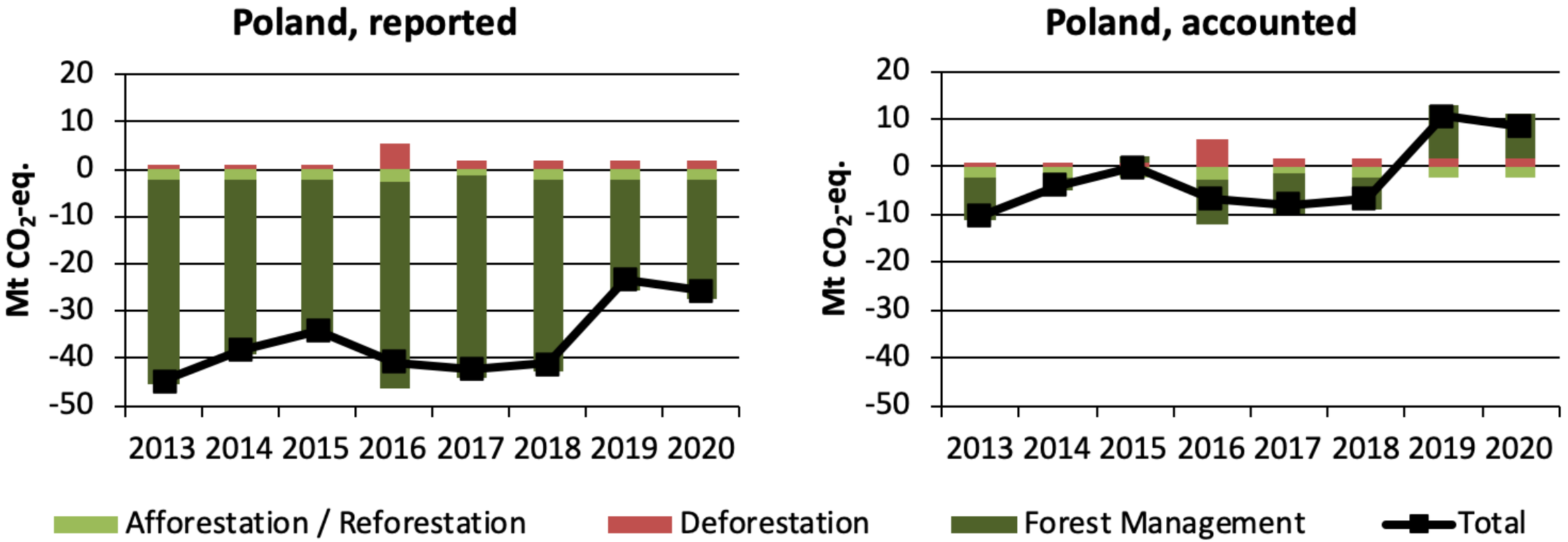
- **Average net removals 0.4 Mt CO_2eq/year (0.12% of EU27 net removals), on average neutral in terms of accounting.**
- **Removals by Forest Management is the only term with remarkable variations and shows a generally decreasing trend of removals except for 2016, 2019 and 2020. The reason is that annual harvest rates differ significantly year by year influenced by timber demand and wood prices, insect infestation or wind throws.**

Netherlands



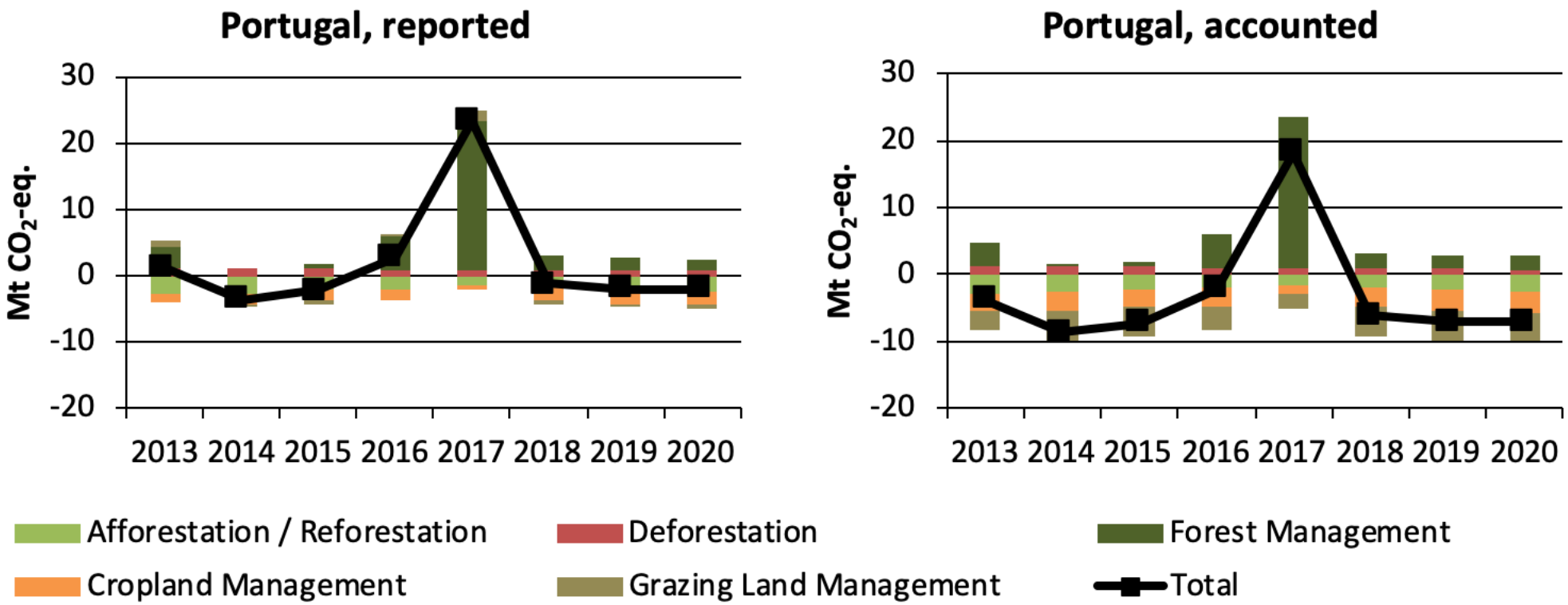
- **Average net removals 1.2 Mt CO_2eq/year (0.4% of EU27 net removals), average net credits 0.1 Mt CO_2eq/year (0.1% of EU27 net credits).**
- **The most significant reporting activity is FM resulting in removals slightly declining during the period. D emissions initially increase, leading to net debits, and then have an abrupt decrease in 2017, followed by another increasing trend. AR removals remain stable.**
- **D debits are the main term in the balance, while the constant decrease in FM removals leads to a reduced contribution of FM in the accounting.**

Poland



- **Average net removals 36.3 Mt CO_2eq/year (11.7% of EU27 net removals), average net credits 2 Mt CO_2eq/year (2.5% of EU27 net credits).**
- **Reported net removals and accounted net credits decrease between 2013 and 2015, followed by an increase until 2018 and then sharply drop in 2019, resulting in net debits for 2019 and 2020.**
- **The D peak in 2016 is due to large conversions of forest to settlements to support the growing population.**
- **Between 2018 and 2019 removals and subsequent credits from FM sharply declined by more than 50% due to extreme events such as drought, pests and windbreaks. The decreasing removals from 2013 to 2015 relate to a harvest increase.**

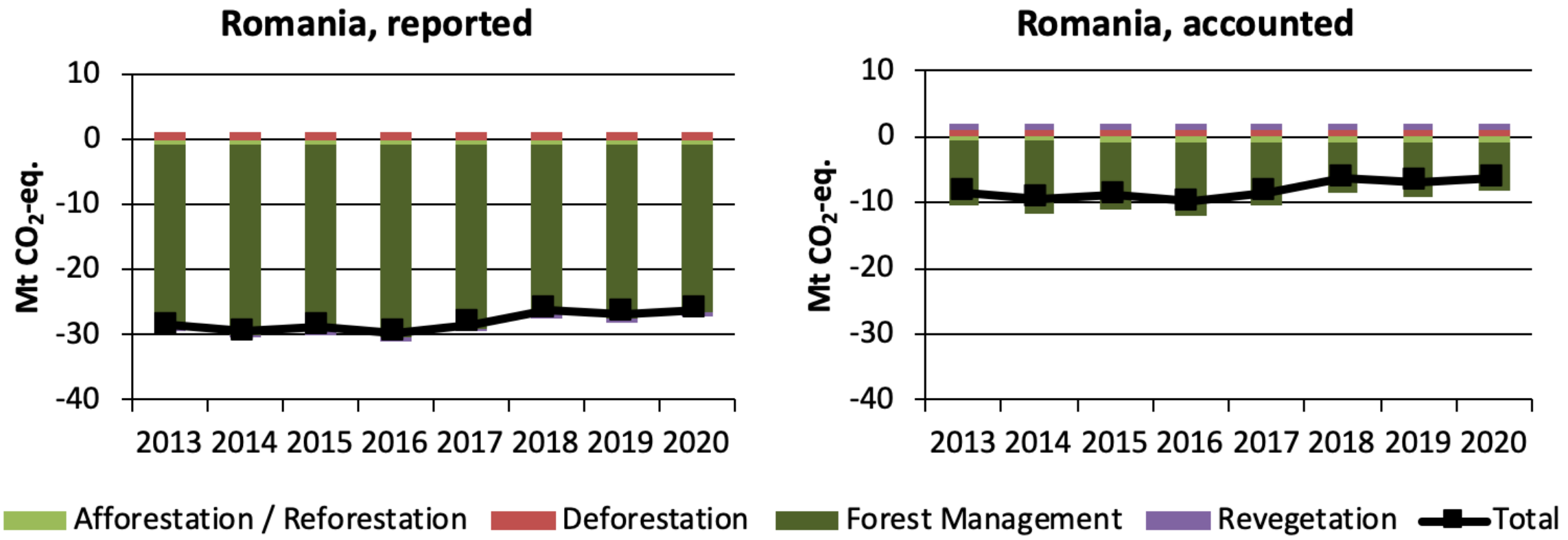
Portugal



- **Average net emissions 2.1 Mt CO_2eq/year (0.7% of EU27 net removals), average net credits 3 Mt CO_2eq/year (3.6% of EU27 net credits).**
- **The dominating reported activity is FM with net emissions in most years. Removals by AR are also relevant.**
- **The abrupt increase of emissions from FM and the subsequent debits in 2017 are the result of the enormous incidence of forest fires which impacted also the overall EU LULUCF balance.**

European Commission

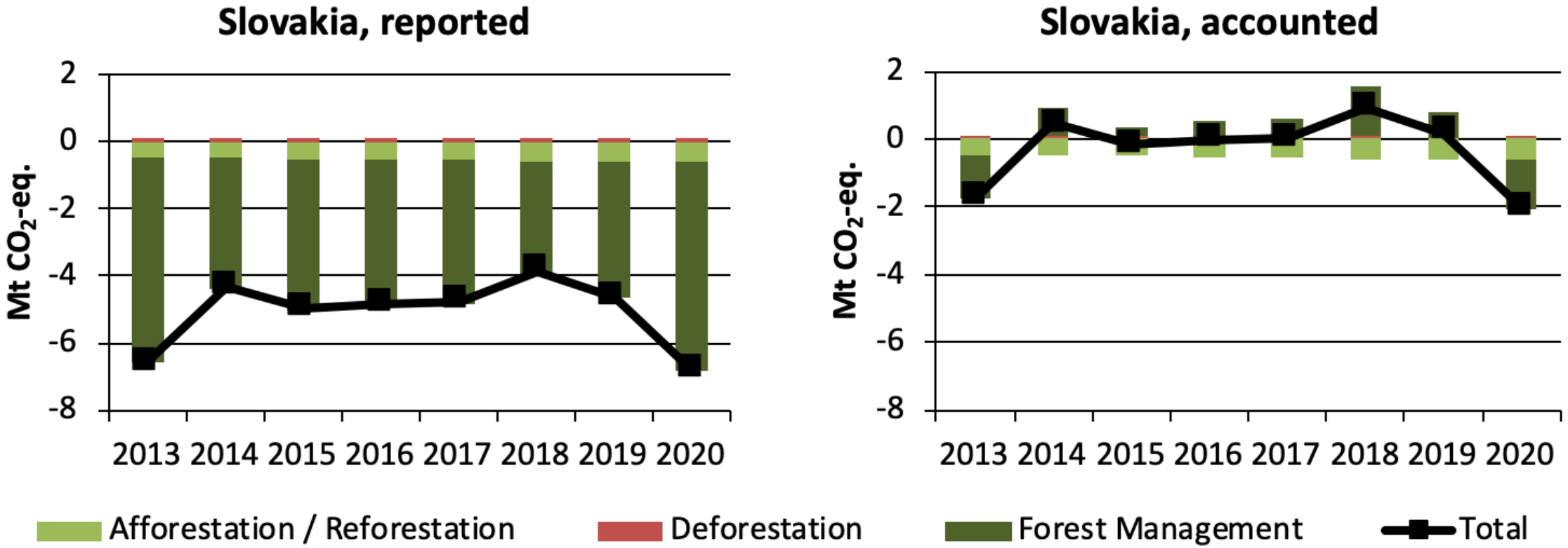
Romania



- **Average net removals 28.1 Mt CO_2eq/year (9% of EU27 net removals), average net credits 8 Mt CO_2eq/year (9.8% of EU27 net credits).**
- **Reported net removals show a slow decrease over the eight-year period. Accounted net credits show limited variations with a decreasing trend from 2016.**
- **FM has by far the biggest impact on reported and accounted quantities. RV (Romania is the only MS which elected this activity) has also an impact slightly lower than AR.**

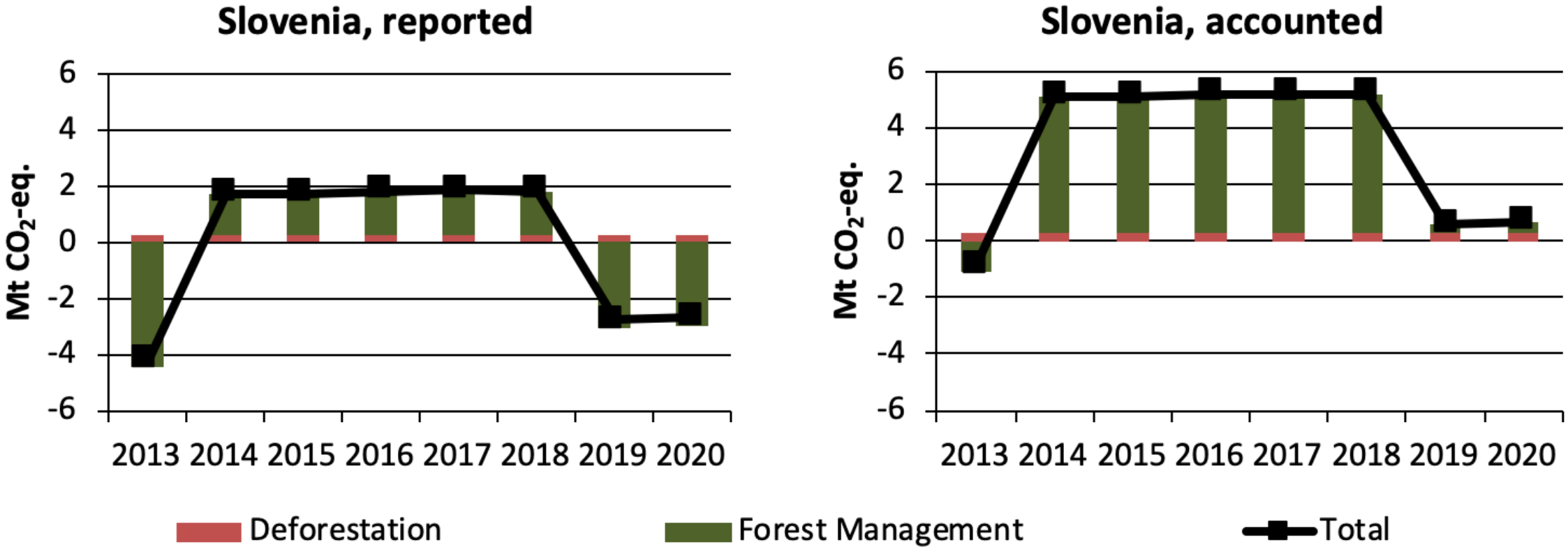
European Commission

Slovakia



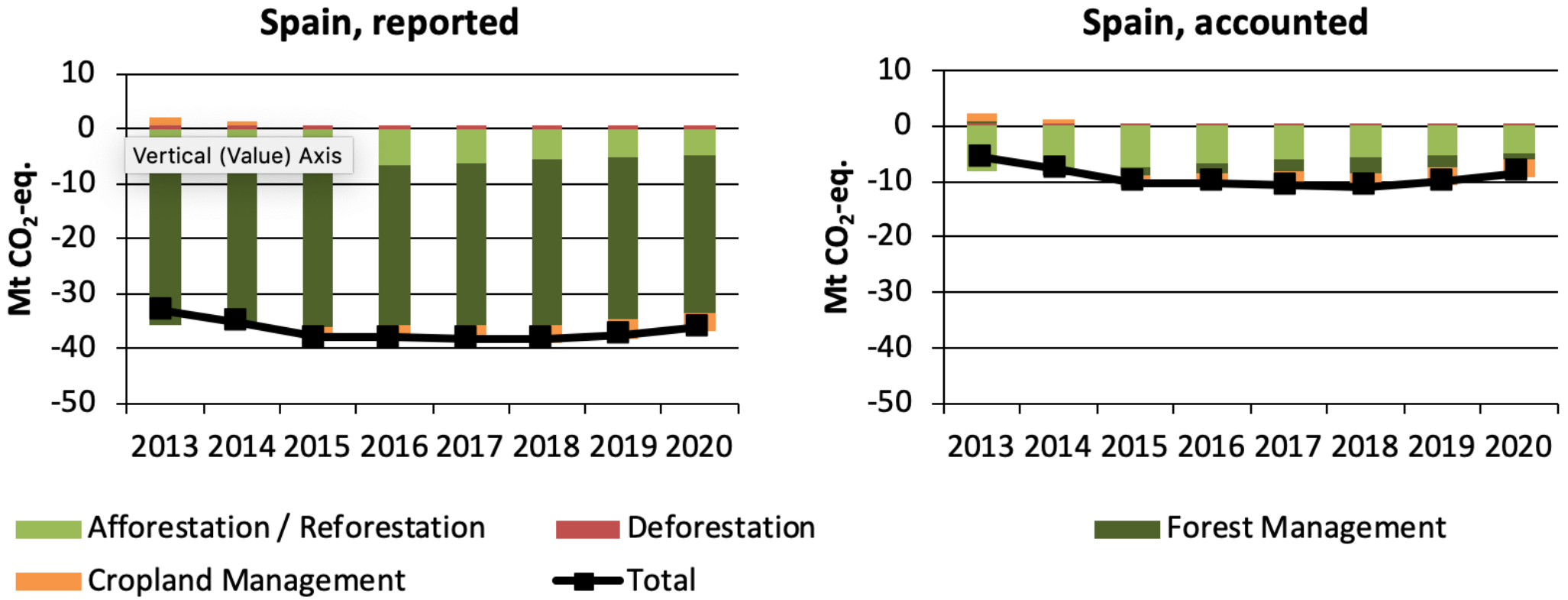
- **Average net removals 5.1 Mt CO_2eq/year (1.6% of EU27 net removals), average net credits 0.3 Mt CO_2eq/year (0.3% of EU27 net credits).**
- **Marked decreases for 2014 and 2018 can be observed in reported and accounted quantities. Net removals and net credits increase substantially between 2018 and 2020.**
- **Removals FM are variable with a decline between 2014 and 2018, and an increase in 2020 due to a significant reduction in harvest (COVID?). The reason for this development is a combination of aging forest, and natural disturbances. The age structure of Slovak forests is unbalanced, with cyclical changes in the volume of growing stock and felling possibilities. The urgency for regenerating the age structure increased the felling volumes during the last 20 years.**

Slovenia



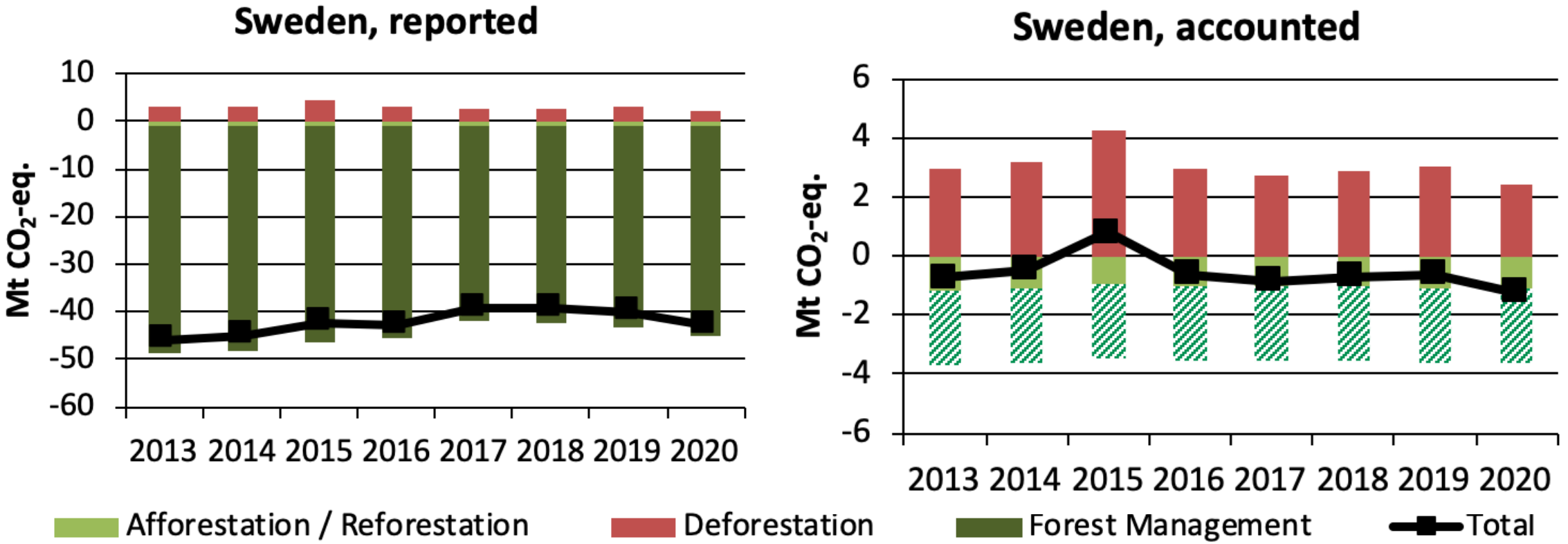
- **Average net emissions 0.1 Mt CO_2eq/year (0.02% of EU27 net removals), average net debits 3.3 Mt CO_2eq/year (10.2% of EU27 debits).**
- **Reported net removals for 2013 decrease markedly to net emissions in 2014 that remain on that level until 2018 and drastically turn back into removals in 2019. Accounted quantities show the same pattern with net credits for 2013 and net debits thereafter.**
- **The changes in FM between 2013 and 2014 are associated with sanitary cuts due to natural disturbances, which significantly affected Slovenian forest since 2014.**

Spain



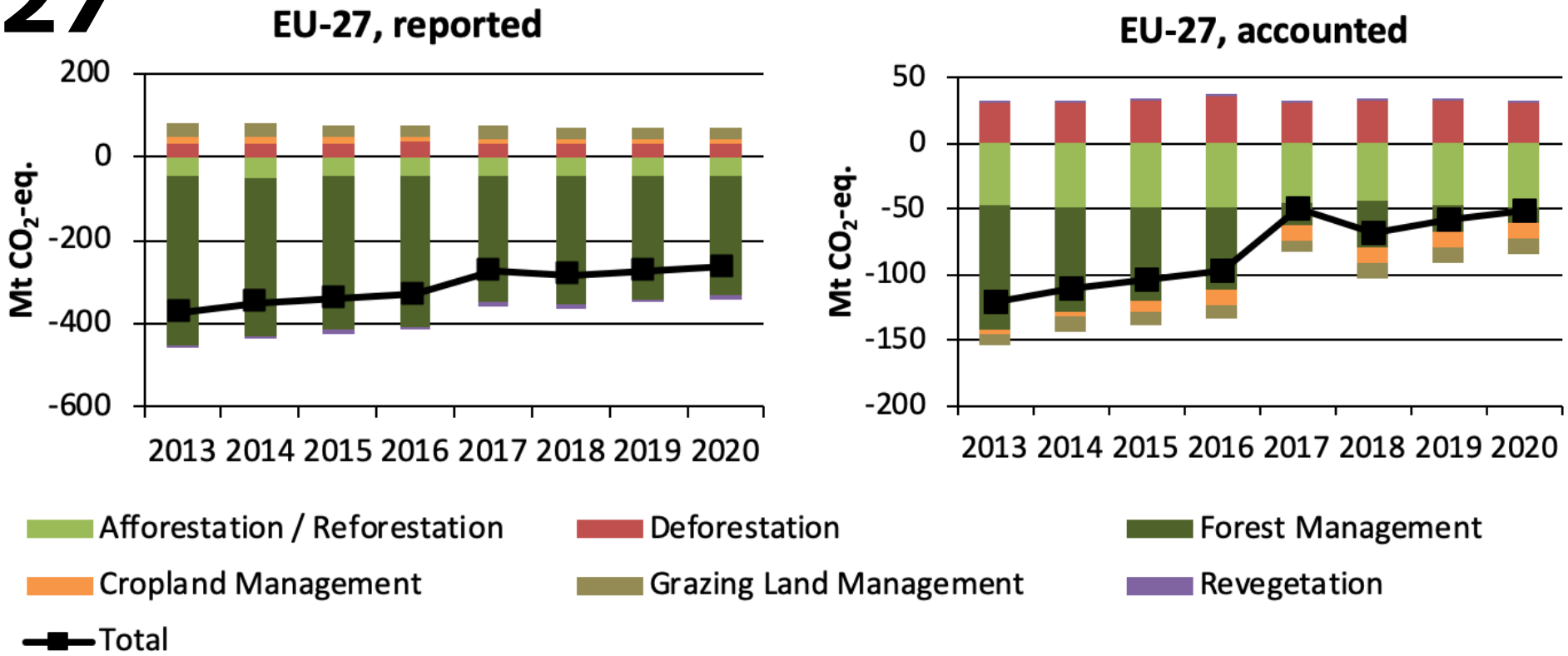
- **Average net removals 36.8 Mt CO_2eq/year (11.8% of EU27 net removals), average net credits 9.3 Mt CO_2eq/year (11.2% of EU27 net credits).**
- **Reported net removals show an increase from 2013 to 2015 which level off thereafter and slightly decrease after 2019.**
- **The dominant reported activity is FM. Small emission by CM for 2013 and 2014 turn into notable removals for the years thereafter. Emissions by D are negligible in the overall emission budget of the LULUCF sector. Removals by FM and CM are increasing, but AR removals are diminishing.**

Sweden



- **Average net removals 42 Mt CO_2eq/year (13.6% of EU27 net removals), average net credits 0.55 Mt CO_2eq/year (0.7% of EU27 net credits).**
- **Reported net removals show small dynamics with no clear trend. Accounted net credits follow the same pattern with net debits in 2015. The dominant reported activity is FM. Emissions by D are in comparison small but play an important role in the accounting. Removals by FM and emissions by D show small variations but no clear trend over the eight-year period. FM is capped to 20.2 Mt CO_2eq over the 8-years period (2,5 Mt CO_2eq per year)**

EU27



- **The dominant reported activity is Forest Management with removals. In comparison, removals by AR and emissions by D are of moderate importance. Emissions by CM and GM (not available for all countries) are relatively small. Removals by Forest Management show a clear decreasing trend.**
- **Reasons for this overall declining sink trend are a combination of aging forests, removing less CO2 from the atmosphere, of the increasing harvest and of natural disturbances such as fires (e.g. in 2016 ans 2017 in Italy and Portugal), droughts, insects (especially in central EU after 2017) and windstorms. Emissions by CM generally decreasing over the eight-year Second Committment Period.**

EU27

EU27 REPORTING	2013	2014	2015	2016	2017	2018	2019	2020	SUM	Yearly Average
Afforestation / Reforestation	-47.5	-48.9	-48.0	-48.5	-45.4	-44.0	-46.3	-48.2	***-376.7***	***-47.1***
Deforestation	31.3	30.6	33.5	36.2	31.2	32.8	32.2	31.2	***259.1***	***32.4***
Forest Management	-403.9	-380.8	-367.5	-357.1	-303.6	-309.9	-295.6	-283.9	***-2,702.3***	***-337.8***
Cropland Management	18.6	17.6	13.6	10.3	10.7	10.0	9.2	10.1	***100.1***	***12.5***
Grazing Land Management	31.6	29.7	29.4	30.3	31.8	29.1	28.6	28.4	***238.9***	***29.9***
Revegetation	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	***-4.9***	***-0.6***
Wetland Drainage and Rewettir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	***0.0***	***0.0***
Total	***-370.4***	***-352.3***	***-339.7***	***-329.3***	***-275.9***	***-282.6***	***-272.5***	***-263.1***	***-2,485.8***	***-310.7***

EU27 ACCOUNTING	2013	2014	2015	2016	2017	2018	2019	2020	SUM	Yearly Average
Afforestation / Reforestation	-47.5	-48.9	-48.0	-48.5	-45.4	-44.0	-46.3	-48.2	***-376.7***	***-47.1***
Deforestation	31.3	30.6	33.5	36.2	31.2	32.8	32.2	31.2	***259.1***	***32.4***
Forest Management	-93.6	-78.7	-71.1	-63.3	-16.6	-34.9	-20.1	-11.7	***-389.9***	***-48.7***
Cropland Management	-3.5	-4.4	-8.5	-11.7	-11.3	-12.0	-12.9	-12.0	***-76.2***	***-9.5***
Grazing Land Management	-8.9	-10.8	-11.2	-10.2	-8.8	-11.5	-11.9	-12.2	***-85.6***	***-10.7***
Revegetation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	***7.7***	***1.0***
Wetland Drainage and Rewettir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	***0.0***	***0.0***
Total	***-121.2***	***-111.2***	***-104.4***	***-96.5***	***-49.9***	***-68.6***	***-58.0***	***-51.9***	***-661.7***	***-82.7***

Thank you for your attention!

0 250 500 1,000 Km

European Commission

Annex 4

Summary of inventories under Decision 529/2013

JRC presentation in Working Group 5 meeting by S. Rossi et al.

Summary of inventories under Decision 529/2013

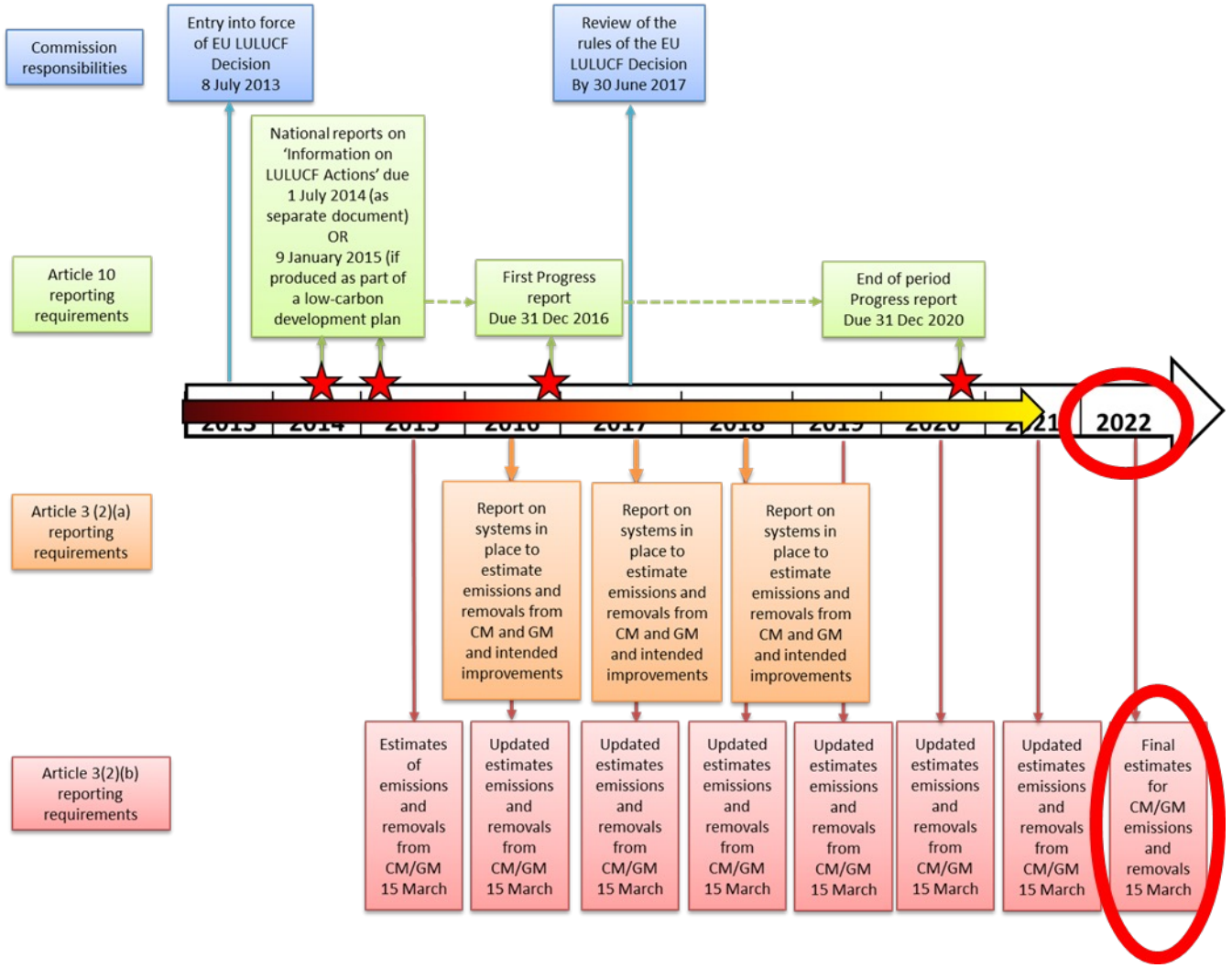
Simone Rossi, Giacomo Grassi, Anu Korosuo

Joint Research Centre (JRC), European Commission

WG5 – 19 April 2023

European Commission

Decision 529/2013: it's been a long way!



European Commission

Decision 529/2013: goal

3) Decision No 406/2009/EC requires the Commission to **assess modalities to include greenhouse gas emissions and removals resulting from activities relating to LULUCF into the Union's greenhouse gas emission reduction commitment, whilst ensuring the permanence and environmental integrity of the contribution of the sector**,[…].

This Decision should, therefore, as a first step, set out accounting rules applicable to greenhouse gas emissions and removals from the LULUCF sector and thereby contribute to policy development towards the inclusion of the LULUCF sector in the Union's emission reduction commitment, as appropriate[…].

Decision 529/2013: goal

8)This Decision should provide for accounting rules applicable on a mandatory basis to the activities of afforestation, reforestation, deforestation and forest management, **as well as to the activities of grazing land management and cropland management**, subject to specific provisions with a view to improving Member States' reporting and accounting systems during the first accounting period.

Decision 529/2013: art 3.2 b and c

(b) Member States shall, prior to 1 January 2022, provide and submit to the Commission by 15 March each year initial, preliminary and non-binding annual estimates of emissions and removals from cropland management and grazing land management using, where appropriate, IPCC methodologies. […]

(c) Member States shall, no later than 15 March 2022, submit their final annual estimates for accounting of cropland management and grazing land management.

Decision 529/2013 – Status of 2022 submissions

Red: missing

Purple: Incomplete

Grey: MS elected CM and/or GM (no need to report under 529)

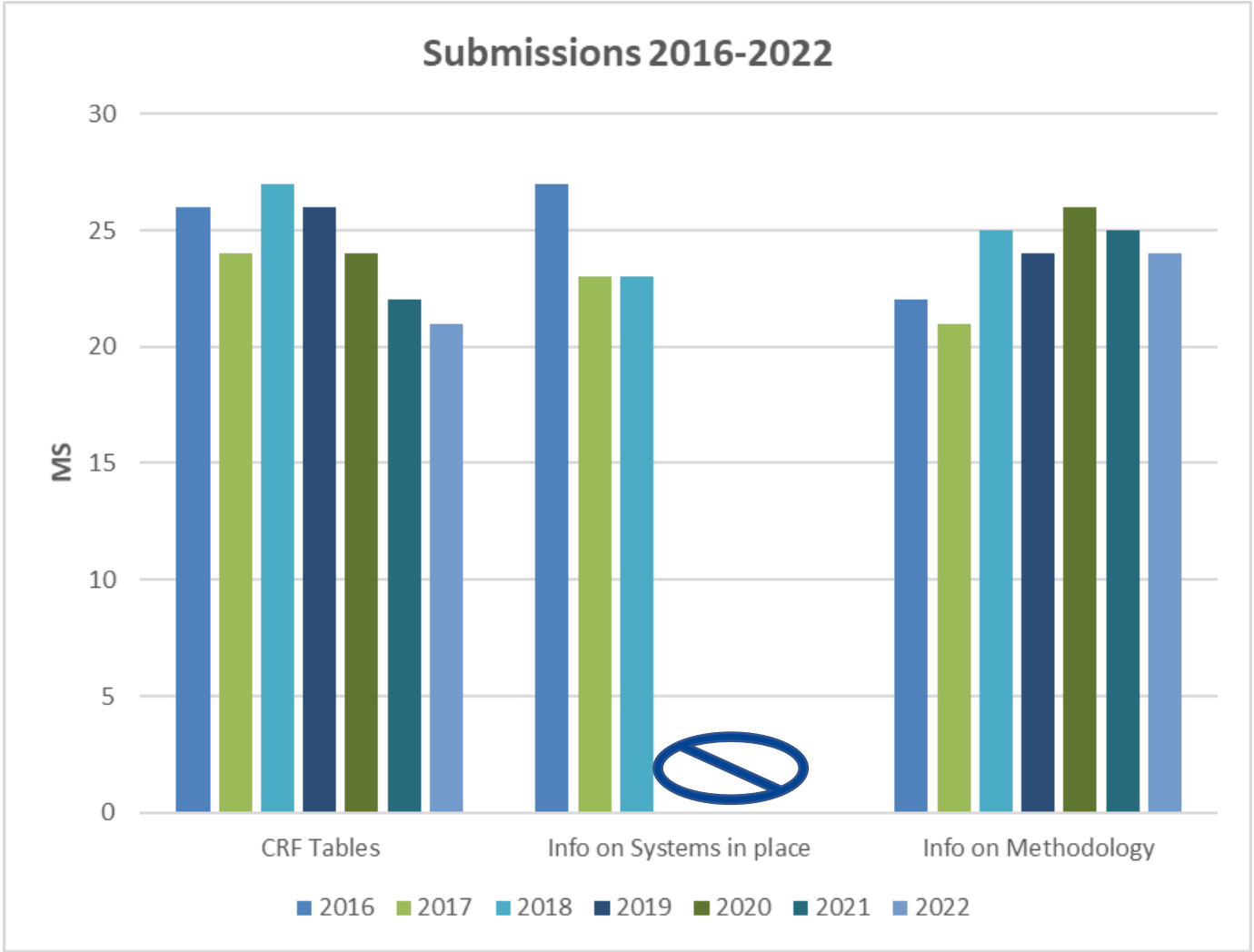
	2022	
	529/ 3(2)b (CRF tables)	749 / 40 (methodologies)
AT	✓	✓
BE	✓	✓
BG	✓(empty)	✓
CY		
CZ	✓(only 2020)	✓
DE		
DK		
EE	✓	✓
GR	✓	✓
ES	✓	✓
FI	✓	✓
FR	✓	✓
HR	✓	✓
HU	✓	✓
IE		
IT		
LT	✓	✓
LU	✓	✓
LV	✓	✓
MT		
NL	✓	✓
PL	✓	✓
PT		
RO	✓ (empty)	✓
SE	✓	✓
SI	✓	✓
SK	✓ (only CM)	✓

PLEASE fix Missing and Incomplete submissions (it's an obligation!)

European Commission

Decision 529/2013 - Status of the submissions

- **NB: 27 MS from 2020.**
- **Decrease in the number of complete submissions (especially for data)**



Cropland Management: Completeness (Notation Keys)

CM	CHANGE IN CARBON POOL REPORTED[1]							GREENHOUSE GAS SOURCES REPORTED[2]							
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		HWP[4]	Fertilization[5]	Drained, rewetted and other soils[6]		Nitrogen mineralization in mineral soils[8]	Indirect N_2O emissions from managed soil[5]	Biomass burning[9]		
					Mineral	Organic[3]		N_2O	CH_4[7]	N_2O	N_2O	N_2O	CO_2[10]	CH_4	N_2O
Austria	R	R	NA	NA	R	NO			NA		R		NA	NA	NA
Belgium	R	NO	NO	NO	R	R			NO		R		NO	NO	NO
Bulgaria	NA	NA	NA	NA	NA	NA			NA		NA		NA	NA	NA
Croatia	R	R	NO	NO	R	R			NO		R		R	R	R
Cyprus															
Czech Republic	NA/R	NA/R	NA/R	NA/R	NA/R	NA/R			NA/NO		NA/R		NA/NO	NA/NO	NA/NO
Denmark	R	R	NO	NO	R	R			R		R		NO	NO	NO
Estonia	R	R	NO, NE	R	R	R			NA		R		NO, NE	NO, NE	NO, NE
Finland	R	R	R	R	R	R			R		R		IE	IE	IE
France															
Germany	R	R	IE	IE	R	R			R		R		NO	NO	NO
Greece	R	IE	NO	NO	R	R			NO		R		NO	NO	NO
Hungary	R	NA	NA	NA	R	NA			NA		R		IE	R	R
Ireland	R	IE	NO	NO	R	NO			NO		IE		NO	R	R
Italy	R	R	NO	NO	R	R			NO		R		R	R	R
Latvia	R	R	NA	R	R	R			R		R		NA	R	R
Lithuania	R	IE	R	NO	R	R			R		R		NO	R	R
Luxembourg	R	R	NO	NO	R	NA			NA		NA		NA	NA	NA
Malta	NA	NA	NA	NA	NA	NA			NA		NA		NA	NA	NA
Netherlands	R	R	NO	NO	R	R			NE		R		NO	NO	NO
Poland	R	R	NR	NR	R	R			NO		NO		NO	NO	NO
Portugal	R	R	R	NO	R	NO			NO		R		R	R	R
Romania	NA	NA	NA	NA	NA	NA			NA		NA		NA	NA	NA
Slovakia	R	NO	NO	NO	R	NO,NE			NO		R		NO	NO	NO
Slovenia	R	R	R	R	R	R			NO		R		NO	NO	NO
Spain	R	IE	NR,R	NR	R	NO			NO		NE,R		NO,R	IE,NO,R	IE,NO,R
Sweden	R	R	R	R	R	R			R		R		R	R	R

Cropland Management: Completeness

CM	CHANGE IN CARBON POOL REPORTED[1]						GREENHOUSE GAS SOURCES REPORTED[2]							
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		Fertilization[5]	Drained, rewetted and other soils[6]		Nitrogen mineralization in mineral soils[8]	Indirect N_2O emissions from managed soil[5]	Biomass burning[9]		
					Mineral	Organic[3]	N_2O	$CH4$[7]	N_2O	N_2O	N_2O	CO_2[10]	CH_4	N_2O
R	21	14	5	5	21	14		6		17		4	8	8
NO	0	2	9	11	0	4		10		1		10	8	8
NA	3	4	6	5	3	5		7		4		6	5	5
NE	0	0	0	0	0	0		1		0		0	0	0
NR	0	0	1	2	0	0		0		0		0	0	0
IE	0	4	1	1	0	0		0		1		2	1	1
Tot	24	24	22	24	24	23		24		23		22	22	22
Not Complete	2	2	2	2	2	2		2		2		2	2	2
Not correct	1	1	3	1	1	2		1		2		3	3	3

✓ AG Biomass and mineral soils pools are reported most often.

European Commission

Grazing Land Management: Completeness

GM	CHANGE IN CARBON POOL REPORTED(1)							GREENHOUSE GAS SOURCES REPORTED(2)							
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		HWP(4)	Fertilization(5)	Drained, rewetted and other soils(6)		Nitrogen mineralizat	Indirect N_2O emiss	Biomass burning(9)		
					Mineral	Organic(3)		N_2O	$CH4^{(7)}$	N_2O	N_2O	N_2O	CO_2(10)	CH_4	N_2O
Austria	R	R	R	R	R	R			R		R		R	R	R
Belgium	R	R	NO	NO	R	R			R		R		NO	NO	NO
Bulgaria	NA	NA	NA	NA	NA	NA			NA		NA		NA	NA	NA
Croatia	R	R	NO	NO	R	R			NO		NO		R	R	R
Cyprus															
Czech Republic	NA/R	NA/R	NA/R	NA/R	NA/R	NA/R			NA/NO		NA/NO		NA/NO	NA/NO	NA/NO
Denmark	R	R	NO	NO	R	R			R		R		R	R	R
Estonia	R	R	NO	R	R	R			NA		NO		IE, NO	R	R
Finland	R	R	R	R	R	R			R		R		R	R	R
France	R	R	R	R	R	R			R		R		R	R	R
Germany	R	R	IE	IE	R	R			R		R		NO	NO	NO
Greece	R	IE	NO	NO	R	NO			NO		R		NO	R	R
Hungary	NA	NA	NA	NA	R	NA			NA		R		IE	R	R
Ireland	R	IE	NO	NO	R	R			R		IE		NO	R	R
Italy	NO	NO	NO	NO	R	NO			NO		NO		NO	NO	NO
Latvia	R	IE	NA	R	R	R			R		R		NA	R	R
Lithuania	R	IE	R	NO	R	R			R		NO		NO	R	R
Luxembourg	R	R	NO	NO	R	NA			NA		NA		NA	NA	NA
Malta	NO	NO	NO	NO	NO	NO			NO		NO		NO	NO	NO
Netherlands	R	R	NO	NO	R	R			NE		R		R	R	R
Poland	R	R	R	R	R	R			NO		NO		R	R	R
Portugal	R	R	R	NO	R	NO			NO		R		R	R	R
Romania	NA	NA	NA	NA	NA	NA			NA		NA		NA	NA	NA
Slovakia	R	NO	NO	NO	R	NO			NO		R		NO	NO	NO
Slovenia	R	R	R	R	R	NO			NO		NO		NE	NE	NE
Spain	NR	NR	NR	NR	R	NO			NO		NE		NE	NE	NE
Sweden	R	R	R	R	R	R			R		R		R	R	R

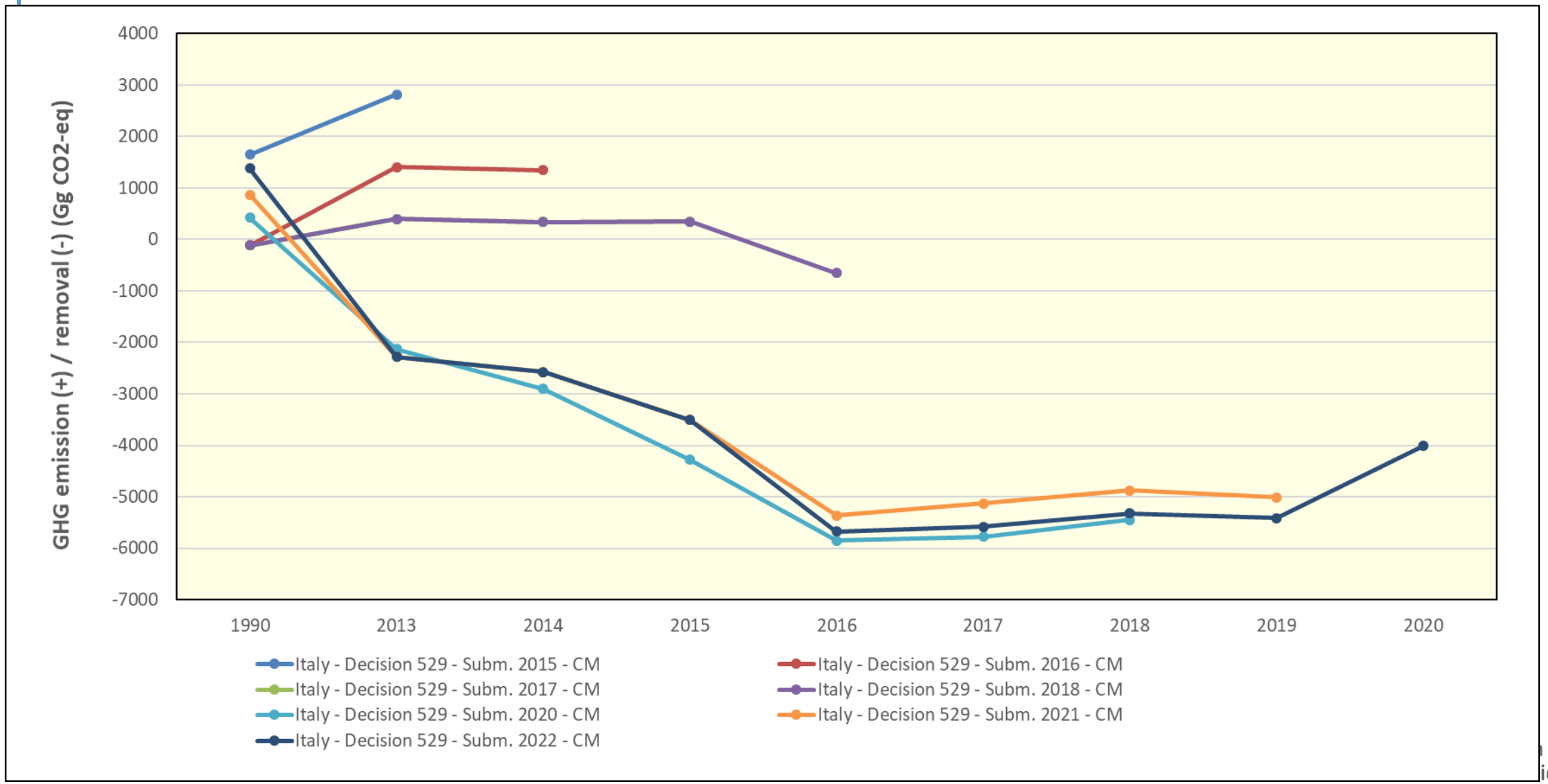
Grazing Land Management: Completeness

GM	CHANGE IN CARBON POOL REPORTED(1)						GREENHOUSE GAS SOURCES REPORTED(2)								
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		Fertilization(5)	Drained, rewetted and other soils(6)		Nitrogen mineralization in mineral soils(8)	Indirect N_2O emissions from managed soil(5)	Biomass burning(9)		
					Mineral	Organic(3)	N_2O	$CH4$(7)	N_2O	N_2O	N_2O	CO_2(10)	CH_4	N_2O
R	20	15	9	9	23	15		10		13		9	15	15
NO	2	3	11	12	1	7		9		7		8	5	5
NA	3	3	4	3	2	4		6		4		5	4	4
NE	0	0	0	0	0	0		1		1		2	2	2
NR	1	1	1	1	0	0		0		0		0	0	0
IE	0	4	1	1	0	0		0		1		2	0	0
Tot	26	26	26	26	26	26		26		26		26	26	26
Not Comple	1	1	1	1	1	1		1		1		1	1	1
Not correct	0	0	0	0	0	0		0		0		0	0	0

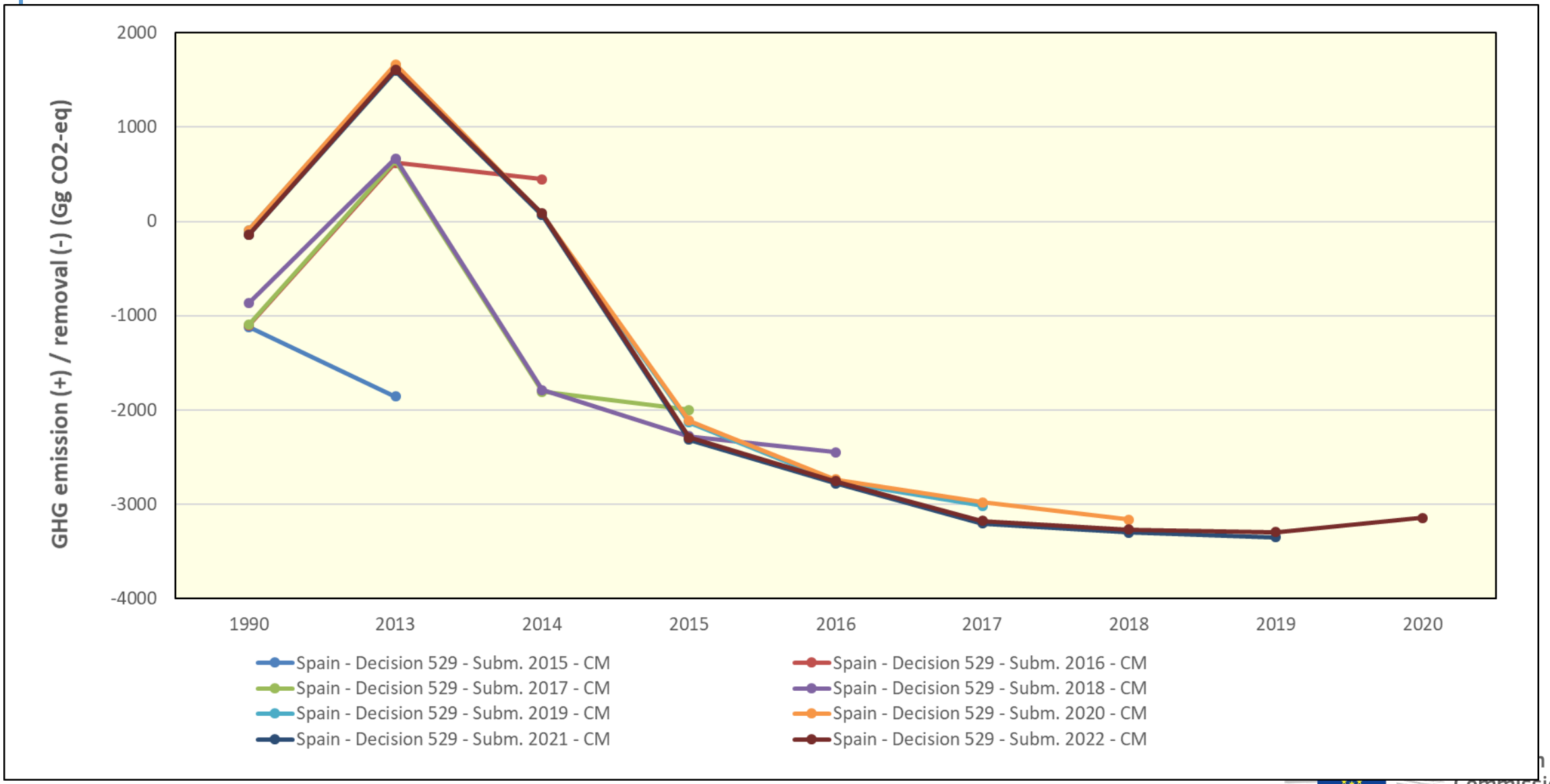
✓ Mineral soils pool is reported most often, followed by AG biomass.

European Commission

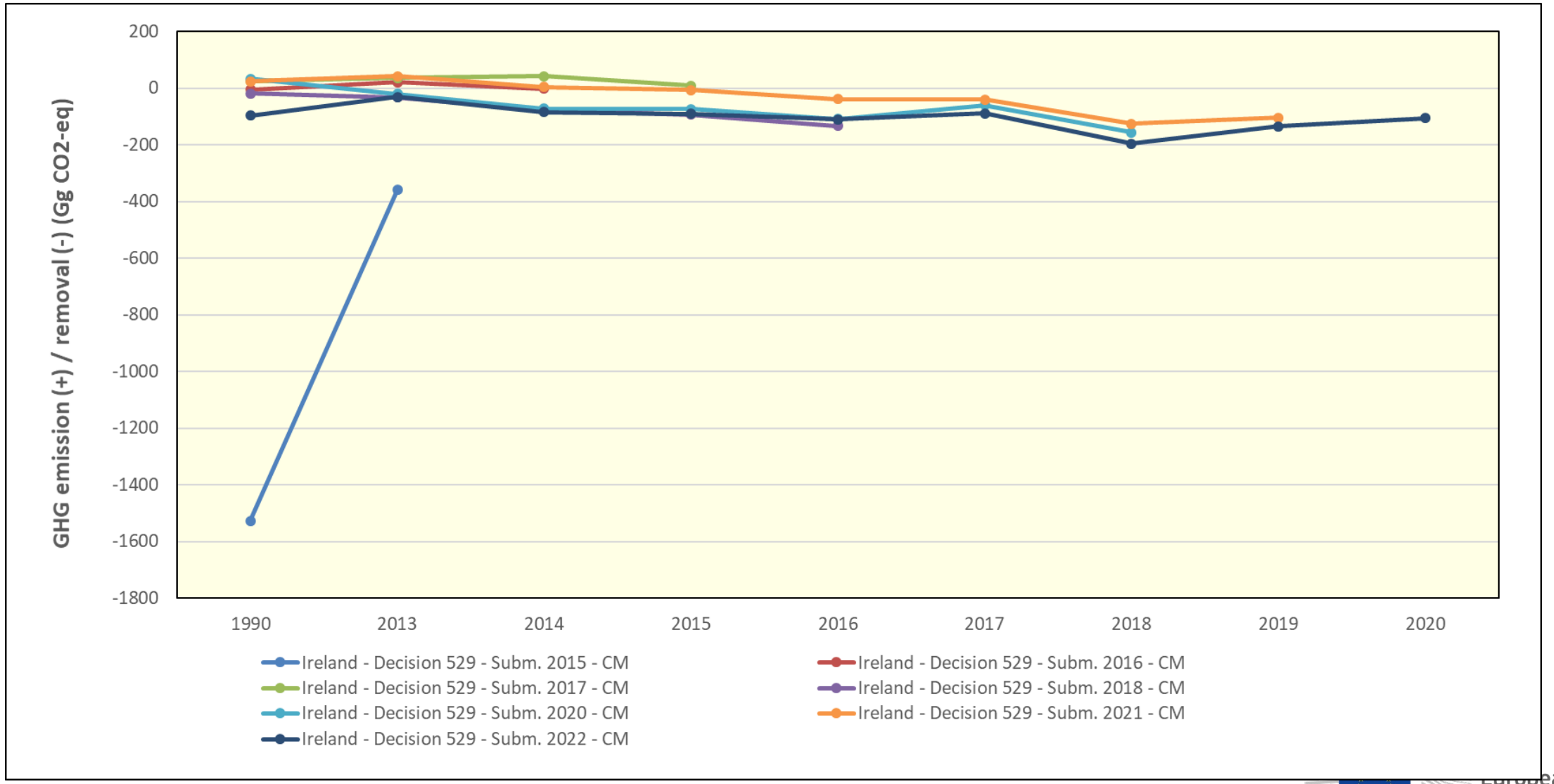
Differences among submissions:
Adjusting the trajectory, Improving the methodology



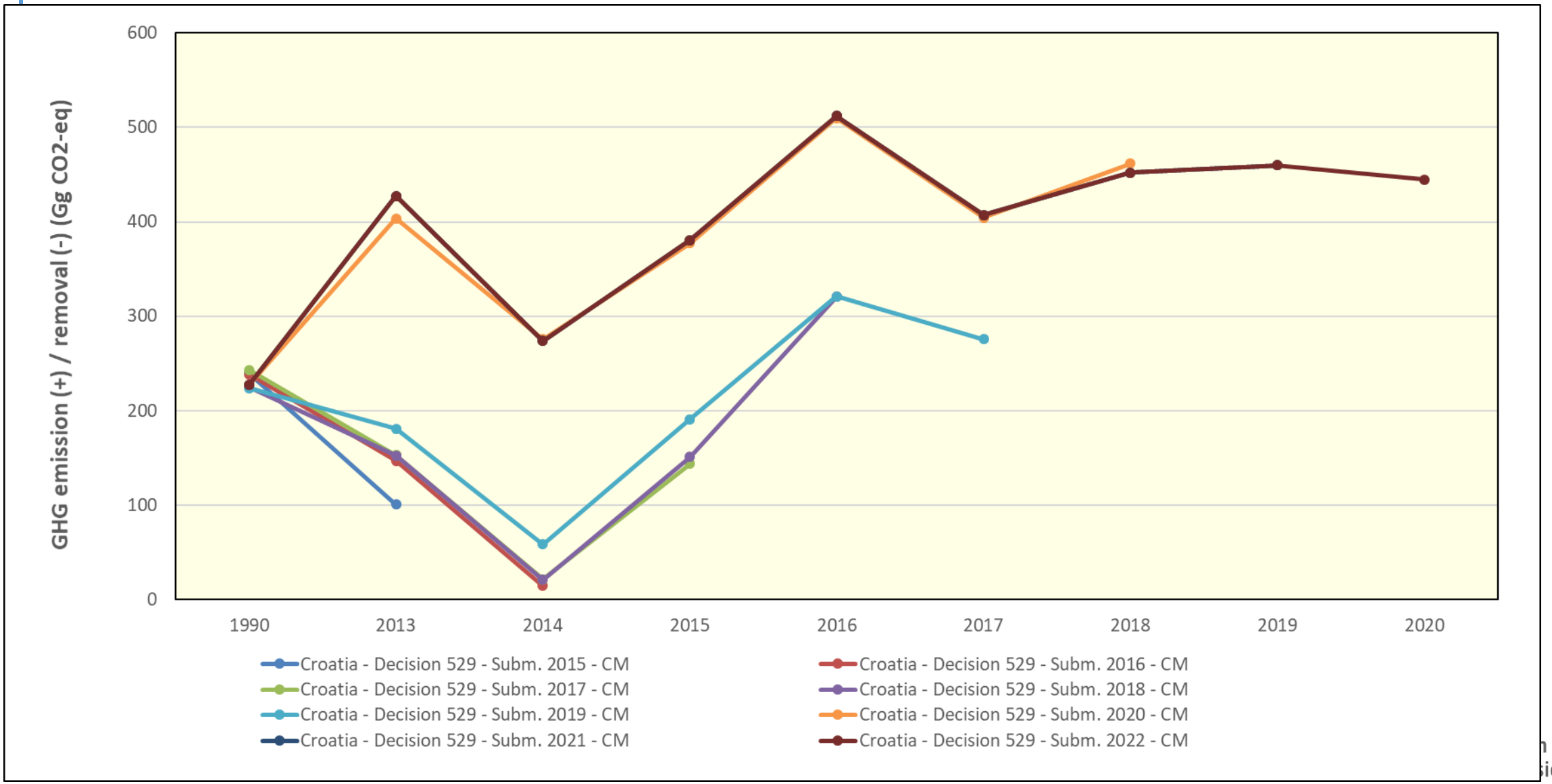
Differences among submissions:
Adjusting the trajectory, Improving the methodology



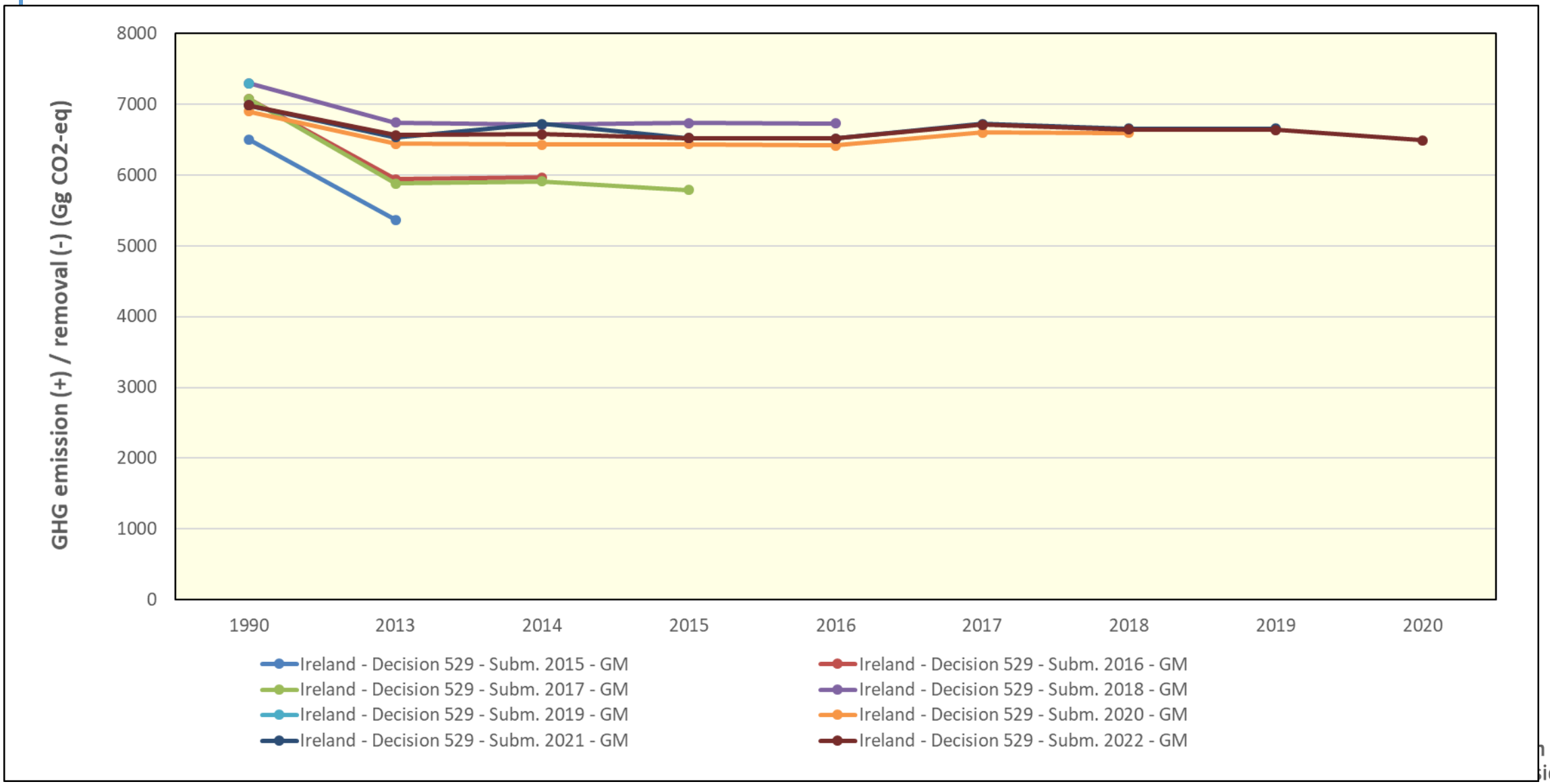
Differences among submissions:
Adjusting the trajectory, Improving the methodology

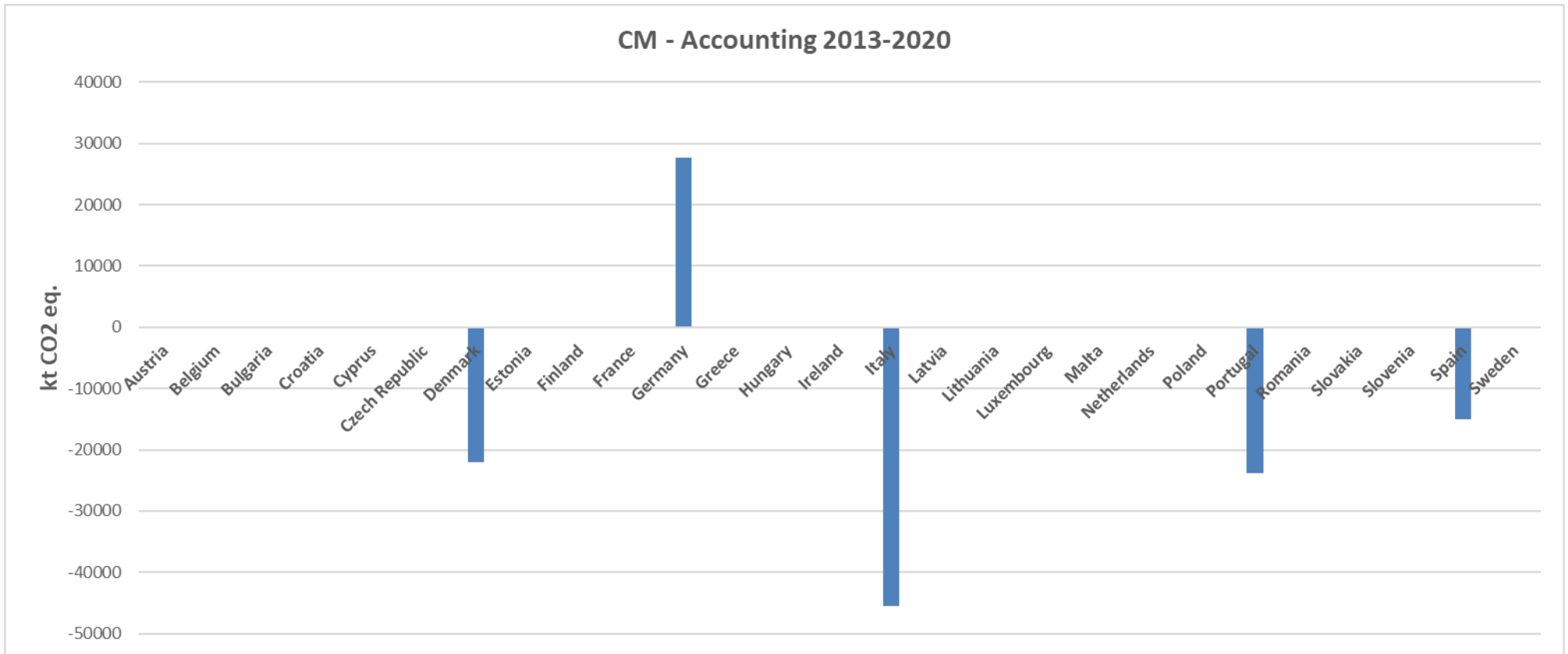


Differences among submissions:
Adjusting the trajectory, Improving the methodology



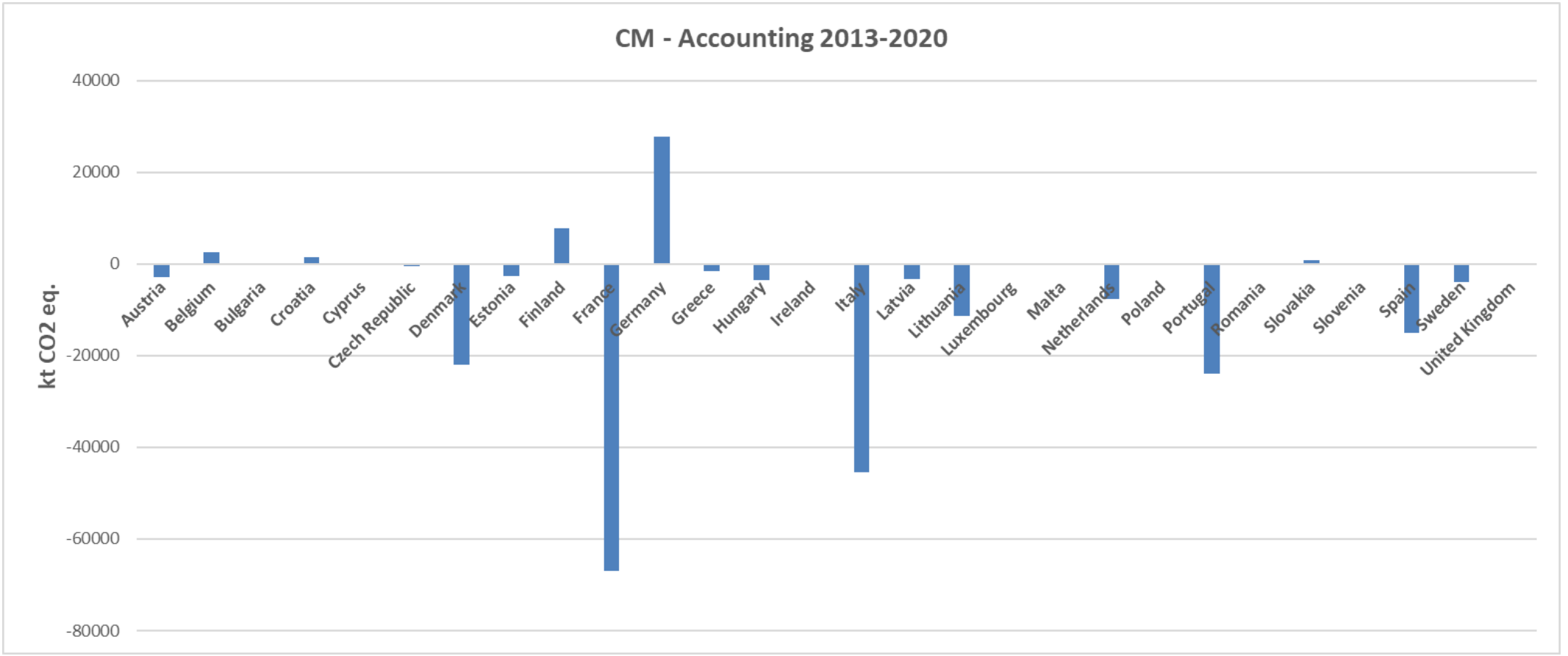
Differences among submissions:
Adjusting the trajectory, Improving the methodology



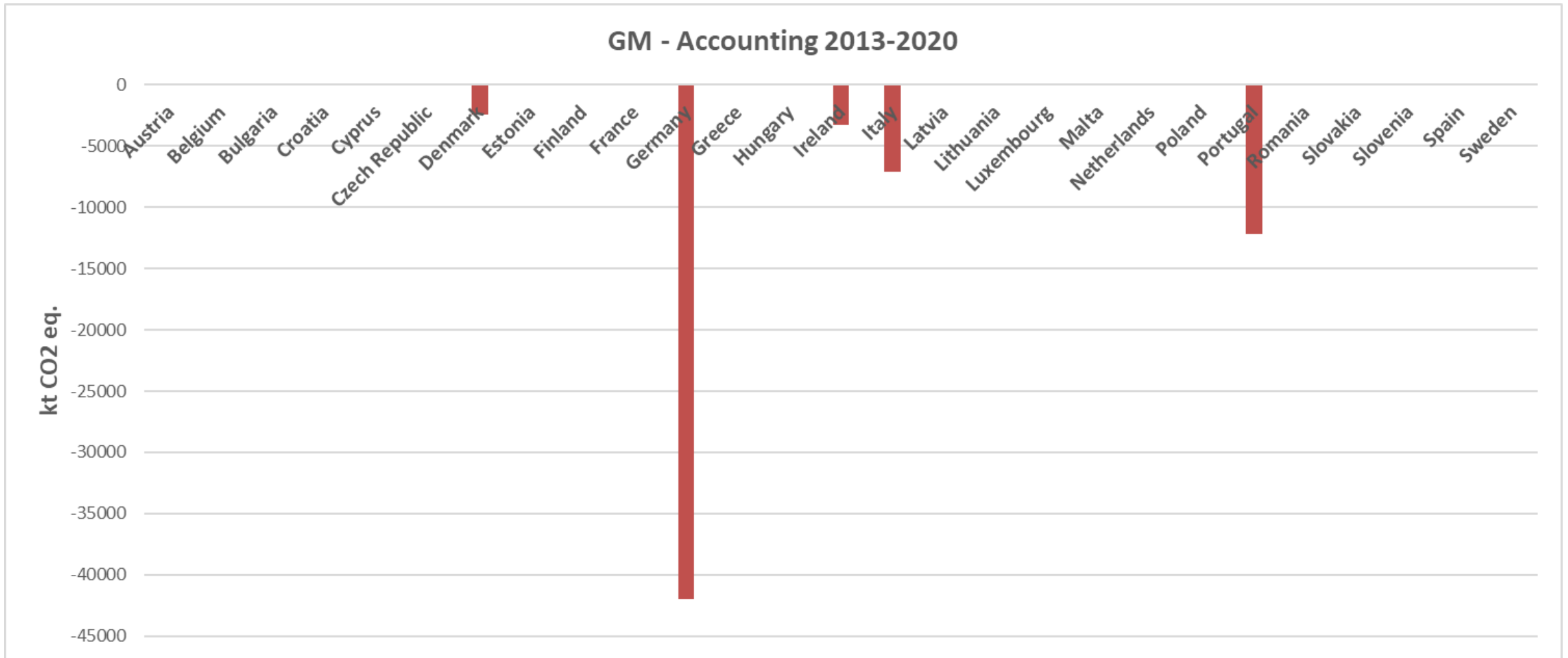


European Commission

Accounting: KP and Decision 529



European Commission

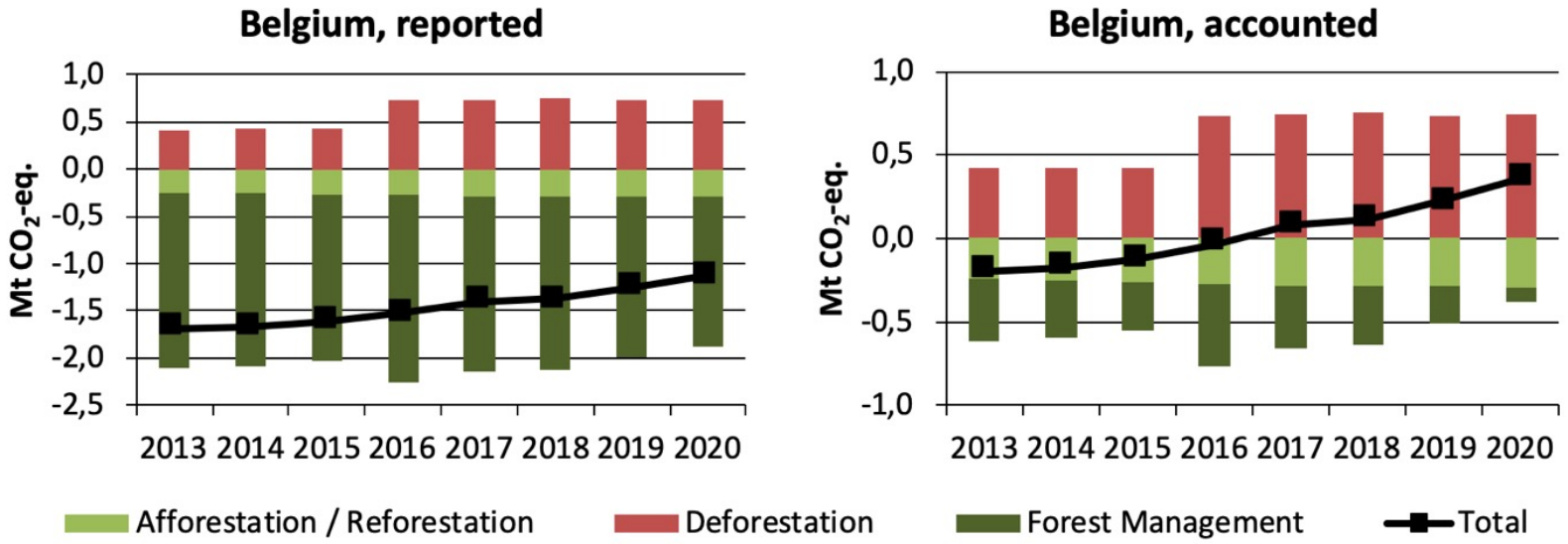


European Commission

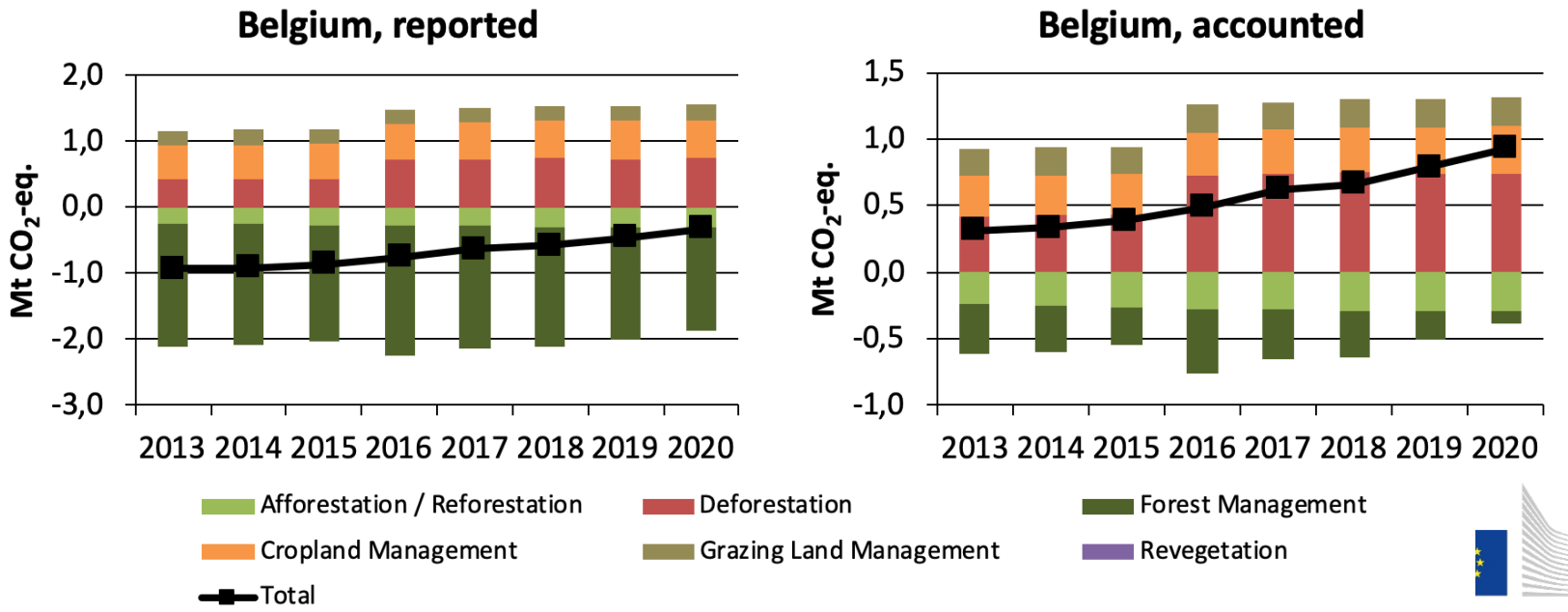
European Commission

Accounting: Decision 529 “completing” KP

KP



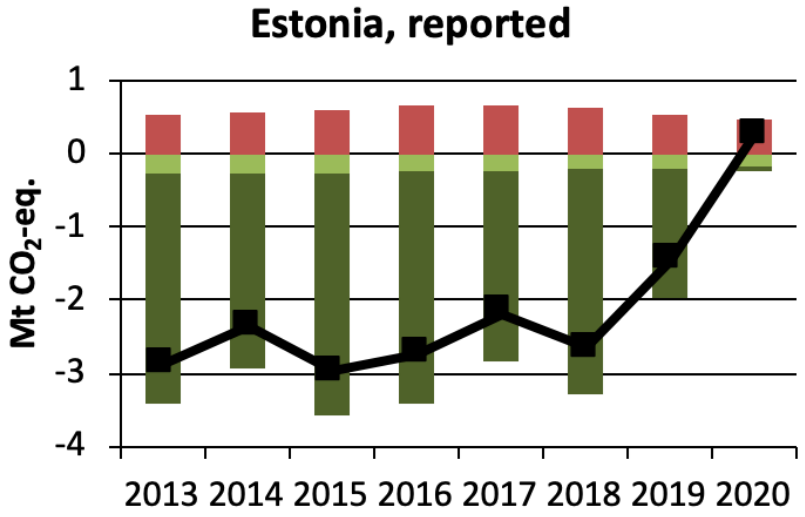
KP + Dec.529

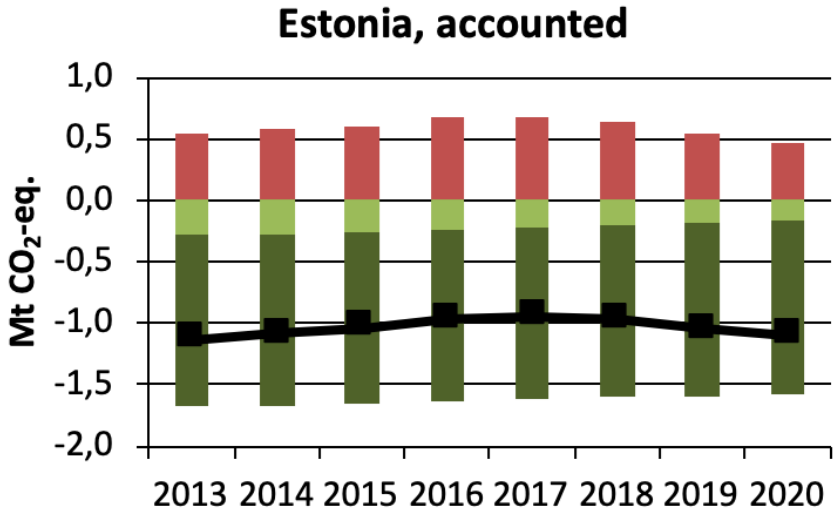


European Commission

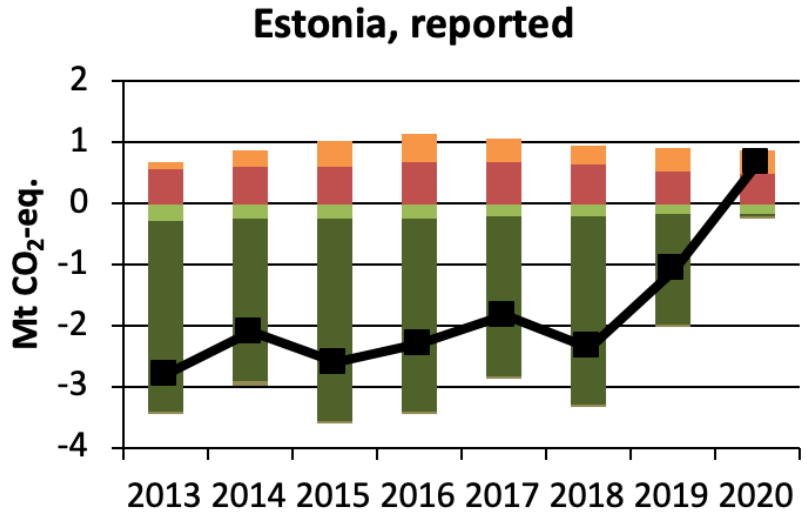
Accounting: Decision 529 “completing” KP

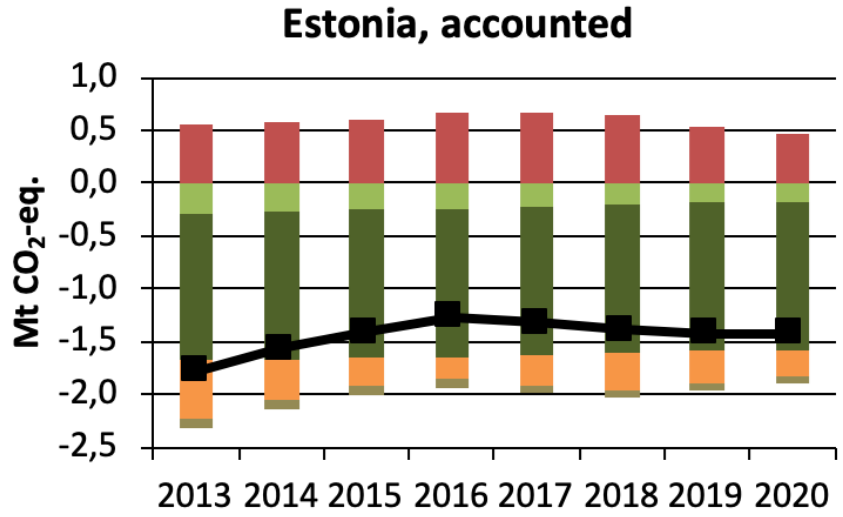
KP





KP + Dec.529



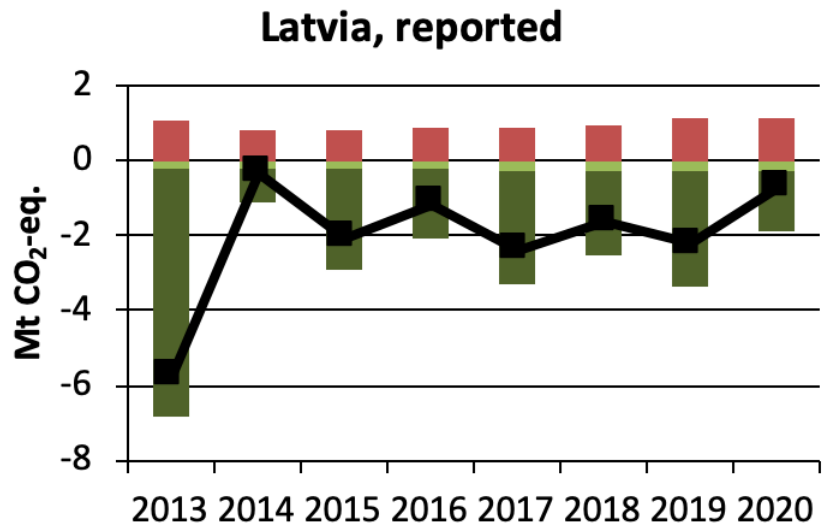


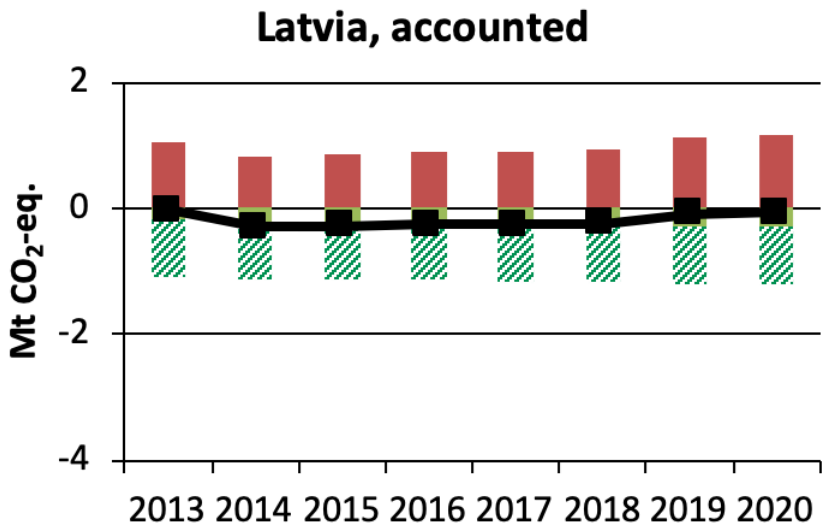
Afforestation / Reforestation
Deforestation
Forest Management
Cropland Management
Grazing Land Management
Revegetation
Total

European Commission

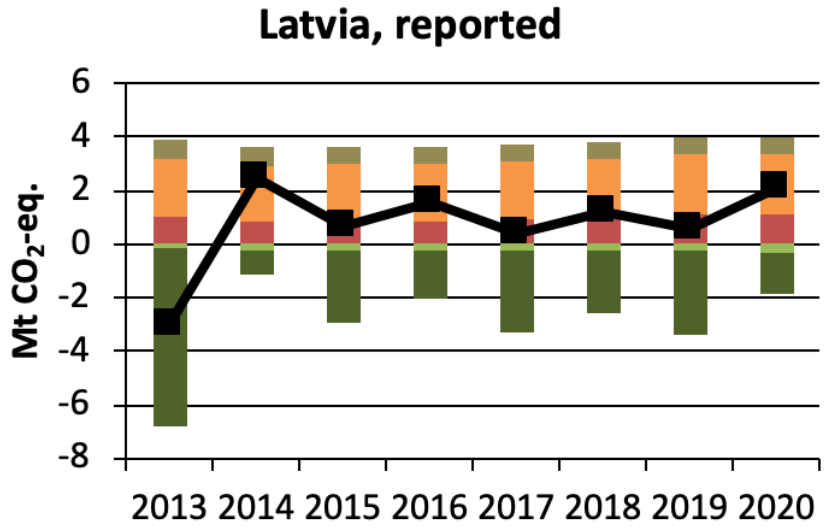
Accounting: Decision 529 “completing” KP

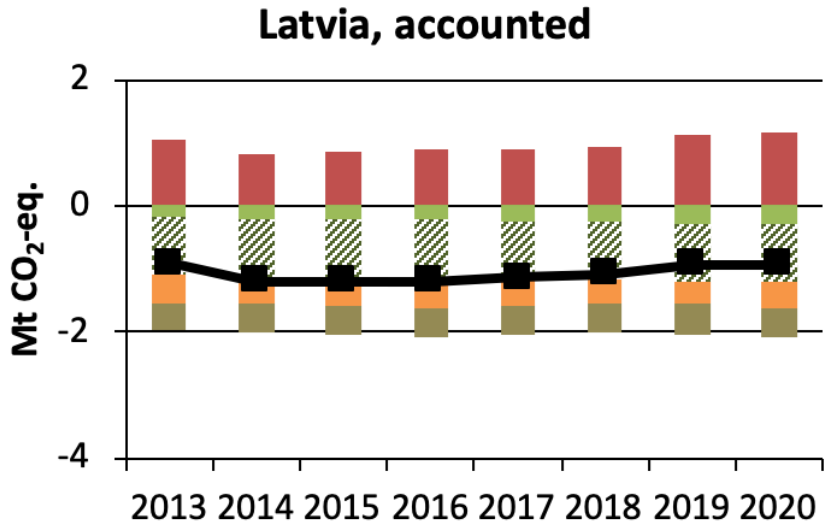
KP





KP + Dec.529



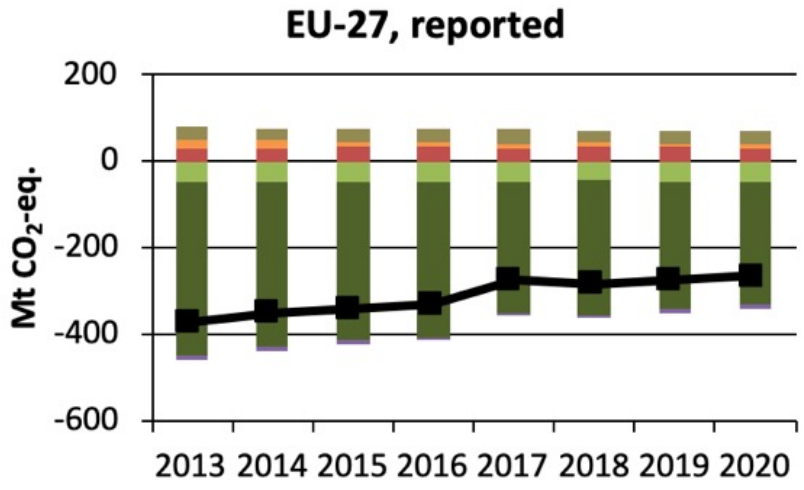


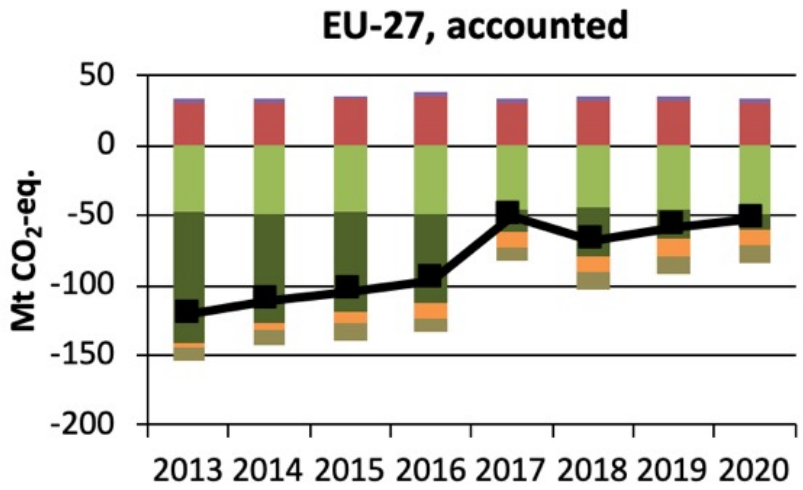
Afforestation / Reforestation
Deforestation
Forest Management
Cropland Management
Grazing Land Management
Revegetation
Total

European Commission

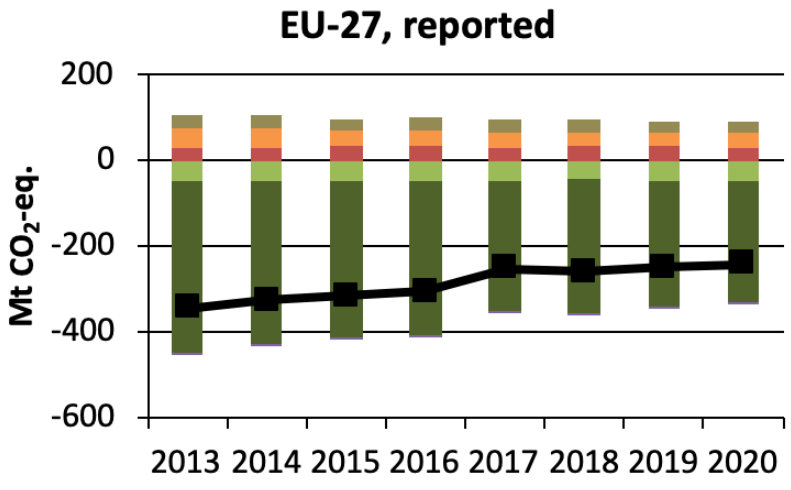
Accounting: Decision 529 “completing” KP

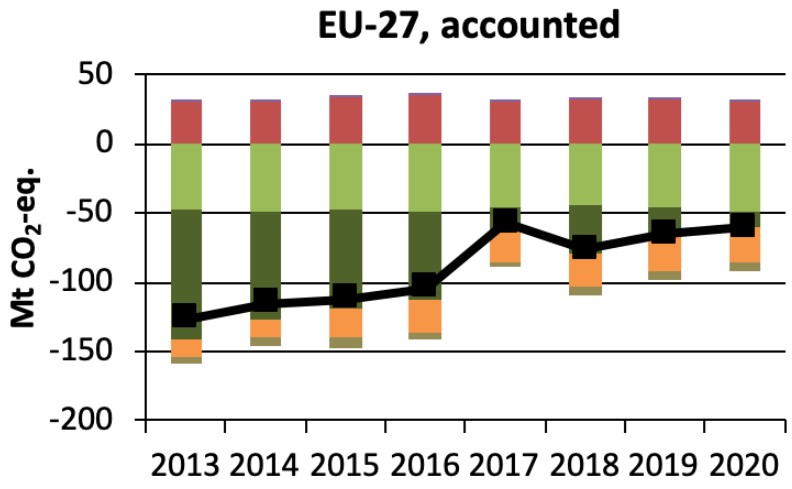
KP

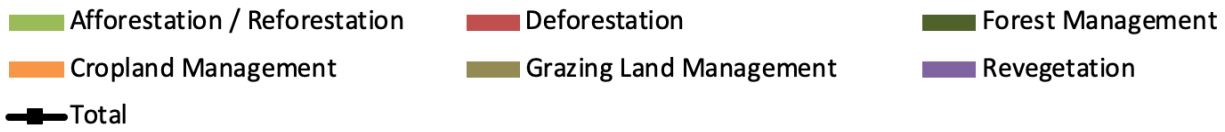




KP + Dec.529







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Conclusions

- The observed increased stability in the estimates in following submissions after initial quite variable results shows the reaching of more robust and established methodologies for CM and GM estimations.

- The increasingly reliable results obtained as a result of Decision 529 on CM and GM can be used to complement the official KP estimates on mandatory and elected activities (art. 3.3 and 3.4) to reach a more complete accounting.

Thank you for your attention!

European Commission

Annex 5

Progress made in LULUCF reporting and lessons learnt, 2013 to 2020

JRC presentation in Working Group 5 meeting by G. Grassi et al.

Progress made in LULUCF reporting and lessons learnt, 2013 to 2020

Giacomo Grassi, Anu Korosuo, Simone Rossi
Joint Research Centre (JRC), European Commission

with contribution from Raul Abad Vinas

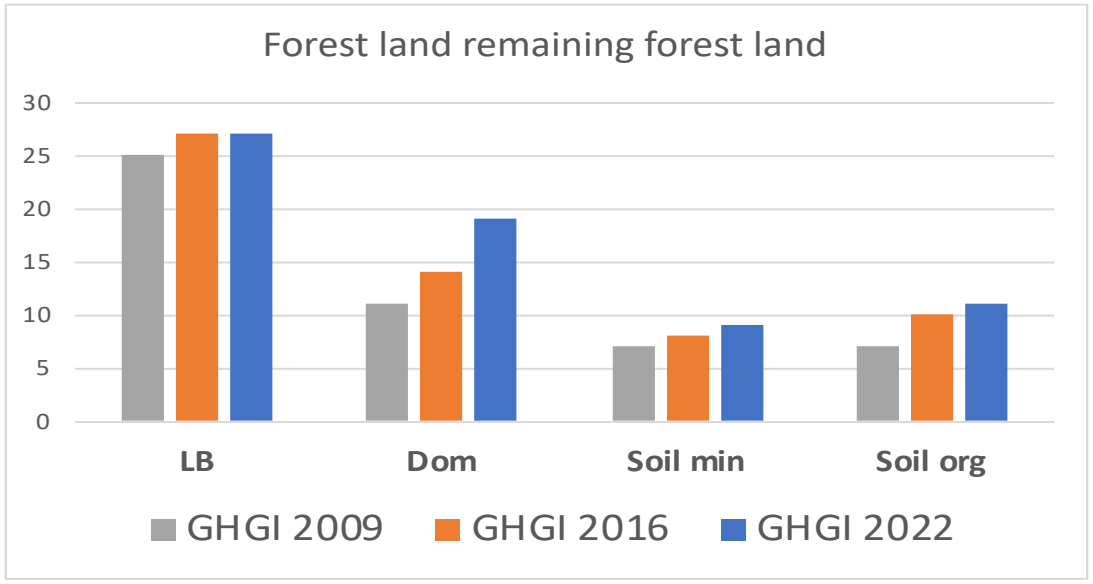
WG5 – 19 April 2023

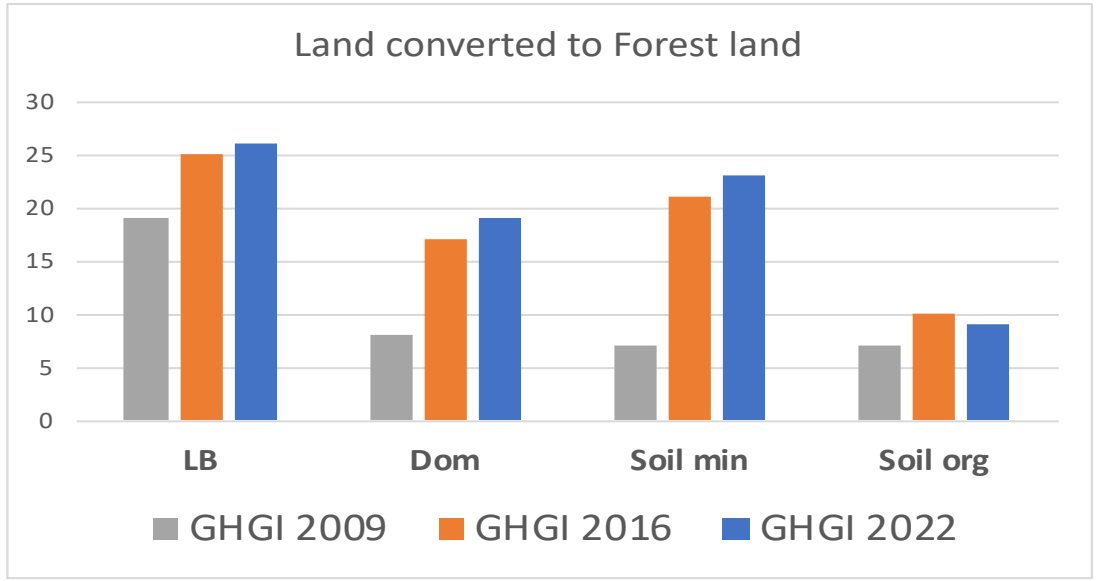
European Commission

OUTLINE

- Completeness (pools and gases)
- Recalcualtions
- Outcomes of the reviews (UNFCCC and EU)
- Verification activities
- Lesson learnt on accounting the forest sink
- Where are we, relative to new reporting requirements of 2018/841?
- Conclusions

Completeness – Forest land (CRF table 4.A)





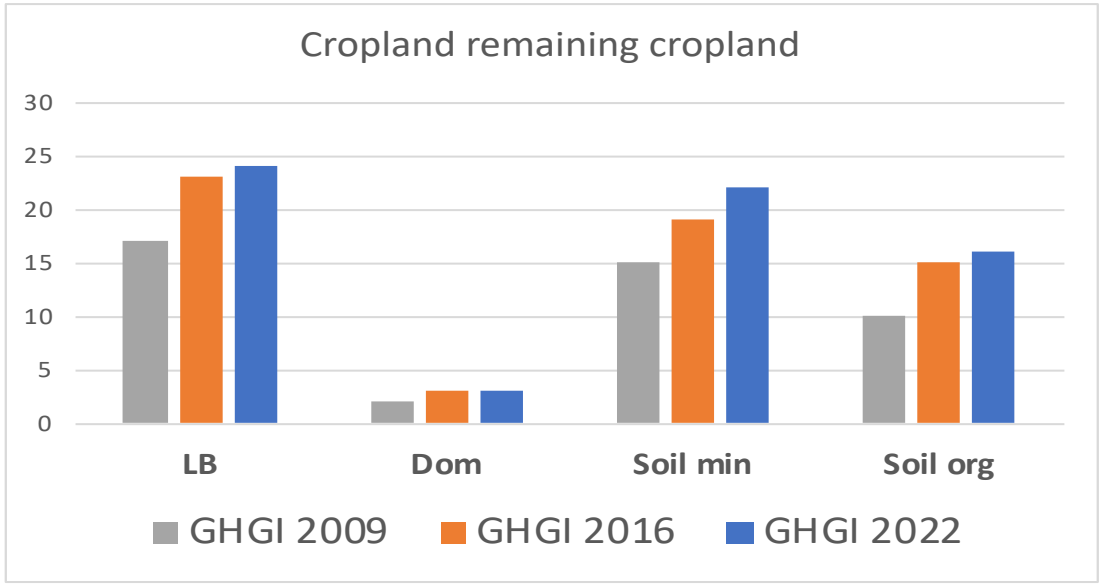
FL is the most important LULUCF category and thus has received the greatest attention since the beginning.

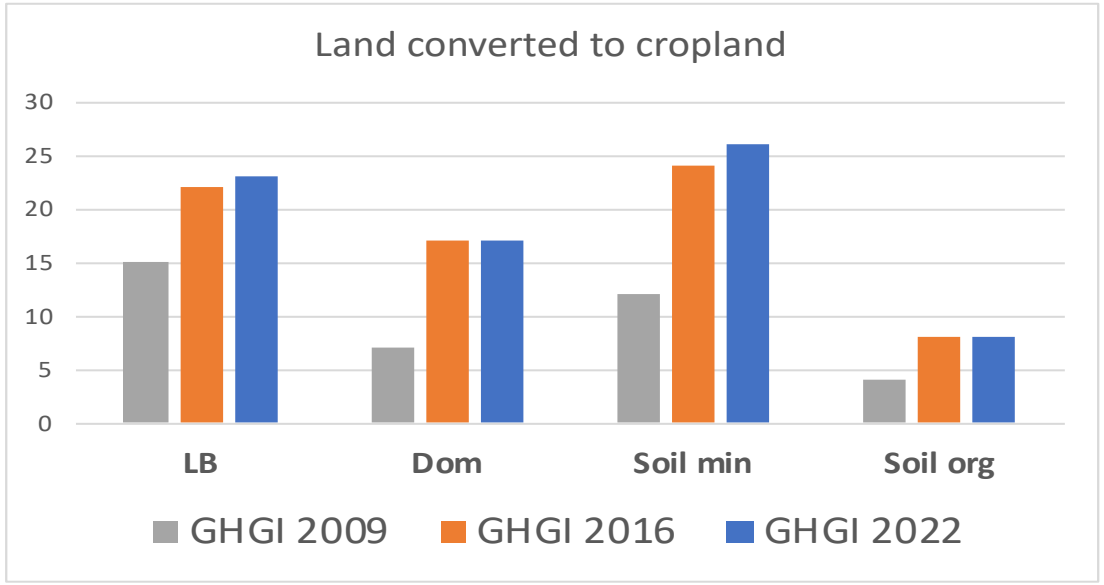
Most of the MS counts on NFIs that allow the reporting of carbon stock changes in LB

Driven by EU and international policies, LULUCF has progressively gained importance. As such, more resources became available for the collection of information on other pools

Developments on the reporting of land use change categories follow the improvement on the land representation systems of the countries .

Completeness – Cropland (CRF table 4.B)



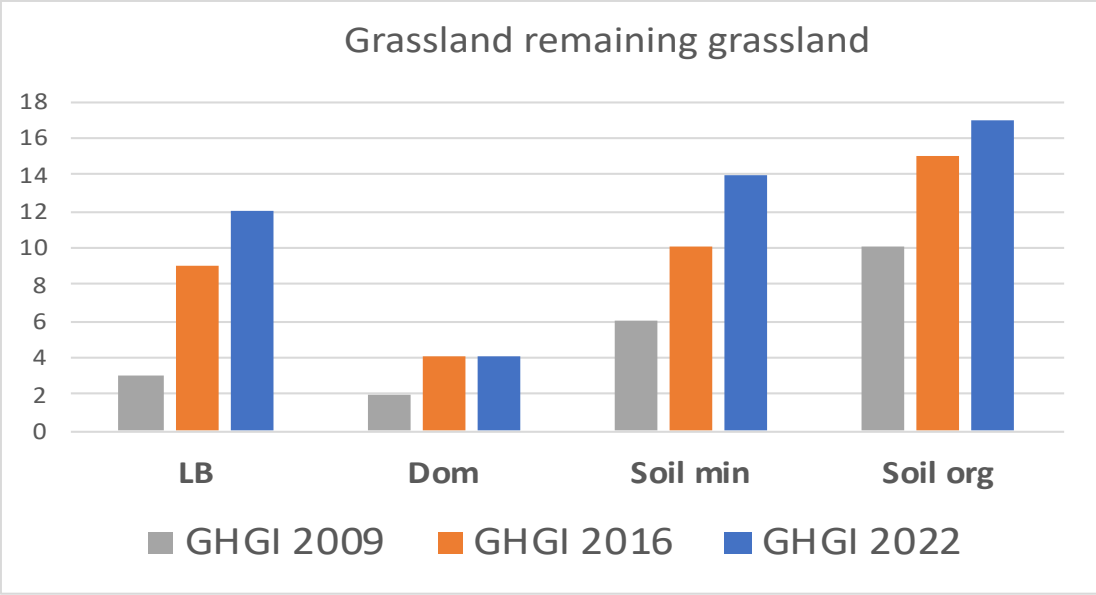


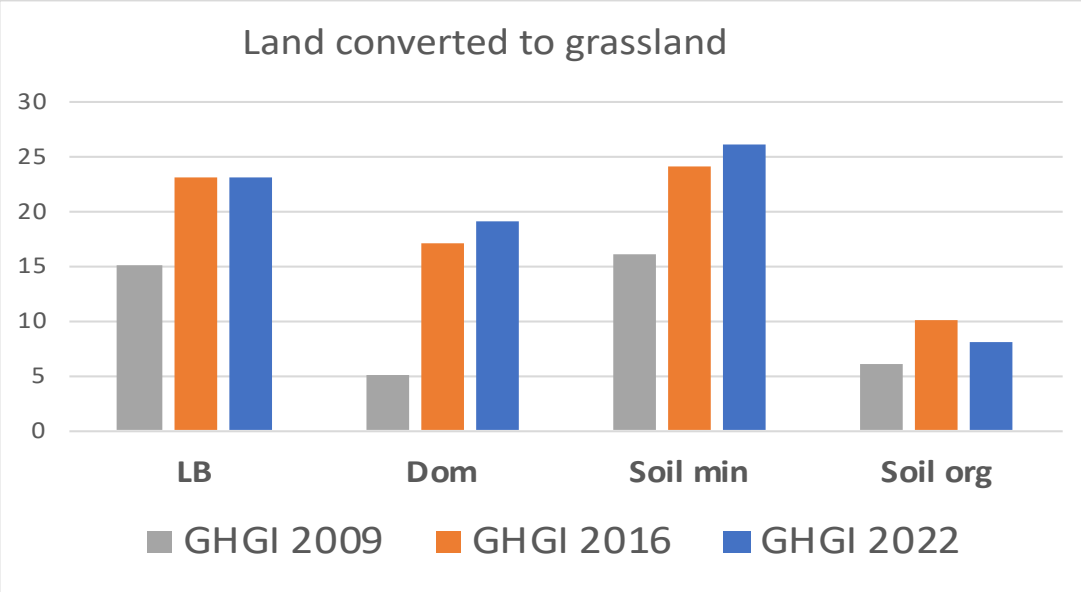
For most MS, CL is the main contributor of emissions in LULUCF (carbon oxidation in soils and non-CO2 emissions).

Mediterranean countries report significant sink in living biomass from woody crops that for some countries and years balance out soil emissions.

From a capacity building perspective, this category has received a great attention. Several EU projects and programs have incentivized/supported MS to enhance the reporting of this category. E.g. LPIS, Medinet, LUCAS, Dec 529/2013,

Completeness – Grassland (CRF table 4.C)



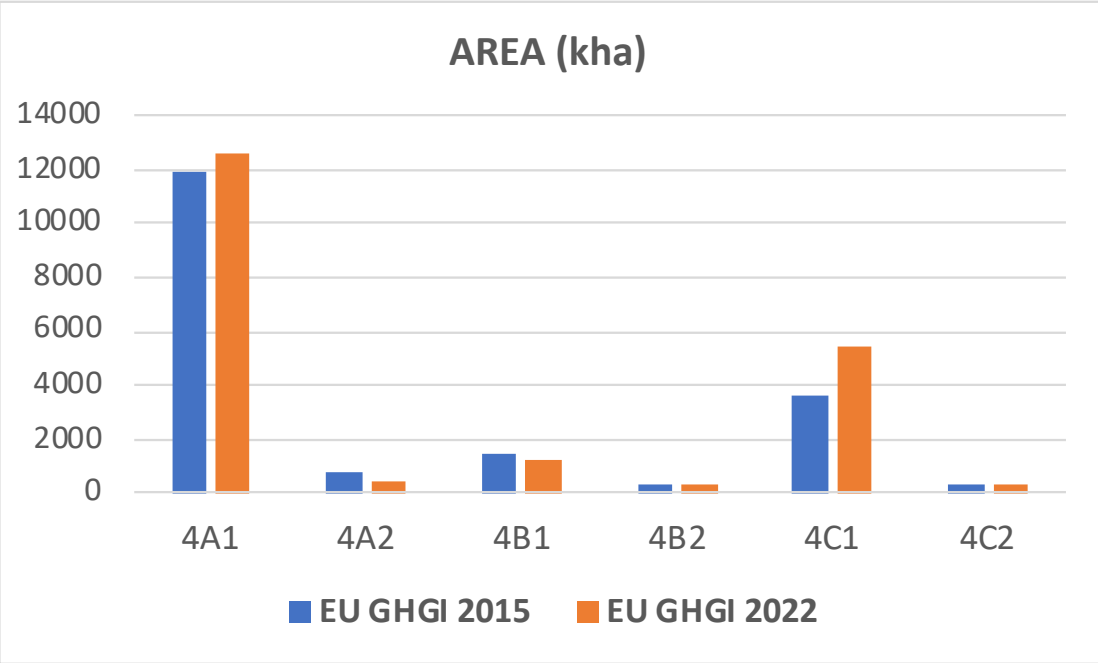


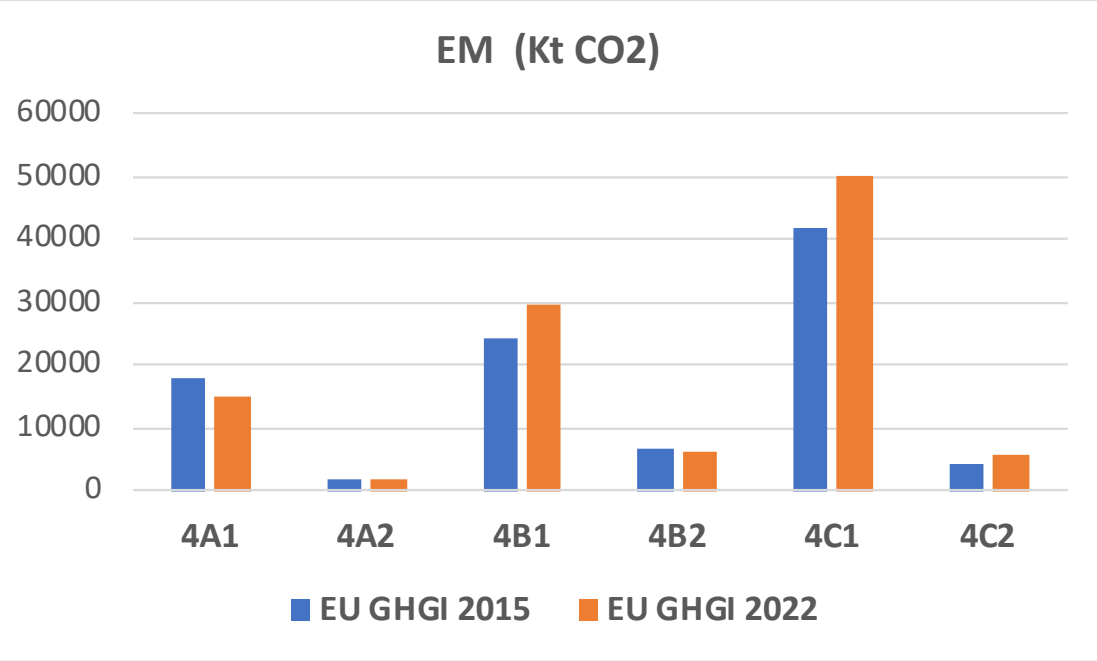
GL is reported either a a source or as a sink depending on the level of disaggregation used to classify lands under this category, the presence of organic soils and the impact of wildfires on these lands.

The attention on the reporting of this category is increasing, going beyond the assumption of Tier1 “carbon equilibrium”

Enhanced land monitoring systems allow nowadays further disaggregation on subcategories of grassland areas which contributes to enhance the completeness of reporting GL.

Reporting Organic soils





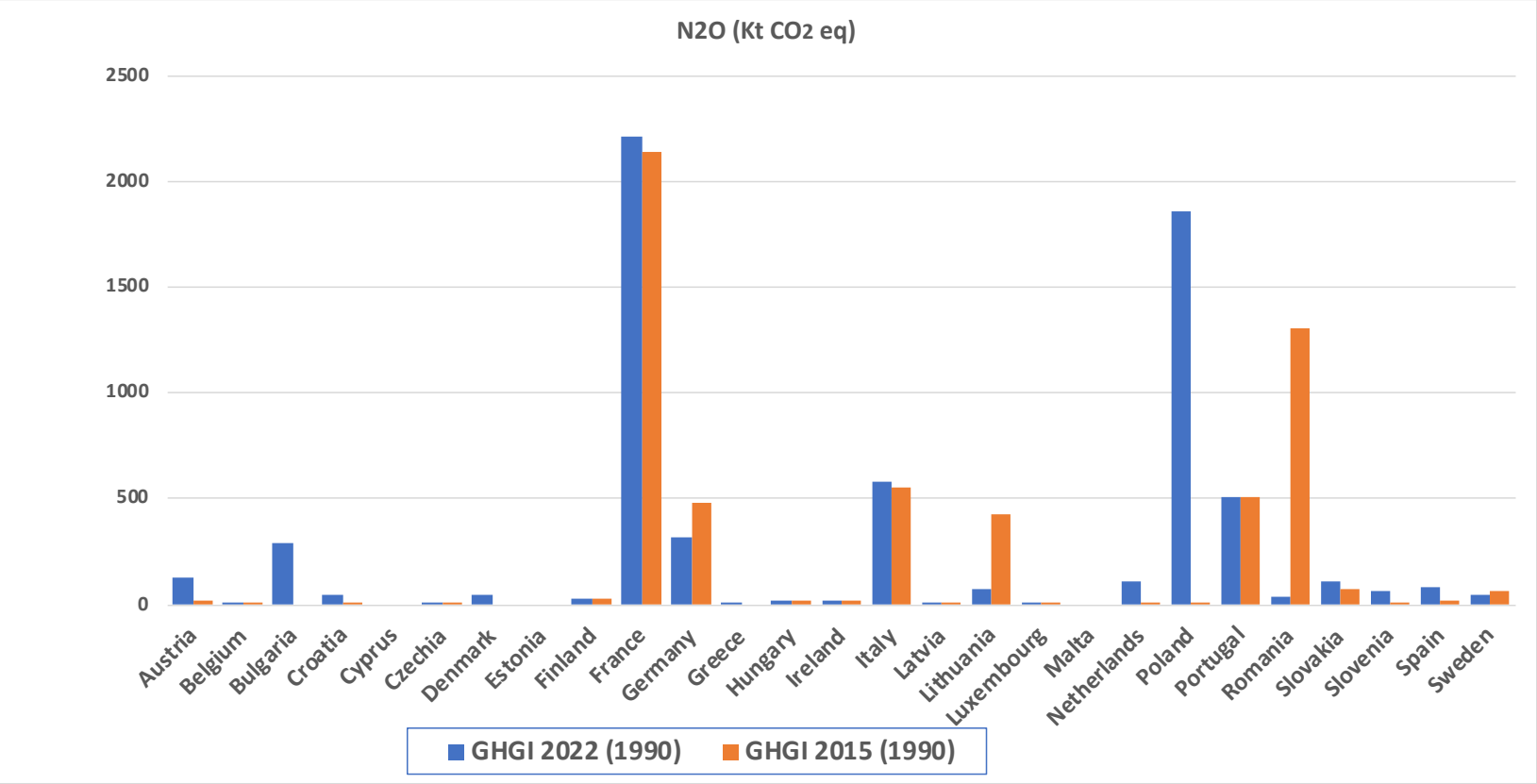
The reporting of emissions from organic soils has in overall undergone minor developments.

In specific cases, dedicated studies were carried out to update the information on the extension of these areas, and on oxidation rates of the carbon.

The IPCC Wetlands supplement has also contributed to refinements in the reporting of this pool by some countries.

Main sources of non-CO2 emissions – N2O 4(III)

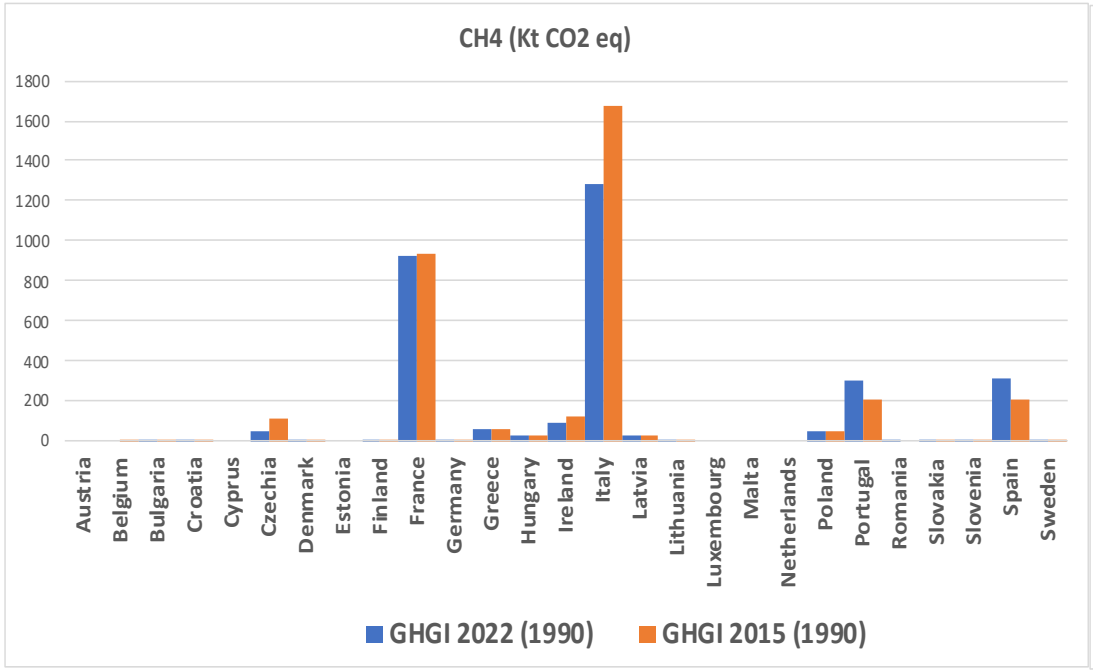
(N2O) emissions associated with loss/gain of SOCmin resulting from change of land use or management – 4 (III).

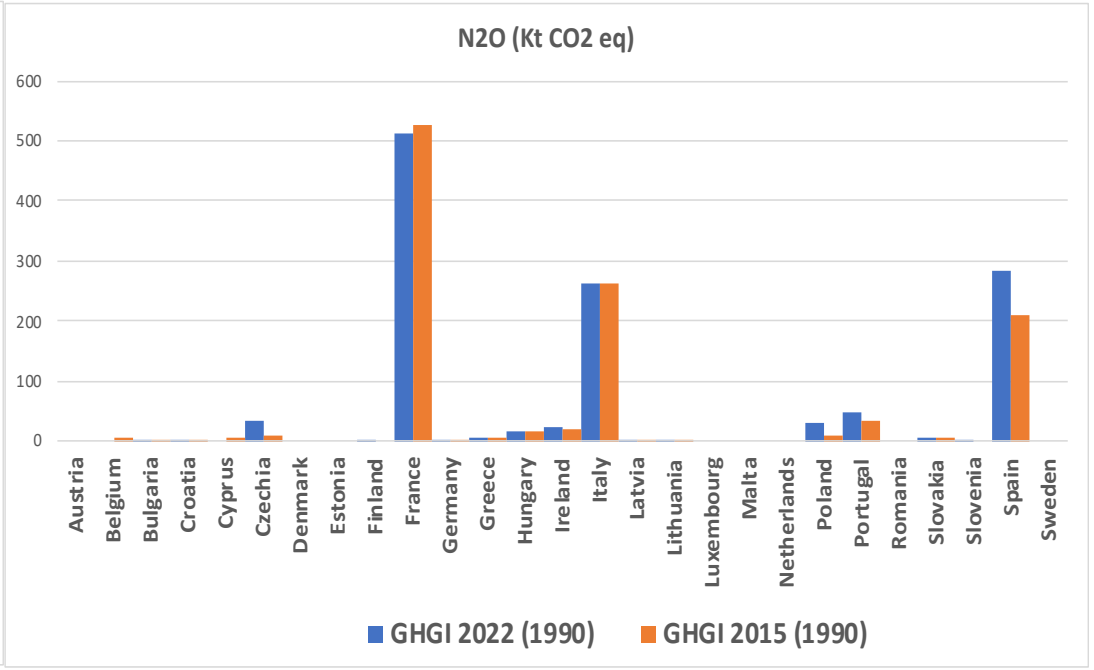


With the exception of wildfires, the reporting of non-CO2 emissions has often received less attention, from both the reporting and reviewers perspectives

The way the CRF tables display the information also hinders a full understanding of what is being reported and the consistency with the reporting of associated CSC. In the last years, aligned with developments on the reporting of SOC, also reporting of non-CO2 emissions in table 4 (III) has received more attention.

Main sources of non-CO2 emissions - Biomass burning 4(V)

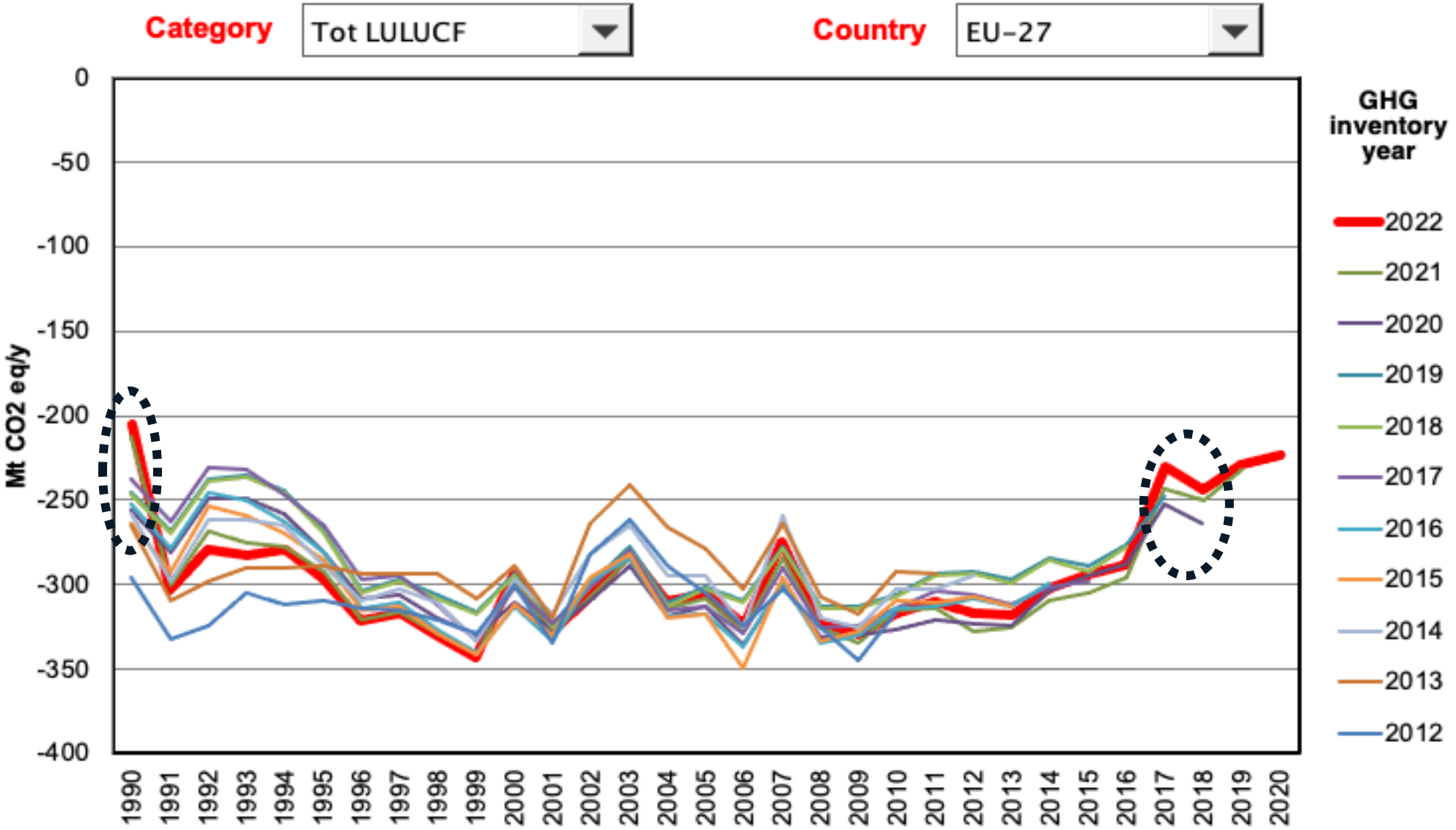




Emissions from biomass burning have always received attention in Mediterranean countries, and more recently also in northern countries.

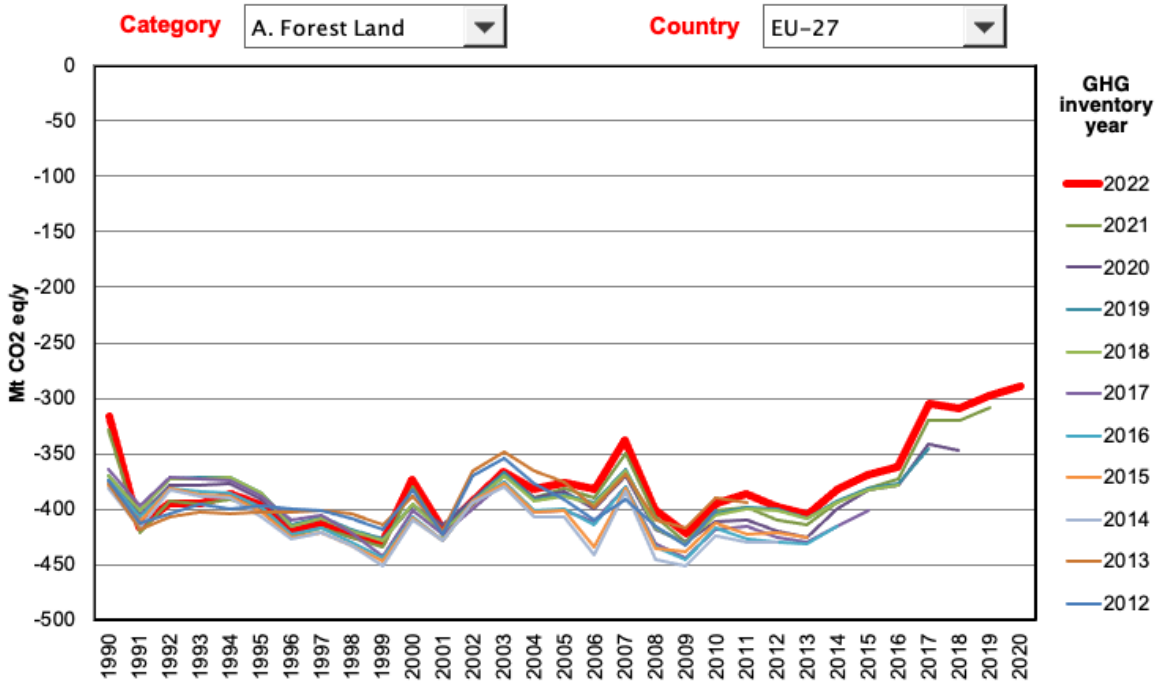
Overall, the reporting of this source often lacks transparency to understand how burned areas are assigned under land use categories. And also, it is often difficult to understand how emissions are estimated and the treatment given to burned areas in subsequent years. Available EU and global wide datasets are available, which potentially could be used to enhance and verify the reporting of this information.

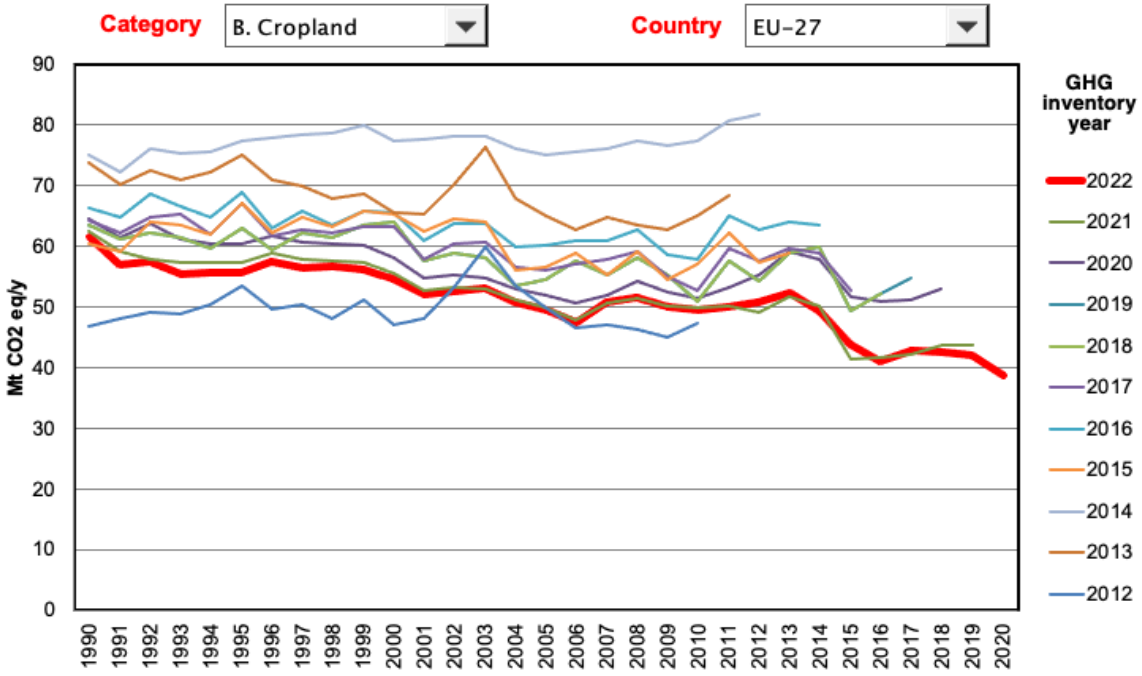
Recalculations

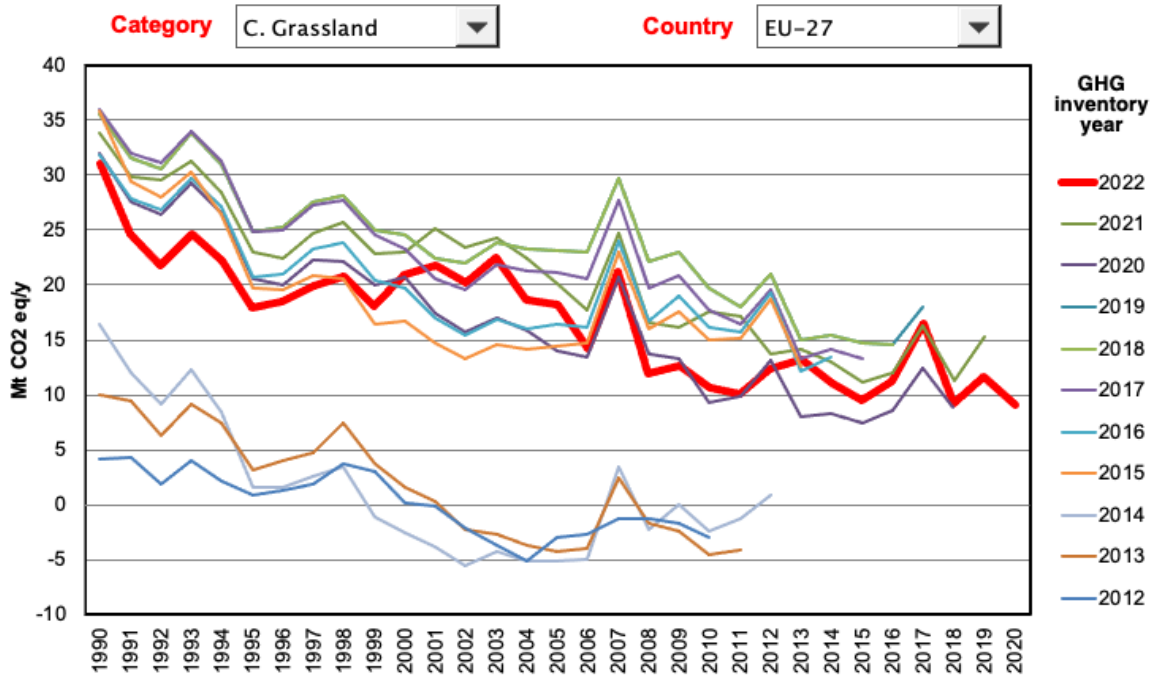


European Commission

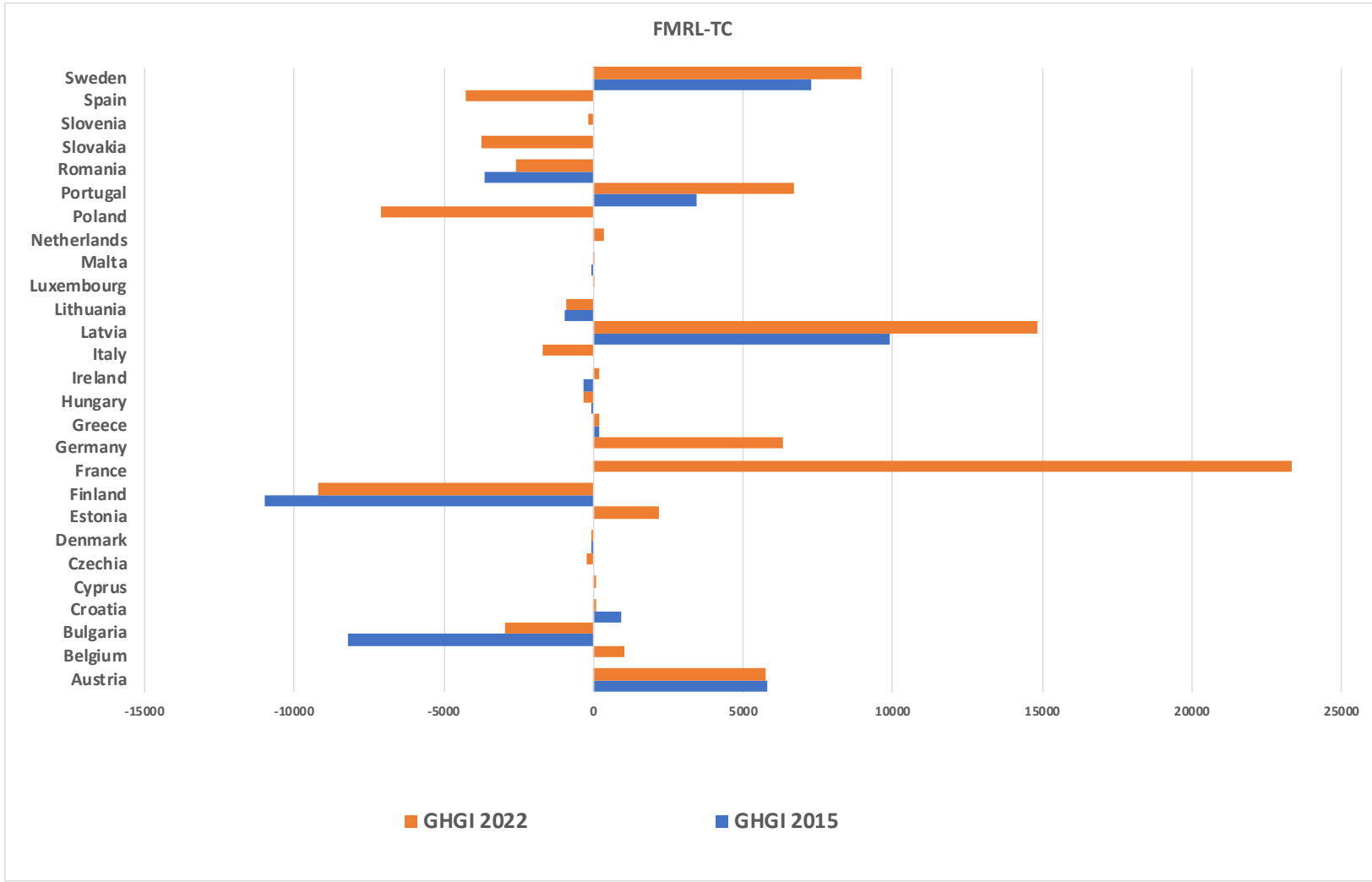
Recalculations







Recalculation of information on FMRL-TC



MS	FMRL	TC	
		GHGI 2015	GHGI 2022
Austria	-6516	5823	5774
Belgium	-2499	NE	1010
Bulgaria	-7950	-8207	-2942
Croatia	-6289	905	97
Cyprus	-157	NA	78
Czechia	-4686	NA	-225
Denmark	409	-83	-83
Estonia	-2741	NE	2164
Finland	-20466	-10975	-9198
France	-67410	NE	23318
Germany	-22418	NE	6331
Greece	-1830	168	210
Hungary	-1000	-40	-334
Ireland	-142	-355	170
Italy	-22166	NE	-1680
Latvia	-16302	9922	14829
Lithuania	-4552	-992	-922
Luxembourg	-418	NA	40
Malta	-49	-2	49
Netherlands	-1425	NE	337
Poland	-27133	NA	-7082
Portugal	-6830	3434	6703
Romania	-15793	-3665	-2578
Slovakia	-1084	NA	-3723
Slovenia	-3171	NE	-161
Spain	-23100	NO	-4261
Sweden	-41336	7268	8943

Examples of comprehensive recalculations in LULUCF reporting systems - moving towards Approach 3 and Tier 3 -

MS	YEAR	LUC	Observation
PRT	2022	LULUCF	The LULUCF was recalculated to incorporate development on AD, EF and methodologies
CZE	2022	FL	The entire category 4.A was recalculated for reporting period to shift to a Tier 3 approach by using the nationally calibrated CBM-CFS3 model (Kurz et al. 2009, Kull et al. 2019)
ROU	2021	AD	The AD was recalculated using explicit geospatial approach for the most accurate determination of areas for each land use category. This also enable a better understanding of carbon dynamics that increase the accuracy of the E/R involving information from scientific studies.

In recent years some MS have implemented significant recalculations of their LULUCF reporting systems.

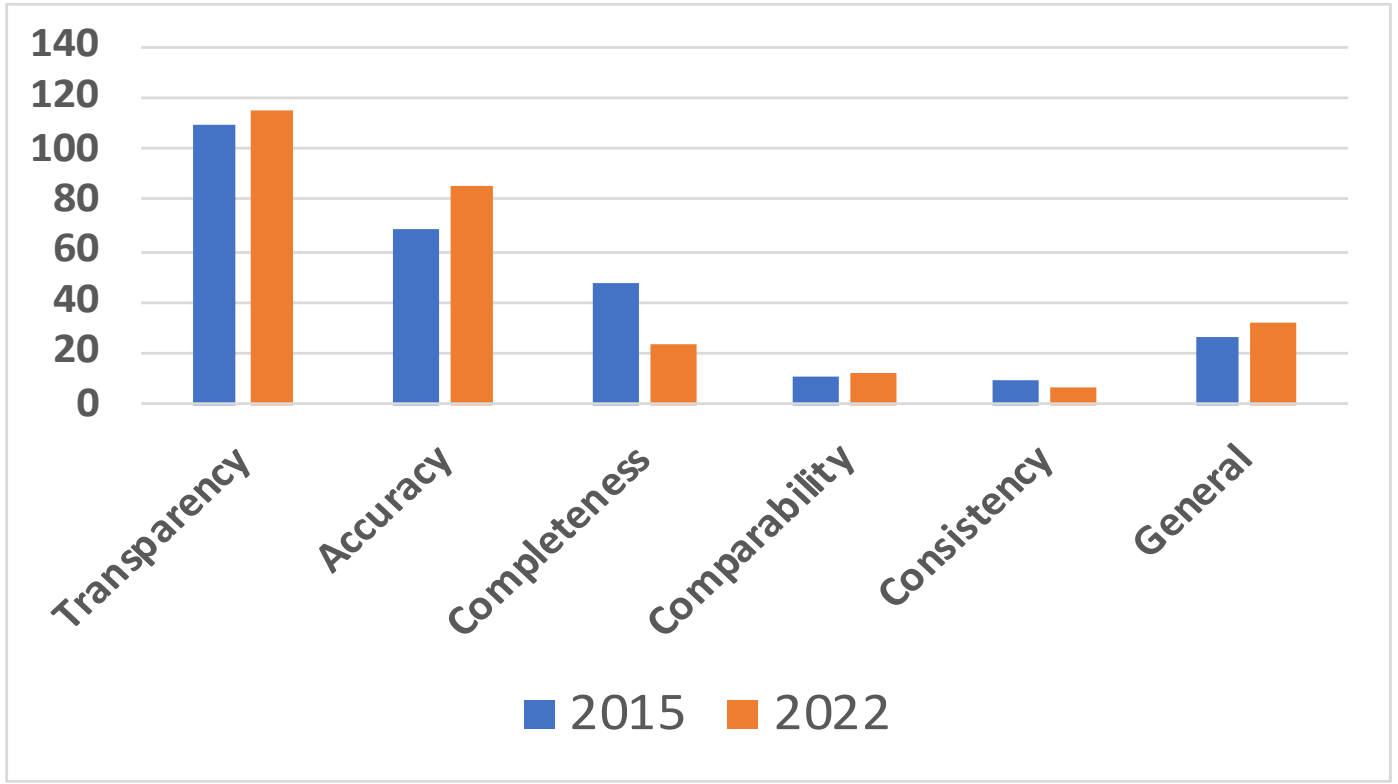
These change are sometimes driven by the need to comply with reporting requirements (both EU and UN), but also by the availability of new data and the need for improvements on the LULUCF sector

Outcomes of the reviews

- Comparison of the UNFCCC Annual Review Reports (ARRs) 2015 vs 2022
- Comparison of the number/quality of issues uploaded into the EU Emission Review Tool (EMRT) in 2015 and 2022

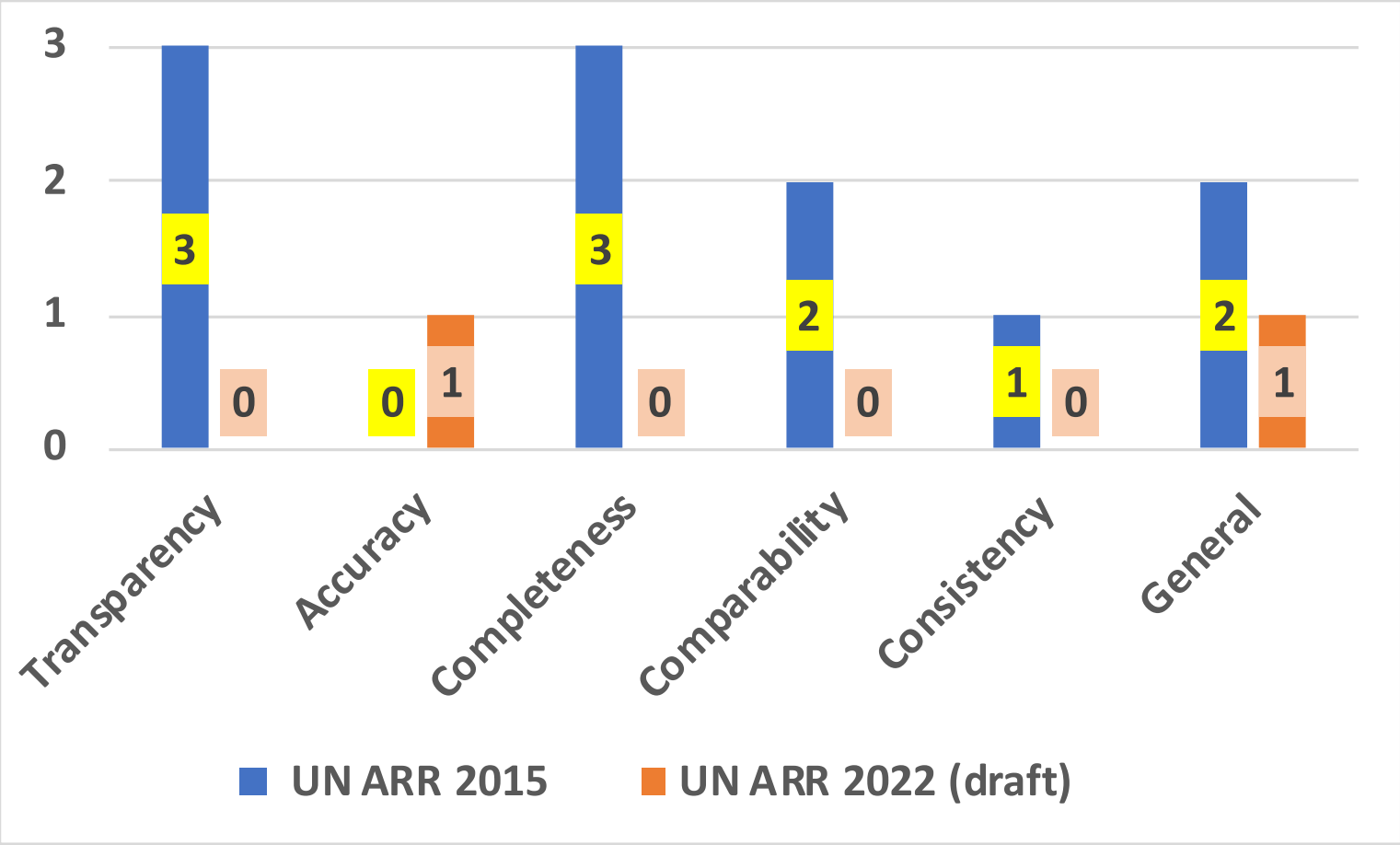
UN ARRs 2015-2022 for the sum of 27 MS

- Issues reflected in ARRs depend on the experience of the reviewer and the reporting status of the inventory, i.e. the more advanced is the inventory, the most detailed is likely to be the review.



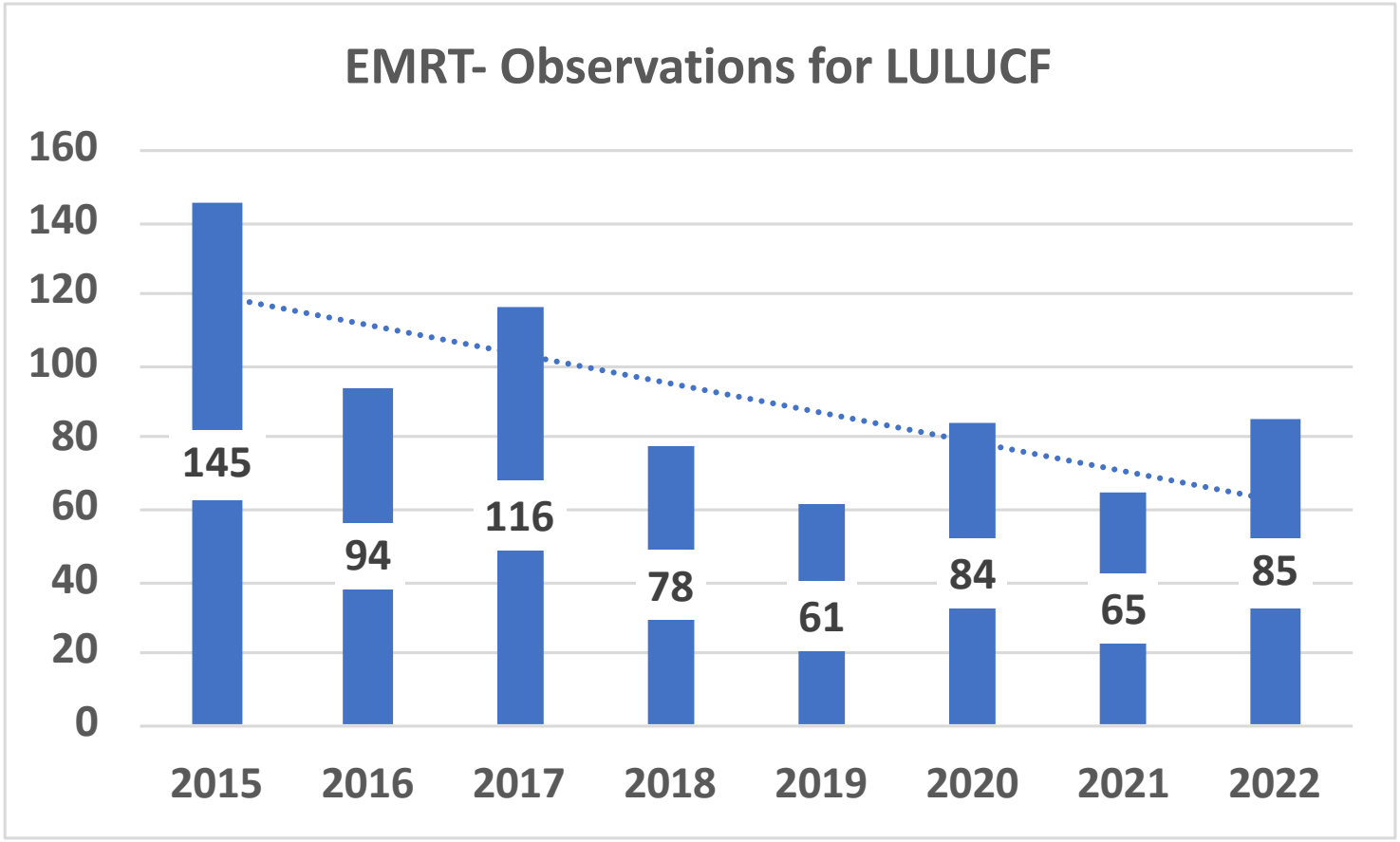
- ERTs pointed their recommendations mainly on Transparency and Accuracy, with recommendations on Completeness decreasing with time

UN ARRs 2015-2022 for the EU GHGI submission



EU GHGI Nº Recommendations (Addressing or not resolved)	
UN ARR 2015	UN ARR 2022
11	**2**

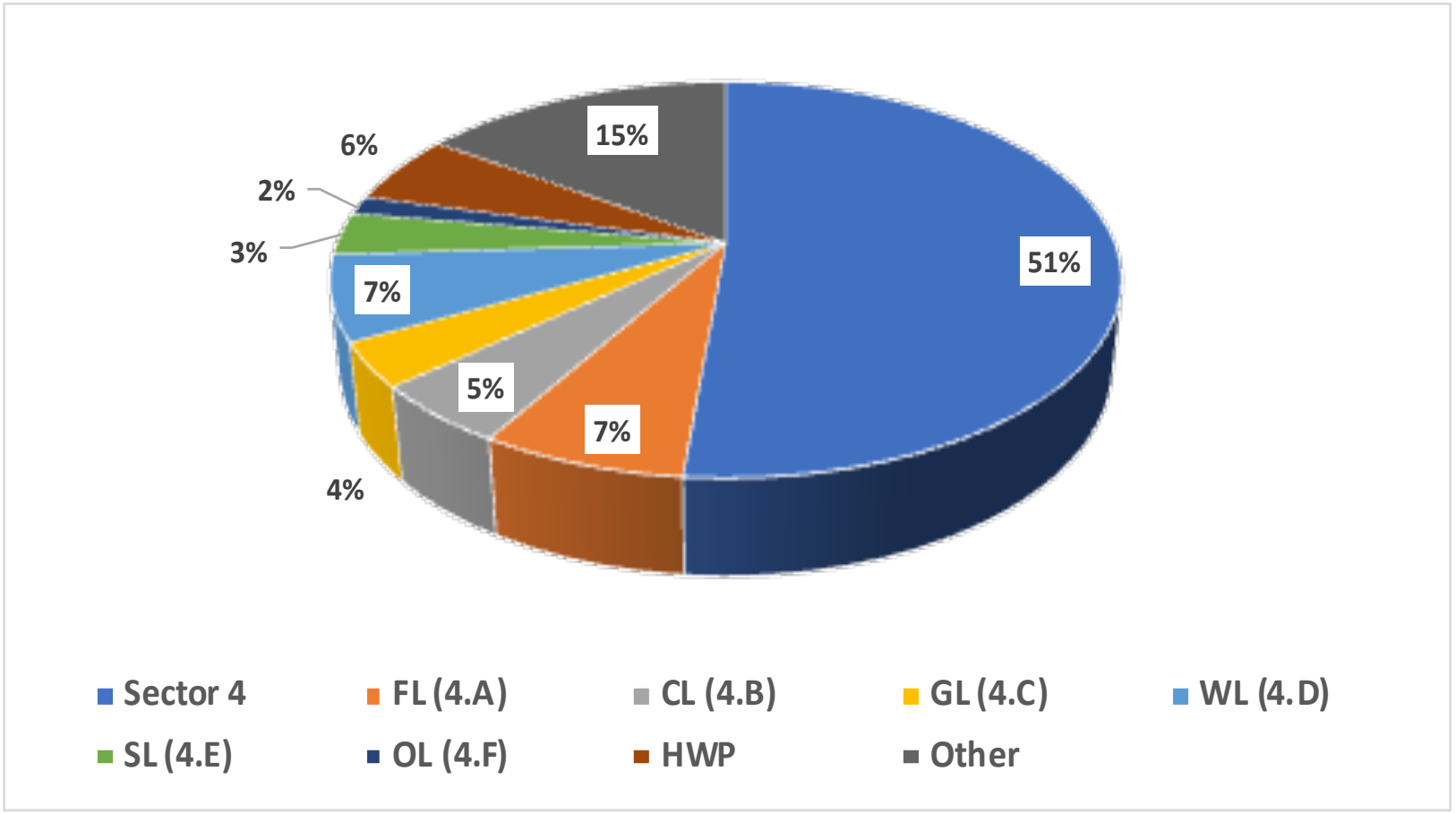
EU QA/QC - EMRT



Across the KP-CP2, some modifications were introduced to the QA/QC checks implemented under the MMR 525/2013, in order to:

(i) Respond to the increase on completeness and accuracy of MS GHGIs
(ii) Address recommendations from the UN ERT.

EU QA/QC- EMRT



Share of issues by LULUCF categories over total EMRT observations 2015-2022

Verification activities

- IPCC 2006 GL: verification activities include **comparisons** with emission or removal estimates prepared by **other bodies** and comparisons with estimates derived from fully **independent assessments**.
- Verification activities provide information for countries to improve their inventories and are part of the overall QA/QC and verification system. Correspondence between the national inventory and independent estimates increases the confidence and reliability of the inventory estimates by confirming the results. Significant differences may indicate weaknesses in either or both of the datasets.

"All information used for the development of the GHG information is archived by the inventory agency. Thus, the correctness of the estimation methodology is in principle *verifiable*"

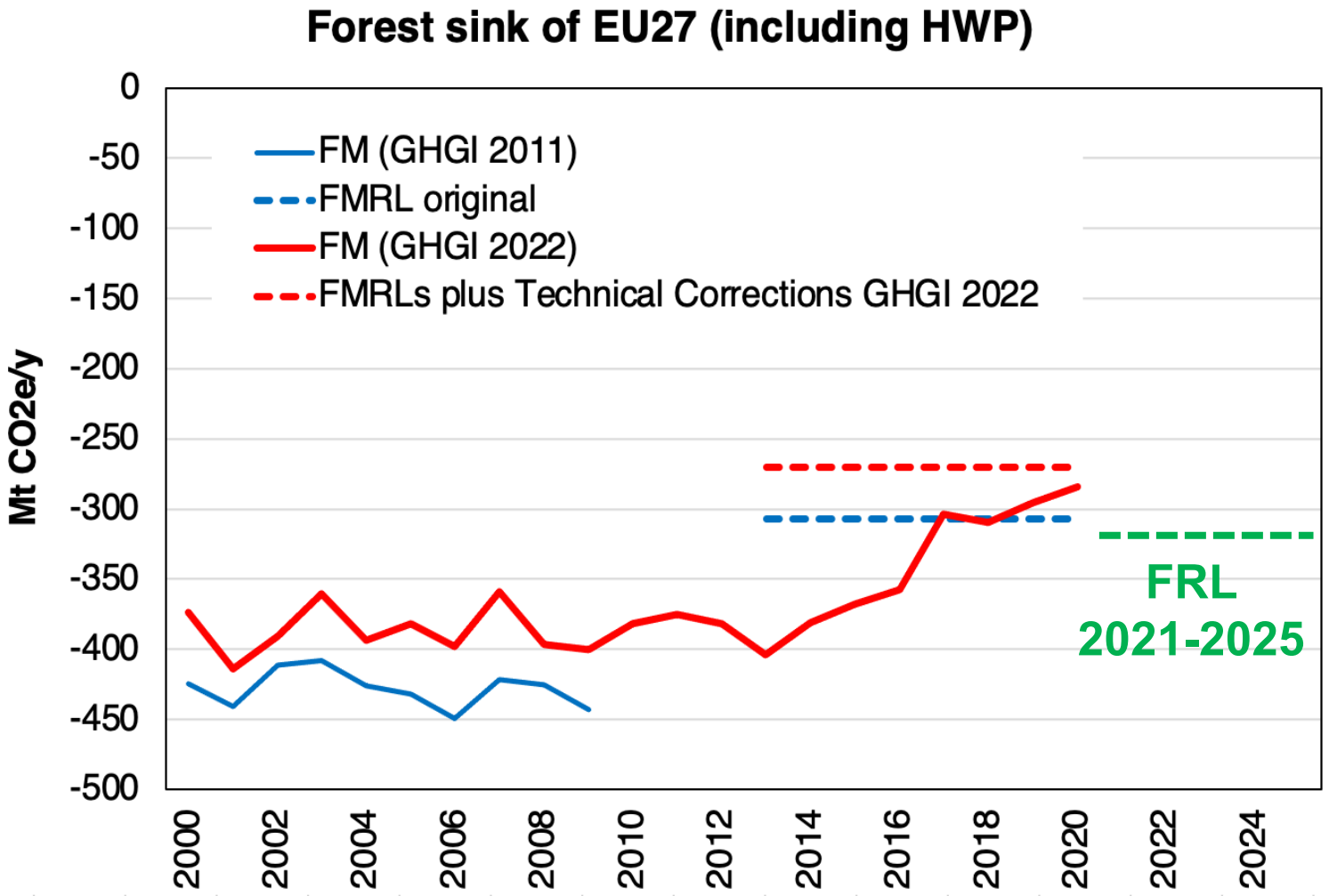
The fact that the methods and calculation steps is archived allow its reproductivity but does not represent a "verification"

- Overall, as compared with the beginning of the KP-CP2, MS are now implementing more verification activities to increase confidence on the estimates for LULUCF. In the 2022 GHGI, 17 MS included a description on the approach taken to verify, partly or totally, their LULUCF information.

Comparison with neighboring countries	Comparison with in-house official information	Comparison with international databases (e.g. FAO)	Dedicated studies to verify inputs for LULUCF	Against IPCC Guidelines
4	10	5	5	2

- However, the information on verification procedures is not always transparent or clearly separated from QA/QC checks.

LESSONS LEARNT – Forest sink accounting



FMRL (2013-2020)

- Complex exercise
- 'Lenient' approaches possible

FRL (2021-2025)

- Complexity remanined
- Capacity buliding
- More robust approach
- Bridge towards the more climate-ambitious 2030 target

Where are we relative to requirements of Reg 2018/841

MSs will have to comply with the use of, at least, Tier 2 methods for estimating emissions and removals in those C pools that account for at least 25-30% of emissions or removals in a key category

MS	Living biomass		Dead wood		Litter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	64%	*T2,3*	4%	*T2,3*	*IE*	*T2,3*	32%	*T2,3*		
BE	100%	*T2,3*	*T1*		*T1*		*T1*			
BG	94%	*T2,3*	6%	*T2,3*	*T1*		*T1*			
HR	100%	*T2,3*	*T1*		*T1*		*T1*			
CY	100%	*T2,3*	*T1*		*T1*		*T1*			
CZ	81%	*T2,3*	5%	*T2,3*	12%	*T2,3*	2%	*T2,3*		
DK	63%	*T2,3*	3%	*T2,3*	22%	*T2,3*	*T1*		12%	*T2,3*
EE	64%	*T2,3*	3%	*T2,3*	*T1*		25%	*T2,3*	8%	*T2,3*
FI	65%	*T2,3*	*IE*	*T2,3*	*IE*	*T2,3*	18%	*T2,3*	17%	*T2,3*
FR	92%	*T2,3*	8%	*T2,3*	*T1*		*T1*			
DE	63%	*T2,3*	6%	*T2,3*	0,8%	*T2,3*	26%	*T2,3*	4%	*T2,3*
GR	100%	*T2,3*	*T1*		*T1*		*T1*			
HU	85%	*T2,3*	11%	*T2,3*	*T1*		*T1*		3%	*T1*
IE	50%	*T2,3*	*IE*	*T2,3*	7%	*T2,3*	1%	*T2,3*	42%	*T2,3*
IT	97%	*T2,3*	1%	*T2,3*	2%	*T2,3*	*T1*			
LV	66%	*T2,3*	26%	*T2,3*	*T1*		*T1*		8%	*T2,3*
LT	87%	*T2,3*	13%	*T2,3*	*T1*		*T1*		*IE*	*T1*
LU	89%	*T2,3*	11%	*T2,3*	*T1*		*T1*			
MT	100%	*T2,3*	*T1*		*T1*		*T1*			
NL	78%	*T2,3*	5%	*T2,3*	14%	*T2,3*	*T1*		3%	*T2,3*
PO	85%	*T2,3*	3%	*T2,3*	*T1*		9%	*T1*	3%	*T1*
PT	98%	*T2,3*	*IE*	*T2,3*	1%	*T2,3*	2%	*T2,3*		
RO	100%	*T2,3*	*T1*		*T1*		*T1*		0,1%	*T1*
SK	90%	*T2,3*	10%	*T2,3*	*T1*		*T1*			
SI	90%	*T2,3*	10%	*T2,3*	*T1*		*T1*			
ES	100%	*T2,3*	*T1*		*T1*		*T1*			
SE	49%	*T2,3*	11%	*T2,3*	12%	*T2,3*	19%	*T2,3*	8%	*T2,3*
IS	99%	*T2,3*	*T1*		*T1*		*T1*		1%	*T1*
Average	**84%**		**8%**		**9%**		**15%**		**9%**	

The reporting of **FL-FL** seems to does not raise incompliance cases as regard the use of Tier methods.

However, some MS may not comply with its article 5 that states that the option of not to include changes in carbon stocks in the accounts shall not apply into the case of Above-ground biomass, Dead wood and HWPs, in the land accounting category of Managed forest land.

Pool assumed in balance under Tier 1

Assessment based on the 2022 GHGI submissions (May)

European Commission

Where are we relative to requirements of Reg 2018/841

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	20%	*T2,3*	*T1*		80%	*T2,3*		
BE	2%	*T2,3*	*T1*		50%	*T2,3*	48%	*T1*
BG	7%	*T1*	*T1*		88%	*T2,3*	5%	*T1*
HR	66%	*T1*	*T1*		8%	*T2,3*	27%	*T1*
CY	100%	*T1*	*T1*		----			
CZ	24%	*T1*	*T1*		76%	*T2,3*		
DK	1%	*T2,3*	*T1*		11%	*T2,3*	88%	*T2,3*
EE	1%	*T2,3*	*T1*		37%	*T2,3*	62%	*T2,3*
FI	0,04%	*T2,3*	*IE*	*T2,3*	11%	*T2,3*	89%	*T2,3*
FR	16%	*T2,3*	*T1*		84%	*T2,3*	*IE*	*T2,3*
DE	1%	*T2,3*	*T1*		1%	*T2,3*	99%	*T2,3*
GR	70%	*T2,3*	*T1*		----		30%	*T1*
HU	12%	*T2,3*	*T1*		88%	*T2,3*		
IE	35%	*T1*	*T1*		65%	*T1*		
IT	18%	*T2,3*	*T1*		64%	*T2,3*	18%	*T1*
LV	1%	*T2,3*	0,04%	*T2,3*	----		99%	*T1*
LT	35%	*T1*	*T1*		65%	*T2,3*	*IE*	*T1*
LU	79%	*T1*	*T1*		21%	*T2,3*		
MT	66%	*T2,3*	*T1*		34%	*T1*		
NL	----		*T1*		----		100%	*T2,3*
PO	63%	*T1*	*T1*		12%	*T1*	25%	*T1*
PT	85%	*T2,3*	*T1*		15%	*T2,3*		
RO	14%	*T2,3*	*T1*		79%	*T1*	8%	*T1*
SK	94%	*T2,3*	*T1*		6%	*T2,3*		
SI	8%	*T1*	2%	*T2,3*	3%	*T1*	88%	*T1*
ES	36%	*T2,3*	*T1*		64%	*T2,3*		
SE	4%	*T2,3*	0,22%	*T2,3*	18%	*T2,3*	78%	*T1*
IS	----		*T1*		2%	*T2,3*	98%	*T1*
Average	**33%**		**1%**		**41%**		**60%**	

The reporting of **CL-CL** raises potential non-compliance cases for MS using Tier 1 methods, or implementing the assumption of equilibrium for pools that are (or potentially seem) significant within a key category

Potential cases of non-compliance appear in the reporting of all the pools for this category.

Clearly non-compliace
Potentially non-compliance
Pool assumed in balance under Tier 1

Where are we relative to requirements of Reg 2018/841

MS	Living biomass		Dead organic matter		SOC mineral		SOC organic	
	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method	Significance (%)	IPCC Method
AT	----		*T1*		3%	*T2,3*	97%	*T1*
BE	----		*T1*		89%	*T2,3*	11%	*T1*
BG	4%	*T1*	*T1*		72%	*T2,3*	23%	*T1*
HR	----		*T1*		----		100%	*T1*
CY	100%	*T1*	*T1*		----			
CZ	----		*T1*		100%	*T2,3*		
DK	2%	*T2,3*	*T1*		*IE*	*T2,3*	98%	*T2,3*
EE	----		*T1*		----		100%	*T2,3*
FI	13%	*T2,3*	*T1*		----		87%	*T2,3*
FR	74%	*T2,3*	*T1*		26%	*T2,3*	*IE*	*T1*
DE	4%	*T2,3*	*T1*		1%	*T2,3*	96%	*T2,3*
GR	100%	*T2,3*	*T1*		----			
HU	----		*T1*		100%	*T2,3*		
IE	----		*T1*		13%	*T1*	87%	*T1*
IT	48%	*T2,3*	5%	*T2,3*	45%	*T2/3*	1%	*T1*
LV	7%	*T2,3*	1%	*T2,3*	----		92%	*T1*
LT	----		*T1*		----		*IE*	*T1*
LU	----		*T1*		----			
MT	----		*T1*		----			
NL	1%	*T2,3*	*T1*		0%	*T2,3*	98%	*T2,3*
PO	----		*T1*		32%	*T1*	68%	*T1*
PT	----		*T1*		100%	*T2,3*		
RO	5%	*T1*	*T1*		94%	*T2,3*	1%	*T1*
SK	----		*T1*		----			
SI	63%	*T2,3*	29%	*T2,3*	8%	*T1*		
ES	----		*T1*		----			
SE	25%	*T2,3*	28%	*T2,3*	21%	*T2,3*	26%	*T1*
IS	0,1%	*T2,3*	0,02%	*T2,3*	0,04%	*T1*	100%	*T1*
Average	**32%**		**13%**		**44%**		**68%**	

As for CL, the reporting of **GL-GL** also raises potential non-compliance cases for MS using Tier 1 methods, or implementing the assumption of equilibrium for pools that are (or potentially seem) significant within a key category

Potential cases of non-compliance appear in the reporting of all the pools for this category.

Clearly non-compliace
Potentially non-compliance
Pool assumed in balance under Tier 1

Conclusions and way forward

The reporting of LULUCF by MS has in all cases (although with difference paces) showed improvements in most reporting principles across the period 2015-2022 → **now we are more confident on LULUCF estimates than 10 years ago**
… *thanks to GHGI compilers, UN/EU reviews, EU/national policies, new data, sharing-knowledge initiatives e.g. JRC LULUCF workshops*

Open issues:
- Reporting/accounting simplified
- **Greater climate ambitions require greater monitoring efforts** → many MS not fully ready yet for the new requirements under 2018/841 & revised LULUCF regulation: **higher tiers, spatially explicit estimates, timeliness.**

If we don't measure *well*, we don't manage *well*

European Commission

Agenda

JRC LULUCF Workshop 2023

LULUCF inventories for enhanced climate action

JRC Ispra and online
11-12 May 2023

European Commission

JRC LULUCF Workshop 2023

LULUCF inventories for enhanced climate action

JRC Ispra (Conference Centre, building 36) and online, 11 May 2023 – Day 1

09:00-09:30 Arrival at the Joint Research Centre

09:30-10:00 Welcome coffee

10:00-10:30 **Welcome and introduction**
Plenary room Director Alessandra Zampieri + JRC LULUCF team

10:30-12:00 **Session 1 – Where are we and where have we decided to go**
Plenary room *Development of LULUCF reporting* – JRC LULUCF team
Revised LULUCF regulation – Simon Kay, DG CLIMA
Evolving needs for GHG inventory data – JRC LULUCF team supported by Asger Olesen

12:00-12:30 **Session 2 – QA/QC of the LULUCF inventories**
Plenary room Peter Iversen, EEA

12:30-14:00 Buffet lunch

14:00-15:30 **Session 3 – Higher Tiers**
Plenary + breakout rooms
Revised LULUCF regulation: what will it mean for soil carbon reporting? – JRC LULUCF team supported by Valentin Bellassen, Emil Cienciala and Aleksi Lehtonen
JRC work on soil carbon data and modelling – JRC LUCAS team

Presentations and reflections by participants

15:30-16:00 Coffee break

16:00-17:15 **Session 3, continued**
Plenary + breakout rooms

17:15-17:30 **Wrap-up of day 1**
Plenary room

17:45 Bus transportation to hotels

19:30 Dinner at La Veranda restaurant, Hotel Conca Azzurra, Ranco

JRC Ispra (Conference Centre, building 36) and online, 12 May 2023 – Day 2

08:45-09:00 Arrival at the Joint Research Centre

09:00-10:30 **Session 4 – Supporting policy relevant and timely inventories**
Plenary + breakout rooms
How remote sensing data may help towards more policy relevant and timely inventories? – JRC LULUCF team, supported by Martin Herold
The role of the LULUCF inventories in supporting climate action – JRC LULUCF team, supported by Asger Olesen

Presentations and reflections by participants

10:30-11:00 Coffee break

11:00-13:00 **Session 4 continued**
Plenary + breakout rooms

13:00-14:30 Buffet lunch

14:30-16:00 **Session 5 – Open discussion and conclusions**
Plenary room

16:00 **Close of day 2**

17:00 Bus transportation to Milano Malpensa airport

Presentation of the past JRC LULUCF worshops available here:
https://forest.jrc.ec.europa.eu/en/activities/lulucf/workshops/

European Commission


LULUCF world

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