Agriculture and LULUCF in the 2030

Final report

May – *2016*

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Final Report

Submitted by ICF Consulting Limited, Alterra, COWI, Ecologic Institute and Umweltbundesamt GmbH

Date: 3 May 2016

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1 Introduction

1.1 The Paris Climate Agreement

In December 2015, parties to the UNFCCC convened in Paris for COP21 and adopted the Paris Agreement that establishes common ground for action on climate change after 2020. The Greenhouse Gas reduction commitments of parties as enshrined in National Determined Contributions submitted under the Paris Agreement ensure continued climate action once the commitments of the Kyoto Protocol (KP) end.

The European Union is currently defining and developing its own climate policy post-2020, namely the Climate and Energy Package for 2030, which will include individual efforts by each Member State for sectors outside of the EU Emission Trading System, the so-called non-ETS sectors, which include LULUCF and agriculture. So far, although agriculture is included under the Effort Sharing Decision (ESD) and agricultural emissions have decreased by 24% since 1990, LULUCF has only been partially incorporated into climate policies to date. This reflects the lack of data, guidelines and reporting systems at the time of the agreement of the current EU Climate and Energy Package in 2007-2009.

During the Kyoto years, much work was done on modalities, procedures and guidelines for the LULUCF and agriculture, and a complex system of reporting and accounting rules and practices has developed. This system could allow for more comprehensive inclusion of the LULUCF and agriculture in both the commitments of parties to the Paris agreement and of Member States of the EU towards the 2030 climate and energy package. Based on this, one of the specific expectations of the agreement to be adopted at COP21 was that more clarity would be provided on the role of LULUCF and agriculture.

It should be noted that the PA takes a bottom-up approach to defining rules, modalities, and procedures, in contrast to the KP's top-down prescriptions. Although many of these details will still be agreed in upcoming UNFCCC COP/MOP sessions, in general parties are likely to be afforded a much greater level of flexibility than was the case under the KP.

The EU has already adopted accounting rules and action plans for LULUCF activities, but has not decided how best to incorporate them into its 2030 framework and emissions targets, and the current EU 2050 roadmap does not include LULUCF at all. Effectively and fairly incorporating the potential of LULUCF and agriculture for emissions or removals will also require flexibility within the EU, due to the geographical variations of emissions or removal potential between MS.

1.2 Aim of the study

A consortium comprising ICF International, Alterra, COWI, Ecologic Institute and Umweltbundesamt was commissioned by DG CLIMA to investigate the implications of the December 2015 Paris climate agreement for agriculture and LULUCF in the EU2030 climate framework. The study was let under framework contract CLIMA.A.4/FRA/2011/0027.

The overall aim of the study was to advise the Commission on the implications of the Paris climate agreement for EU climate policy action, and the impacts of potential changes involved. The assignment also advised on the potential implications for related EU policy areas.

The study was structured in two main tasks:

Task 1 involved undertaking a screening and scoping exercise, to provide a thorough assessment of the new elements concerning agriculture and LULUCF in the Paris climate agreement and their implications for the 2030 framework;

Task 2 involved identifying consequent changes to be brought to the mainstreaming of climate actions in EU policy areas. This includes identification of new or better developed tools for climate action, as well as potential new policy orientations with regard to climate mainstreaming and related policy areas.

This report presents the findings of both tasks, Task 1 examining new agriculture and LULUCF elements in the Paris agreement and providing an initial discussion of their implications for the 2030 framework, and Task 2 that builds on the Task 1 analysis by assessing the specific implications for EU policies in the 2030 Framework. Task 1 was led by COWI, and Task 2 by Alterra, with each of the other partners in the consortium providing inputs into both tasks.

1.3 Structure of the report

The report is structured as follows:

- Section 2 provides an overall assessment of the Paris Agreement (PA) and a commentary on the main elements relating to agriculture and LULUCF;
- Section 3 presents a discussion on the potential contribution of LULUCF and agriculture in relation to increased ambition and aspirations of balancing emissions and removals;
- Section 4 provides an analysis of other relevant INDCs and the role of LULUCF and agriculture within them;
- Section 5 examines the implications of the PA regarding accounting options for LULUCF;
- Section 6 discusses the implications for data needs and monitoring in the EU;
- Section 7 assesses the implications for EU policies, including the CAP, EU Forest Strategy, Biomass/Bioenergy/RED, Nature and Biodiversity, and international forest policy; and
- Section 8 presents our overall conclusions about the implications of the PA for the 2030 framework and the resulting changes that may be required in EU policies.

Specific references in the Paris Agreement and Decision relevant to agriculture and LULUCF are itemised in detail in Annex 1. Annex 2 summarises experiences gained from the existing reporting and accounting system as a basis for future accounting. Annex 3 discusses issues relating to projections for LULUCF, especially with respect to forest management. Annex 4 presents options for elements of a LULUCF accounting system for the EU under the PA. Annex 5 gives an overview of characteristics of National Forest Inventories in the EU.

1.4 Scope of the report

The title of the study was “Agriculture and LULUCF in the 2030 Framework”. This report therefore covers agriculture and LULUCF as a whole, in recognition of the strong interdependencies between them in policy terms. The analysis of the Paris Agreement identifies relevant elements relating to agriculture and food security as well as LULUCF. However, many of the specific challenges for EU climate policy discussed in this report – such as in relation to accounting for emissions and removals and related data needs (Sections 5 and 6) - relate primarily to LULUCF.

This report scrutinises all climate change mitigation elements relevant to LULUCF and agriculture in the Paris Agreement and the Decision (1/CP.21), explicit and direct as well as implicit and indirect. Its purpose is to detect changes and additions with a climate mitigation and LULUCF and agriculture component, which may affect the EU Climate and Energy Framework for 2030 and/or other EU policies. Adaptation elements, even if related to LULUCF and agriculture, are not covered.

The subject of the scrutiny is furthermore limited to the articles and sections of the Agreement and the Decision with relevance for internal EU policies. Thus, all elements relevant for External relations, *EuropeAid*, Development Cooperation (such as capacity building, finance, technology transfer, joint mitigation) are not comprehensively covered. An exception to this is REDD+ and Sustainable Management of Forests covered in article 5 of the Agreement. The outcome of work stream two under the Doha Agreement on enhanced action before 2020 is not covered.

1.5 Notes for the reader

Section 2 of this report consists of sections on general and specific observations, where the latter include analysis of land specific elements. Annex1 includes a table consisting of article by article, paragraph by paragraph assessment of LULUCF and agriculture relevance.

The assessment has been kept very close to the letter of the Decision and the Agreement. However, in many cases interpretations have been necessary due to unclear wording, and these are clearly pointed out in the text. As the work was undertaken in the month immediately following COP21, very little supporting material has been available. Thus only the section on assessment of the contribution of LULUCF and agriculture in NDCs and towards the long term goals includes and has built on external work.

In this report, PA or the Agreement always refers to the Paris Agreement. The Decision in all cases means Decision 1/CP.21. For the Agreement the reference key 'article number (paragraph number)' has been used, while for the Decision reference is made to the paragraph number only. In both cases, 'para' has been used for paragraph. Throughout the report Convention means the UNFCCC and KP means Kyoto Protocol.

Where the Decision or Agreement text is directly cited, double citation marks "*xxx*" in combination with *italic* text is applied. When paraphrasing or referring to a single word, the single quotation mark is used ('xxx'). Bold text has been used to emphasise certain words or phrases, but this is in all cases the responsibility of the authors.

1.6 Abbreviations and glossary

Accounting	Using all or some of the reported data to calculate the accountable contribution of a Party towards a commitment
Agreement	Paris Agreement
AR	Assessment Report (outcome of Expert Review of submitted material)
AWG-PA	Ad-Hoc Working Group on the Paris Agreement
CAP	Common Agricultural Policy
CCS	Carbon Capture and Storage
CP	Commitment Period
Decision	Decision 1/CP.21
FMRL	Forest Management Reference Level
GHG	Greenhouse Gas
IACS	Integrated administration and control system
INDC/NDC	Intended Nationally-Determined Contributions/Nationally-Determined Contributions
IPCC	Intergovernmental Panel on Climate Change

KP	Kyoto Protocol
LPIS	Land Parcel Identification System
LULUCF	Land Use, Land Use Change and Forestry
MPG	Modalities, procedures and guidelines
NIR	National Inventory Report
PA	Paris Agreement
Para	Paragraph
REIO	Regional Economic Integration Organisation
Reporting	The process of compiling GHG data on emissions and removals within the territory of a Party to the Convention, with the purpose of submitting this in a National Inventory Report
SBSTA	Subsidiary Body for Scientific and Technological Advice
TACCC	Transparency, Accuracy, Completeness, Comparability and Consistency
TER	Technical Expert Review
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

2 Assessment of the Paris Agreement

2.1 General observations

This section covers content in the agreement (UNFCCC, 2015) and the decision that frames the process and the understanding of the more specific elements. These more general observations are presented here to provide an overview, and are not intended as an exhaustive assessment.

2.1.1 UNFCCC, KP and the Paris Agreement

The United Nations Framework Convention on Climate Change, which covers all parties, will remain in place after 2020, whereas the mandate of the Kyoto Protocol ends by 2020, the final year of the second commitment period agreed upon in Doha in 2012. The Paris Agreement ensures a continued commitment by Parties after 2020 and as such also takes the place of the Kyoto Protocol for those countries which had KP targets. Decision 1/CP1 gives effect to the agreement and sets out how various processes and work programmes shall run in order to prepare for the Agreement coming into force and for Parties' actions on climate change after 2020.

2.1.1.1 Paris Agreement: timeline, ratification, entry into force and the first session

The below timeline (Figure 2.1) summarises processes, deadlines and submissions stipulated in the Agreement and the decision. The activities of parties are highlighted in orange, whereas COP/AWG-PA activity is presented in green. This figure is informed by findings and interpretations presented in relevant sections later in the report.

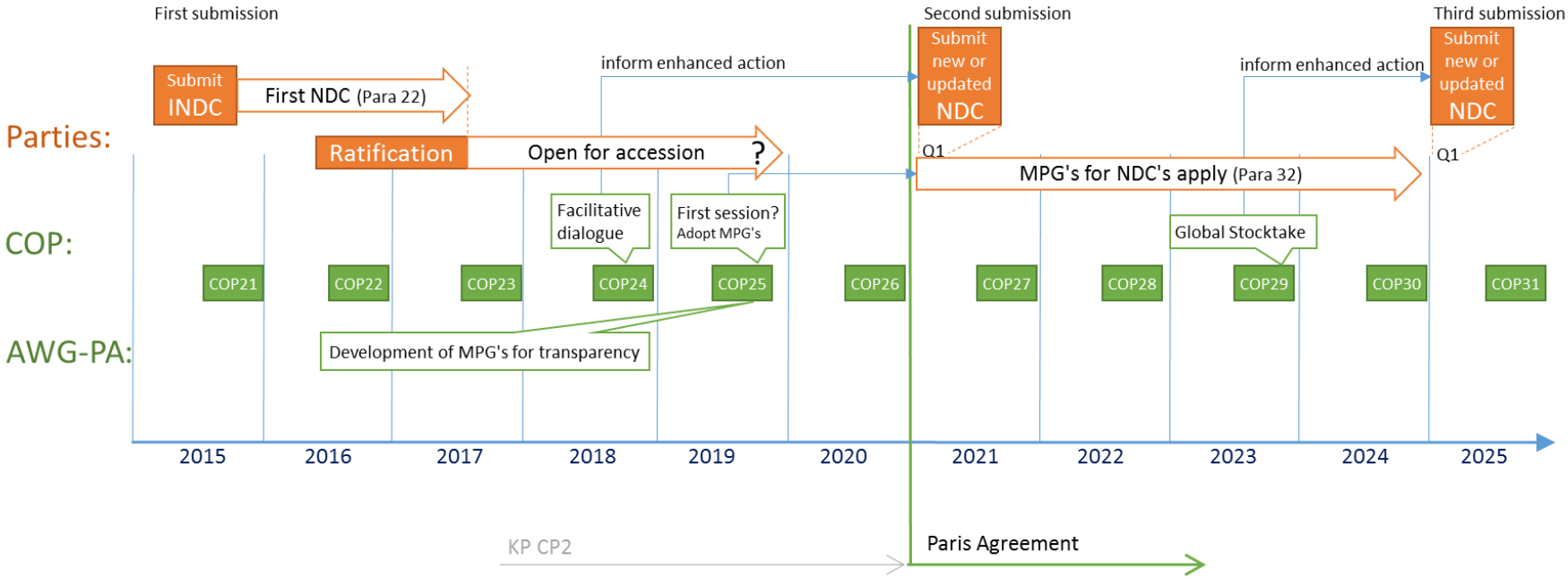

Figure 2.1 Timeline: Processes, deadlines and submissions.

An important element is the entry into force of the Agreement. Notwithstanding that (I)NDCs have been submitted already covering the time period after 2020, the entry into force of the Agreement, and thus the commitments taken by parties, is conditional on the process of ratification. Not until 30 days after at *"least 55 parties, covering at least an estimated 55% of the total greenhouse gas emissions, have deposited their instrument of ratification, acceptance, approval or accession"* (PA, article 21(1)) with the Depositary (the Secretary General), will the agreement enter into force.

Signature and subsequent deposition of instruments of ratification etc. is supposed to take place between 22 April 2016 and 21 April 2017 (PA, article 20(1)), which means that if the above requirement is met, the PA can enter into force by 21 May 2017. However, the second sentence of article 20(1) reads that the "agreement shall be open for accession…" from 22 April 2017, which allows later entry. Thus, if fewer than 55 parties or less than 55% of emissions are covered by the parties having ratified by 21 April 2017, the agreement will only enter into force at a later stage. The immediate consequence of this is that the first session of the Conference of the Parties serving as the meeting of the Parties, will be postponed. If however the PA can enter into force by May 2017, then COP23 could serve as the first meeting of the parties. However, much of the work requested for the AWG-PA needs completion by 2018 for 'adoption at the first session,' indicating that the parties foresee COP24 to be the earliest possible meeting of the parties to the PA. For comparison, in the KP, article 13(6) clarifies, that the 'first session of the parties to the protocol shall be convened…in conjunction with the first Conference of the Parties scheduled after the date of the entry into force of the protocol'.

The issue of when the first session will take place is open for some level of interpretation, and in any case dependent on the ratification process. Therefore, and to ensure consistency in representation, in this report it is assumed that the first session will be at COP25 in 2019, as this allows for some delay in entry into force and at the same time allows for adoption of recommendations by the AWG-PA in time before the commitments in the NDCs apply.

Further to this, the ratification process has a derived effect on the negotiating process. In case China, US and a number of other parties ratify early so that the 55 parties/55% criteria will be met, the first COP thereafter will be capable of adopting decisions on new modalities, procedures and guidelines on e.g. the transparency of action (see later sections) under the Paris Agreement (COP-PA). If any major parties (e.g. the EU, Brazil, Russia, Australia, etc.) have not ratified, they are only entitled to an observer status at any COP-PA and, in principle, cannot vote. Recent indications in the press and from Council meeting reports, as well as past experience in the UNFCCC setting, indicate that the EU may not be able to agree on ratification this year, and so the above situation could become relevant.

2.1.2 Regional Economic Integration Organisations

The texts concerning Regional Economic Integration Organisations (such as the EU) in the PA are slightly different from those in the KP. The changes seem to reflect a need to streamline the handling and integration of REIOs without changing operation in practice.

2.2 Specific observations

Many specific observations can be made from the Agreement and the Decision text. As the context is LULUCF and agriculture, a number of issues are of direct importance, such as the new transparency system and in particular the inclusion of LULUCF and agriculture emissions and removals in the language of the Decision and the Agreement. However, before we address these, it is helpful to examine the issue of goals and aspirations, as LULUCF and agriculture may play a prominent role in achieving or fulfilling these, even if this is not mentioned explicitly in the texts. Furthermore, the goals and aspirations may have a profound effect on the targets of various EU policies towards 2030, in the context of which LULUCF and agriculture play a prominent role. Most notable among these are the EU2030 Climate and Energy Package and the post-2020 CAP.

2.2.1 Long-term goals

In the Paris Agreement, the parties agreed to three long-term goals concerning the level of greenhouse gases in the atmosphere:

- Commitment to limiting global warming to below two degrees Celsius (1./CP.21, para 17),
- However, aspiring to limit temperature increase to one-and-a-half degree Celsius (1./CP.21, para 17)
- Aim to balance global emissions and removals sometime after mid-century (PA, art 4(1))

By introducing both a commitment and an aspiration, the Agreement shows recognition that the current level of ambition, and thus the aggregate effect of the submitted NDCs, is far from sufficient to keep the temperature increase below 2^{o}C above pre-industrial levels. This sends a clear message that action should be scaled up, even if parties for the time being cannot commit to such action: *"…efforts of all Parties will represent a progression over time, while recognizing the need to support developing country Parties for the effective implementation of this Agreement."*

The second goal recognises that limiting global warming to two degrees Celsius will likely not be enough to prevent "dangerous anthropogenic interference with Earth's climate system," as enshrined in the UNFCCC, Art. 2, and that the global community should thus aspire to limit temperature increase to 1.5 degrees Celsius and it implies that CO_2 emissions need to go negative, as there will always be some emissions from non-CO_2 GHG.

2.2.1.1 Balance between anthropogenic emissions by sources and removals by sinks

The third long-term goal, to balance anthropogenic emissions and removals after 2050 is a new element or new type of aim not seen in the Kyoto Protocol or the convention. This can be seen as an implicit acknowledgement of the fact that in order to fulfil goal 1 or 2, a balance of emissions and removals (i.e. net zero emissions) is needed after 2050 (*'in the second half of the century'*).

Achieving this aim will require significant efforts, as current total removals (e.g. uptake by growing forests, biomass energy carbon capture and storage (BECCS) or capture by technology in geological formations (e.g. CCS)[1] far from balances global emissions caused by use of fossil fuels and changes to land use (IPCC, 2014). As recognized in the preamble, "sustainable lifestyles and sustainable patterns of consumption and production" play an important role in mitigation of climate change. As such, structural changes in forest and agricultural production (e.g. climate-smart agriculture, sustainable intensification) and consumption patterns (e.g. food waste reduction, supply chain optimisation, reduced consumption of high-intensity foodstuff) could contribute to meeting EU (and global) LULUCF targets, with some targets possibly dependent on changes to production and consumption patterns.

[1] Gross removals, not net removals

It is understood in the study that the aim refers to a global balance, as regional or even national balances will impose very different challenges on individual countries. For example, regional balances would mean that forest rich parties with (reported) removals already in excess of emissions would have to undertake no action, whereas subtropical, forest poor countries would have very limited room for increasing removals, and would thus be forced to undertake significant emission reductions.

Furthermore, the distinction between anthropogenic and non-anthropogenic emissions and removals is important. Balance between *anthropogenic* emissions and removals does not mean that the level of carbon in the atmosphere is stable or decreasing, it merely means a situation where emissions caused by human activity are equal to removals caused by human activity. The balance referred to in article 4, para 1 of the Paris Agreement includes *anthropogenic* emissions and removals, not *non-anthropogenic*.

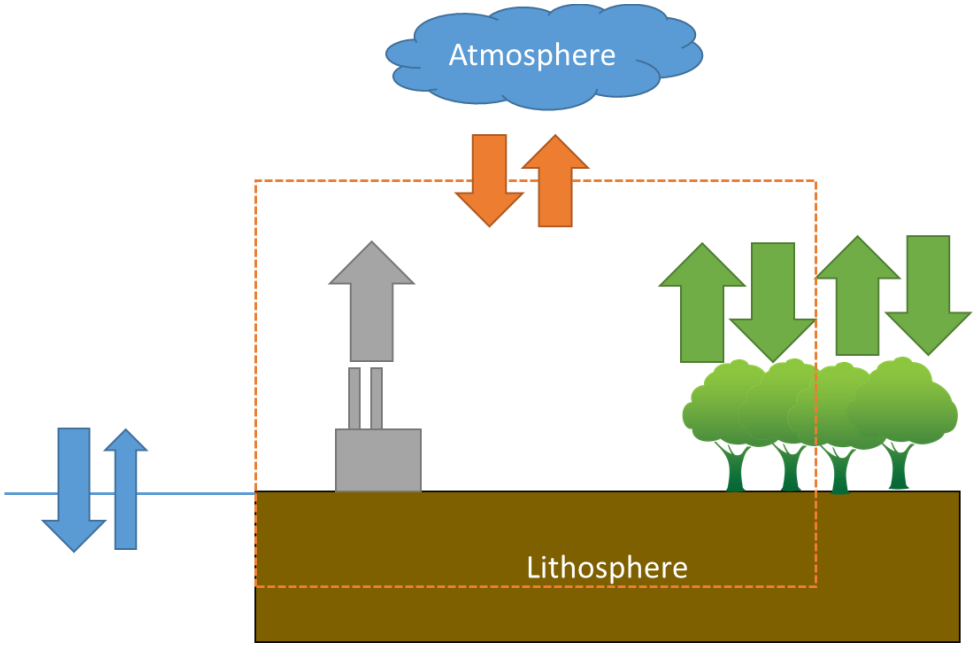

Figure 2.2 Balance of emissions flux.

The aim to balance emissions and removals depends on ensuring that the flux out of the orange box in Figure 2.2 is equal to the flux going in. In other words that the *direct, immediate* change to the atmospheric level of GHG caused by human activity is zero. This does mean that changes indirectly linked to human activities in the past (i.e. with an inherent time lag[2]) can still cause increases in atmospheric carbon. Also, it is important to recall that significant amounts of carbon are both emitted and sequestered in forests and soils continuously without human interference and that these fluxes are not included in the interpretation of balanced *anthropogenic* emissions and removals.

The deeper understanding of the aim to balance emissions and removals entails a differentiation between a geochemical and an accounting balance (Table 2.1), with the latter further posing a number of questions on how to define 'balance.' The true balance would be possible to determine if all fluxes could be measured in real-time, however, as this is not possible, the balance will have to be determined and evaluated for on the basis of non-exhaustive, approximate data.

[2] increased levels of carbon in the atmosphere could still drive diffusion processes with oceans towards an equilibrium, and atmospheric changes force changes in e.g. evapotranspiration of vegetation

Table 2.1 Overview of two different types of global carbon balances.

Type of balance	Understanding	Implication
Geochemical (and anthropogenic)	Means the actual emissions as they happen and when they happen, i.e. as continuous atmospheric measurements would detect them.	A balance in this sense is the true balance, but would require fully exhaustive, global, real time measurements of all fluxes of GHGs. Since this is not possible, the limitations following from the current scientific data and national reporting systems will lead to some degree of approximation in determining the balance.
Reporting and Accounting	The systems in place or being developed to aggregate and report data in an inventory in a consistent and comparable manner that allows for compiling a global carbon inventory. Once all available data have been compiled, a balance can be calculated.	A balance in this sense is constructed, and thus its accuracy is highly dependent on the quality and type of data, as well as the modalities, guidelines and procedures for compiling inventories.

It is expected that the determination of the balance between emissions by sources and removals by sinks will be undertaken based on reported data, submitted in National Inventory Reports (NIRs) following modalities, guidelines and procedures adopted at the first session of the Conference of the Parties serving as the meeting of the parties to the Paris Agreement (PA), based on work by the Ad-Hoc Working Group and building on experiences gained from the existing reporting system under the Convention. Therefore, the rules adopted may have a profound effect on the calculation of the balance and thus how it is to be understood in practice. A number of practices employed under the Kyoto Protocol accounting system may have influence on the calculation of the balance, such as forward discounting of emissions from use of woody biomass in energy production or specific rules allowing for exclusion of certain pools and fluxes under specific circumstances, if widely applicable. As concerns the latter, the Paris Decision, paragraph 31, letter c and d continues the practice of allowing exclusion of certain categories of emissions or removals.

Paragraph 20 of 1/CP.21 sets out that by 2018 parties should convene to take stock on the progress towards the long-term goal of achieving balanced emissions and removals. It is anticipated that this *facilitative dialogue* will yield further insights into how the balance is to be understood, determined and reported.

2.2.1.2 Global carbon balance and LULUCF and agriculture

Notwithstanding the above observations, there are two principal pathways to the fulfilment of this aim, one relying very much on LULUCF and agriculture by increasing global removals to balance emissions (Figure 2.3). In practice, a middle scenario involving a combination of emissions reductions and increased removals might be expected.

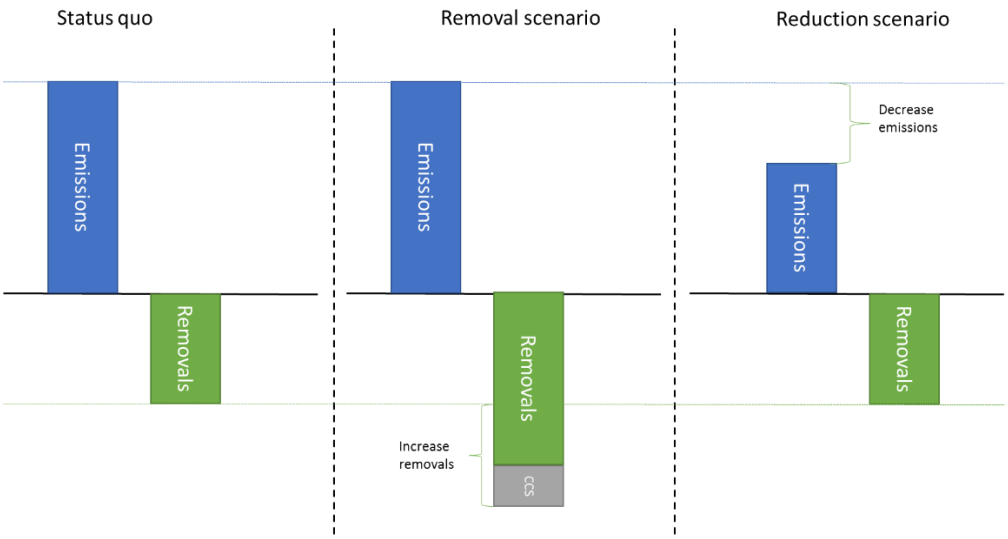

Figure 2.3 Principal approaches to achievement of the aim to balance global emissions and removals after 2050. CCS can play a role as a removal activity, as indicated by the grey column. No indication of this is given in the PA or the Decision. Note that the size of the columns is purely indicative.

Viewed in this framing, the role of LULUCF and agriculture, and their potential contribution through sequestration of carbon ('removals'), could become decisive for achieving balanced emissions and removals. Firstly, both LULUCF and agriculture can contribute through a reduction of emissions caused by land use change, e.g. deforestation or drainage of wetlands, which would contribute to an overall reduction in emissions. Secondly, carbon can be sequestered in growing biomass (e.g. forest growth, afforestation, restoration of degraded land). However, it must be noted that maintaining the continued additional sequestration of carbon over time becomes difficult due to saturation, meaning that reductions will be needed as well.

While in practice a combination of the two scenarios seem most likely, the balanced emissions aim indicates an important role for LULUCF and agriculture in the coming decades, which sets the stage for increased negotiating attention to modalities, guidelines and procedures for reporting and accounting on this sector. This situation is taken further in later sections, see 2.2.3.

Although the two targets for limits to temperature increase and the balanced emissions and removals aim are fundamentally different in nature, the three achievements form a hierarchy and a progression over time towards increasing level of ambition.

1. Two degrees Celsius goal: The median emission levels in 2030 in scenarios that have a >66 percent chance of staying below two degrees Celsius are 31-44 $GtCO_2e$. Current INDCs project emissions of 55 $GtCO_2e$ in 2030, but to stay below two degrees (>66 percent chance), emissions will have to be no larger than 40 $GtCO_2e$. Thus, a significant gap of **14-16 $GtCO_2e$** in 2030 exists between the political two degrees Celsius ambition and current intended contributions, even taking into account full implementation of INDCs. The gap in 2025 is around **7 $GtCO_2e$**, with a range of 5-10 (UNEP, 2015, p. 4). Another way of looking at this is to take into account cumulative emissions; in order to stay below two degrees Celsius, the total carbon budget is in the order of 1000 $GtCO_2$ (UNEP, 2015)
2. One-and-a-half degree Celsius goal: Currently, fewer than 10 scenarios have modelled what emissions reductions are needed to stay below 1.5 degrees Celsius, so a range is not given. The minimum and maximum values provided by these are 37 $GtCO_2e$ and 40 $GtCO_2e$ in 2030, respectively (UNEP, 2015). In many regards, the pathway for an increase in temperature no larger than one-and-a-half degree Celsius is similar to the

two degree Celsius pathway, but earlier and greater reductions are needed to achieve this scenario. The reduction of emissions to a level sufficient to stay below one-and-a-half degree Celsius is to be identified in a special report provided by the IPCC in 2018 (Para 17 and 21).

3. A balance between anthropogenic emissions and removals is also sometimes referred to as 'Net zero emissions.' A paper in nature (Rogelj et al., 2015) found that to limit temperature increase by 2100 to one-and-a-half degrees Celsius, net zero carbon emissions worldwide would be needed between 2045 and 2060, with net negative emissions in the 2050–2100 period. In scenarios consistent with a two degree Celsius rise in temperature, net zero emissions are required about 10 to 20 years later, and net negative emissions in the 2050-2100 period are not required (Rogelj et al., 2015). This is consistent with the estimate provided by UNEP (2015) which assesses that net zero emissions should be achieved by 2060-2075.

The goal to achieve a "balance between anthropogenic emissions by source and removals by sinks" (PA, art. 4(1), means that anthropogenic GHG emissions in the second half of the century must be offset by anthropogenic sinks, which for LULUCF and agriculture include actions such as afforestation, but can also include carbon capture and storage (CCS). In the two degree Celsius scenario, global emissions must be in the order of 17-29 $GtCO_2e\ yr^{-1}$, meaning that to achieve "net zero" emissions, removals must be in the same order of magnitude (Table 2.2). For a 1.5 degree Celsius scenario, emissions must be 4-14 $GtCO_2e\ yr^{-1}$; alternatively, if emissions are higher, removals will have to increase in tandem (UNEP, 2015). In general, enhanced action before 2020 would ease the challenge and reduce overall cost of transitioning to least-cost pathways after 2020 (UNEP, 2015), regardless of whether the goal is two degrees Celsius, one-and-a-half degrees Celsius, or "net zero" emissions.

Table 2.2 **Global annual emissions (GtCO2e) for various scenarios. *Based on UNEP Emissions Gap Report 2015 (UNEP, 2015). **Based on Netherlands Environment Agency (PBL) INDC Assessment (PBL, 2015). Based on Joint Research Center Science for Policy Report on LULUCF.**

	Current (2014)	2030	2050	2100	Net zero emissions
Current trends	53 (48-58)*	60 (58-62)*	82 (70-90)*	-	-
INDC	-	56 (54-59)* (unconditional) 56 (55-60)** (unconditional) 54 (52-58)** (conditional)	-	-	-
2 degrees Celsius	-	40 (31-44)*	23 (17-29)*	-3 (-9-(-1))*	2060-2075*
1.5 degree Celsius	-	39 (37-40)*	8 (4-14)*	-5 (-5-(-3))*	2045-2060****
LULUCF		0.6 (2005)***	2.1 (country BAU)*** 0.6 (existing pledges and policies, pre-INDC)***	-	-	No Net removal of GHGs from LULUCF under BAU***
LULUCF INDC		-	-0.2 (unconditional)*** -1.0 (conditional)***	-	-	LULUCF to be a net removal by ~2010***

2.2.1.3 LULUCF contribution

The emissions reported in Table 2.2 above are net emissions, i.e. the figures include gross emissions (all sectors) minus gross removals (i.e. LULUCF, CSS). Without the INDCs, but taking into account previous pledges and existing polices, the expected net emissions from LULUCF are around 0 in 2010, gradually rising to 0.8 $GtCO_2e\ yr^{-1}$ in 2030 (Figure 2.4). In a "business-as-usual"-scenario, where existing pledges are not fulfilled, LULUCF emissions rise to 2.1 $GtCO_2\ yr^{-1}$ in 2030. The unconditional pledges in INDCs turn LULUCF into a net CO_2e sink by 2030, with a total removal of 0.2 $GtCO_2e\ yr^{-1}$. Taking into account conditional pledges, the sink increases to 1.0 $GtCO_2e\ yr^{-1}$ (Grassi & Dentener, 2015). There is thus a difference of about 1.6 $GtCO_2e$ between current pledges and conditional INDC pledges, and an even bigger difference of 3.1 $GtCO_2e$ between conditional INDCs and country BAU, i.e. the actual change in net emissions from LULUCF from 2005 to 2030. Note that this is actual net emissions, i.e. "what the atmosphere will see over time," (Grassi & Dentener, 2015), not the contribution of LULUCF towards meeting the INDC pledges of each country, which depends on the way each country considers the contribution of LULUCF to mitigation (i.e. the accounting rules followed by each country) (Grassi & Dentener, 2015).

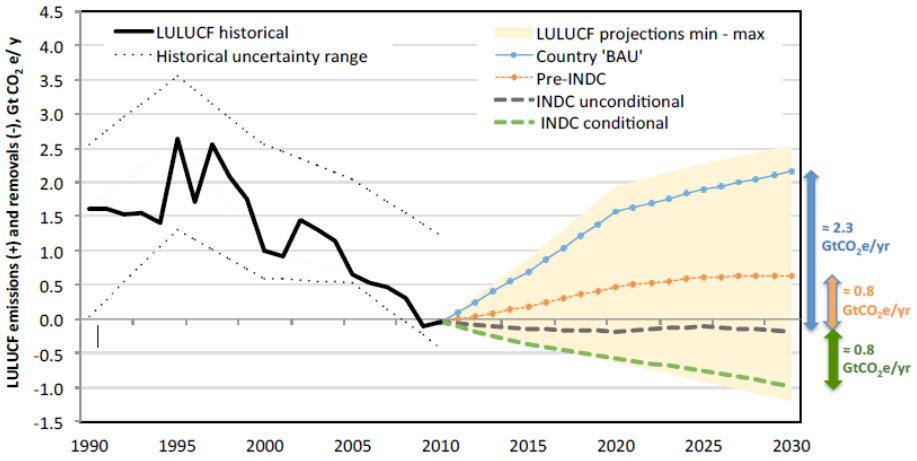

Figure 2.4 Global LULUCF trend of emissions and removals, and future scenarios analysed (Grassi and Dentener, 2015)

A total of 156 INDCs were assessed by the Netherlands Environment Agency (PBL, 2015) in their assessment of the INDCs. Of these, 95 were found to explicitly include LULUCF in their mitigation targets, while 36 of them provide specific measures or targets to reduce LULUCF emissions. 61 (of 156) explicitly state that LULUCF are not part of mitigation targets; however, 42 (of the 61) do propose measures or policies to reduce net LULUCF emissions (PBL, 2015).

Overall, the total mitigation contribution from LULUCF in INDCs relative to emissions from all sectors amounts to 20-25%, though this varies between countries and the type of mitigation targets set by these countries. Those who treat LULUCF as any other sector within the INDC and have set an absolute target relative to a base year (i.e. Australia, Brazil and the US), together expect LULUCF to contribute 42% of total mitigation (mainly due to reduced deforestation in Brazil). Those countries who treat LULUCF as any other sector within the INDC, but who have set a reduction relative to a BAU scenario (most countries currently classified as developing countries) expect LULUCF to contribute 48% of the total mitigation within the INDC. Finally, the EU, Canada, Japan, Kazakhstan, New Zealand, Norway, Russian Federation, Switzerland, Turkey and Ukraine, who have set special accounting rules for the LULUCF sector, expect 13% of total mitigation to be provided by this sector, as do the countries who have set intensity targets (i.e. reductions in emission intensity) (Chile, China and India) (Grassi & Dentener, 2015).

2.2.1.4 *Global stocktake and NDC update cycle*

The PA introduces the new concept of 'Global Stocktaking', which is to take place for the first time in 2023 and every five years thereafter. The global stocktake will inform a process of updating of NDCs, which will take place two years after each global stocktake, but starting in 2020 (i.e. 2025, 2030 etc., following from art 4(9) of the Agreement). The 2018 *facilitative dialogue* (Paragraph 20 of 1/CP.21) will further inform the preparation of NDCs of which the first is to be submitted in 2020.

In practice parties *shall* submit NDCs 9-12 months in advance of the relevant meeting of the parties to the PA (1/CP.21, para 25), meaning by Q1 of the year of the COP at which level of ambition is to be enhanced. For example, following from the Global Stocktake at the expected COP29 in Q4 2023, parties will update their NDCs and submit enhanced contributions by January-March 2025, to allow for a synthesis of contributions before the COP31 in Q4 2025 where the parties adopt a new reduction commitment. The process is illustrated as a part of the timeline in **Error! Reference source not found.** 2.1 in Section 2.1 above.

The value and effect of this linked process is to ensure a continuous monitoring of whether or not global efforts are sufficient, leading to a bottom-up process where parties can commit to increased contributions that then translates into a new global reduction commitment. This regime ensures that scale of action is assessed at regular intervals, preventing that global efforts are locked into 8-10 ten year protocols, where scale up of ambition is tied up to the negotiation and adoption of a new protocol or agreement.

2.2.1.5 *Backsliding*

Backsliding is interpreted as scaling down level of ambition and could include allowing practices that were previously ruled out. Backsliding in the former meaning is not mentioned explicitly, however the emphasis on progression of commitments over time (found in the Agreement article 3, para 1 and in 1/CP.21 articles 2(1)(a) and 4(3)), indicates that the status quo or indeed backsliding is not an option in terms of level of ambition. Backsliding as concerns rules, practices, modalities, procedures etc. is not mentioned directly.

Indirectly, article 4 includes text that could interpreted as no backsliding (para 14): "In the context of their nationally determined contributions, when recognizing and implementing mitigation actions with respect to anthropogenic emissions and removals, Parties should take into account, as appropriate, existing methods and guidance under the Convention." It is a rather vague wording, but shows that after all parties should not discard all work done so far on methods and guidance. Also, in paragraph 93 it reads "(e) The need to ensure that Parties maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention", which oblige parties to maintain current frequency and quality in the data they submit under the convention.

Nevertheless, the review process for NIRs and information on implementation of NDCs as set out in article 13 of the PA and in paras 85-99 of the decision is rather vaguely described, and potential 'backsliding' should be avoided during the work of the AWG-PA. For more on this, see the next section.

2.2.2 Transparency of Action, Reporting and Accounting

2.2.2.1 *Transparency of action*

Quite fundamentally, the PA establishes one 'enhanced transparency system' (PA, art 13(1)) with two compartments, namely one for action (concerning *mitigation* as set out in NDCs) and one for support (mostly *finance, technology transfer, capacity building*). The system for transparency on support is not included in the analysis below, even if some of the procedures and modalities may concern both systems. In practice, both systems will report in the same NIR and be compiled in the same internal process in the national system of each party.

In the Kyoto Protocol, transparency was to be ensured via the MRV system, also referred to as the 5-7-8 system, pointing to the provisions stipulated in articles 5, 7 and 8 of the protocol. The system therein established is not given a name, and is introduced matter-of-fact, without the wording on building 'trust and confidence' of art 13(1) of the PA. This change may indicate an increased focus on the importance of reporting and accounting systems since 1997, where the focus appears to have been on compliance check.

Similar to the 5-7-8 system, under the PA the transparency system will consist of three parts, namely an inventory and communication system, reporting and submitting and an expert review. In the Protocol it stipulated how parties must submit National Inventories, and in accordance with the Convention National Communications.

After 2020 each party shall provide two types of information (see PA art 13(7)), namely a national inventory and 'information necessary to track progress made in implementing and achieving its NDC' (letter b). The two tiered system could be a simplification, as the current setup with NIRs and NCs, Biennial Reports and subsequent Updates, is not *per se* continued, but 'shall form part of the experience drawn upon for the development of the modalities, procedures and guidelines (MPGs) to be developed under the PA'. The formulation indicates that the most useful and valuable parts of the existing system shall be taken forward, but ensures sufficient flexibility and room for manoeuvre in order to allow for a new system, where the two submissions mentioned in PA article 13(7) are the sole submissions. As set out in para 99, the new system is supposed to "build upon" and "supersede" the MRV system agreed upon in Cancun (1/CP.16) and Durban (2/CP.17), indicating that the reporting elements should be carried forward into the new system of transparency.

2.2.2.2 *Reporting: National Inventory Reports and National Communications*

As the National Inventory Reports will continue, the principle of aggregating and compiling data on emissions by sources and removals by sinks will also continue. This is clearly phrased in PA article 13 (3), where it reads: *"The transparency framework shall build on and enhance the transparency arrangements under the Convention"*. Furthermore, para 93, letter e) stipulates that parties *"maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention"* and in para 94 "*Further requests the Ad Hoc Working Group on the Paris Agreement, when developing the modalities, procedures and guidelines referred to in paragraph 92 above, to draw on the experiences from and take into account other on-going relevant processes under the Convention".*

The Ad Hoc Working Group on the Paris Agreement (AWG-PA) is requested to develop recommendations for modalities, procedures and guidelines for reporting (Para's 92-95) and to conclude the work by no later than 2018 (Para 97). This seems to be a very tight schedule for developing and informally agreeing on MPGs for such complex issues as reporting, unless there is agreement to extend the current MPGs more or less unchanged. Para 98 puts further strain on the process as it is *decided* the new MPGs shall apply at the entry into force of the agreement. Expectedly this should happen before 2020, but it depends on the ratification process and the interpretation of para 20(1).

As concerns the content and process for NIRs post-2020, the Agreement is not very clear, nor is the Decision. The Decision does however specify how the work of the AWG-PA should be informed and inspired, i.e. what should guide the work. The Decision differentiates between what should be taken into *account* (para 93) and what should be *considered* (95). The latter is interpreted as being less binding. At the same time, the former include principles whereas the latter is more concrete and for example specify content that should be included in the reporting of parties.

The top principle in para 93, and thus for the work of the AWG-PA on MPGs is that reporting and transparency is to improve over time. Thereafter, it is noteworthy, that in both para 93 and 95, *flexibility* is among the two first-mentioned principles. Flexibility refers to lending time

for formerly non-Annex countries to get their systems in place and establish procedures and produce data (Para 93, letter b and repeated in Para 95, letter a). This was presumably a demand from these countries in order to accept a reporting provision in principle similar for all parties. From the perspective of LULUCF and agriculture, the immediate effect of this granted (and probably justified) flexibility could very well be that reporting for the sectors will only become comprehensive years, if not decades, after the entry into force of the PA. Currently, the reporting of GHG data for land at tier 2-3 and approach 2-3 level seems unlikely for many of these parties. Against this backdrop, capacity building on inventory and reporting systems in former non-Annex 1 parties (as laid out in paras 85-86 of the decision), thus becomes ever more relevant and necessary in view of providing full and comprehensive data for the global stocktakes that are eventually to inform the need for increased ambition.

Lastly, and in principle applying to all parties, the MPGs should take into account both the TACCC principles and environmental integrity. This caters for a continuation of existing and fundamental principles of the Convention and indeed the Protocol.

As concerns methodological issues, neither the PA nor the Decision gives much guidance on the work of the AWG-PA, except for pointing out that undue burden and double counting should be avoided. Para 95 (b) is however quite important from a LULUCF and agriculture perspective as it points out that the AWG should consider *"consistency between the methodology communicated in the nationally determined contribution and the methodology for reporting on progress made towards achieving individual Parties' respective nationally determined contribution"*. This could be an indication that the NIRs and the accounting towards the NDC should be comparable in numbers and methodologies applied, which was not the case during the Kyoto Protocol commitment periods, as KP accounting and reporting, in the case of LULUCF and agriculture, follows quite different systems. In other words this might be an opening to align reporting and accounting for LULUCF and agriculture along the lines discussed in the context of applying KP accounting rules on NIR data. This last finding is highly speculative.

In summary, the overall framework for reporting after 2020 appears to be in place and continues the current practice. This is as such no surprise as the reporting system largely is provided for in the Convention itself, and specified further in a number of COP decisions. At the same time, the wording in article 13 of the Decision does leave room for quite substantial changes, as it is made clear that the new system should be developed taking into account, and in some case 'only' considering, experience gained from the existing system. As the outcome of the process is supposed to be known by the end of 2018, the next two years of continued talks will be important. However, this timing is suboptimal in view of ongoing policy development in the EU, notably the possible integration of LULUCF and agriculture into a non-ETS pillar, and the establishment of possible targets.

2.2.2.3 Accounting (implementation of NDCs)

In principle, the PA continues the practice of both reporting and accounting. As mentioned, art 13(7) stipulates that two types of information *shall* be provided on a regular basis, namely NIRs (covered in the previous section) and "*Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4*" (NDCs, *ed.*). As article 4 (13) reads "*Parties shall account for their nationally determined contributions.*" it seems prudent to conclude that article 13(7) b refers to information that allows for accounting.

The information communicated should allow for assessing whether or not the individual party meets its own commitments in terms of reducing emissions. Para 27 of the decision, which is a repeat of the Lima (COP20) 'Upfront Information' decision, indicates what parties should include in their NDCs. In NDCs, information should facilitate clarity, transparency and understanding, but as concerns its content, it "may include, as appropriate, inter alia, quantifiable information on the reference point (including, as appropriate, a base year), time frames and/or periods for implementation, scope and coverage, planning processes, assumptions and methodological approaches including those for estimating and accounting

for anthropogenic greenhouse gas emissions and, as appropriate, removals, and how the Party considers that its nationally determined contribution is fair and ambitious". The two underlined pieces of text are essential, as there is no obligation to provide the listed information, and furthermore, removals are listed after a second, dedicated "as appropriate". From a LULUCF and agriculture perspective, this formulation introduces *double* uncertainty about whether data on removals will be comprehensively included in (the first submitted) NDCs, thus rendering it even more difficult to assess – in accordance with the TACCC principles – the fulfilment of the aim to achieve balanced emissions and removals, as we approach the second half of the century.

In order to provide consistent and comparable information allowing for the assessment of the implementation of commitments taken in the NDCs, parties need guidance on how to approach the task of providing information. In para 31, the AWG-PA is requested to elaborate (not 'develop') such guidance, *"drawing from approaches established under the Convention and its related legal instruments* (e.g. the KP, author's insertion) *as appropriate*". Further to this, the AWG-PA is requested to also *"develop further guidance on the information to be provided…"* (para 28). In combination, these requests and their formulation, indicate that established approaches will continue to some extent, and that the list of information items given in para 27, may very well become more detailed and demanding, although always as recommended items, given the very nature of guidance material.

Apart from that, there is no explicit mention of a system for accounting separate from the reporting system or indeed separate MPGs for accounting. Rather, article 13(13) reads that the COP/PA at the first session *"shall … adopt common MPGs … for the transparency of action and support."* where transparency of action includes both the NIRs and the NDC accounting information.

Overall, it appears that there will be two main reporting obligations, namely NIRs and NDC accounting, but that a common set of rules for the transparency system will be developed. Further to this, guidelines on the recommended content of NDCs will be elaborated, thus in total two sets of guidelines.

2.2.2.4 Technical Expert Review post-2020

The key provisions on the review set up after 2020 are in PA article 13, paragraph 11 and 12. In the Decision, review is only mentioned in the context of review of NDCs by parties themselves, which is different from the Technical Expert Review (TER).

Article 13(11) starts out by stipulating that both NIRs and information on NDCs shall undergo Technical Expert Review. This is quite fundamental, and as such a continuation of the current practice. In Article 13 (12), it is further specified that the review (of developed country parties) shall consist of three elements:

1. Consideration of the information provided and the Parties' implementation and achievement of its NDC commitment
2. Identify areas of improvement
3. Review of consistency of the information with the MPGs adopted by the COP-PA at its first session.

This is somewhat shorter and less detailed than the six paragraphs in the KP on Technical Expert Review (article 8). Under KP, the composition of Expert Review Teams and their coordination by the secretariat is spelled out, just as the COP, with the assistance of the SBI and SBSTA is asked to consider and eventually take decisions on implementation based on the review. Furthermore, paragraph 3 of article 5 of the KP reads: *"The review process shall provide a thorough and comprehensive technical assessment of all aspects of the implementation by a Party of this Protocol*". This is potentially more far-reaching than the mandate given to ERTs after 2020, which mainly concerns reviewing consistency of information with the MPGs. Bullet one in the above, on consideration of implementation, is an inherently vague formulation and until guidelines or practice are clearer, there is a risk

that it can potentially result in a weaker review mandate. In context of the greater flexibility for rules and modalities available to parties under the PA's bottom-up approach, in many cases requirements will indeed be looser in comparison to the KP's prescriptions.

Worth mentioning is that there is no mention of an assessment report (AR) anywhere in article 13, whereas one such is mentioned in the second sentence of article 5(3) of the KP. For the time being, it is unclear, reading the letter of the PA and Decision text, whether the TER will produce a report, and if so, how this is to be received by the COP. In the Decision, article 13(4) mentions that among other things the "international assessment and review" shall form part of the experience drawn upon for the development of the MPGs. This however, points to the reviews of Biennial Reports, which is different from the review of NIRs and contributions. On contrary, the lack of mention of the current TER practice and indeed the ARs could be an indication that TER in the future could play a less prominent role.

2.2.3 Land and forests

The scope of this study is LULUCF and agriculture. However, in preceding sections, the focus has been on general aspects of the agreement that could have direct or indirect effects on the way LULUCF and agriculture could contribute and be reported on and accounted for. As detailed in the next sub-section, a), direct mentions of LULUCF and agriculture in both the PA and the Decision are few and far between. Indeed, outside of the preambles, LULUCF, agriculture, and land-use issues are only mentioned indirectly.

Due to this, the main part of section 2.2.3 consists of

- A combined interpretation of the full body of direct references to sinks, reservoirs and removals in the PA and the Decision. This is included in subsection b.
- An assessment of how existing practices of reporting and accounting for LULUCF and agriculture could be influenced by the perceived changes following from the observations made in previous sections. This is found in subsections c, d and e.

2.2.3.1 a) Mention of LULUCF and agriculture in the Paris Agreement

Neither LULUCF nor agriculture are directly and/or explicitly mentioned in the Decision preamble nor the Paris Agreement (PA) in the sense that the words land, land use, LULUCF, and agriculture do not exist in the PA text. Forests, however, are mentioned in the preamble (III/55) and the agreement (Art. 5(1) to take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases, which concerns removals by LULUCF and agriculture, including forests, and Art. 5(2), including the need to reduce emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks.

However, several indirect and implicit mentions of LULUCF and agriculture are included in the Decision preamble and the PA (preamble and articles). The sector is most often referred to through the mention of "anthropogenic greenhouse gas removals," which is mentioned thrice in the decision preamble (paras 27, 31, and 37), especially with regards to methodologies to estimate and account for these removals (III/31) and guidance to ensure that double counting is avoided (III/37). "Removals" are mostly mentioned in Article 4 of the PA (4(1), 4(13), and 4(14)). Art. 4(1) refers to the aim to reach a global peak in GHG and the need to achieve a balance in emissions and removals of GHG, meaning that the net emissions of LULUCF and agriculture are to contribute to the goal of net zero emissions. Art. 4(13) explains that Parties shall account of NDCs, including removals (i.e. account for LULUCF and agriculture contributions), while Art. 4(14) notes that existing methods and guidance under the Convention should be taken into account when accounting for these removals. Art. 13(7a) concerns the need to provide a national inventory report of anthropogenic emissions and removals, meaning that LULUCF and agriculture should be accounted for in the NIR.

Finally, when the decision preamble (paras 31, 37) and PA (preamble and Art. 5(1)) mention "sinks" or "reservoirs," and recognise the importance of conservation and enhancement of

these, this implicitly refers to, *inter alia*, LULUCF and agriculture. In conclusion, while LULUCF and agriculture are not explicitly very visible in the implementing parts of the Decision (in concrete principles for reporting and accounting rules), they do play quite a role in delivering removals for the achievement of the long term goals.

2.2.3.2 b) Removals, reservoirs and sinks

The removal capacity of LULUCF and agriculture is mentioned several times in the Agreement. Paragraph 1 of article 5 of the Agreement mirrors article 4, paragraph 1d of the Convention[3], in that it concerns the conservation and enhancement of sinks and reservoirs, and the sustainable management of their containing ecosystems. This is one of the most explicit references to the removal capacity of LULUCF and agriculture in the Agreement and Decision combined. The long term goal of article 4(1) on the balance between emissions by sources and removals by sinks is a separate, and new, long term goal that places removals (Carbon Sequestration and CCS) at centre stage.

This emphasis is mirrored in the provisions stipulating how parties are to account for their commitments taken in the NDCs. It reads, *"Parties shall account for their nationally determined contributions. In accounting for anthropogenic emissions and removals…"* (PA, article 4(13)), thus making removals an integral part of accounting. Again in 13(7) it reads "*Each country shall regularly provide a national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases".* The NIR is however not intended for accounting, merely for reporting.

However, in para 27 in the decision, specifying what information should go into the NDCs, the text reads that information *"may include…, as appropriate, removals"*. The use of both 'may' and 'as appropriate' lend some freedom to parties on whether or not to include this information in NDCs. Bearing in mind the formulations of Articles 4(13) and 13(7) of the PA, it will become difficult for Parties to account for removals if no information is provided.

To facilitate the role of removals, and to guide the reporting, accounting and contribution of removals, the AWG-PA is requested to develop MPGs for both reporting and recommended information in NDCs to allow for accounting. Paragraph 31a of the Decision stipulates that *"Parties account for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the Intergovernmental Panel on Climate Change and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement*". In 31c, the first part reads "*Parties strive to include all categories of anthropogenic emissions or removals in their nationally determined contributions"*. The former is a very clear statement, in the sense that the existing body of IPPC Good Practice Guidelines and Supplements shall inform the development of MPGs, whereby all current reporting and accounting practices are in play. This does not mean they will eventually continue to apply after 2020, but they have not been excluded. The latter (and 31d) however softens the recommendation to include all categories.

In summary, there is an obligation ('shall') to account for removals in NDCs, and the current guidelines and thus methodologies shall inform the development of MPGs for this accounting, however Parties may leave out information on removals from their NDC, if "appropriate", provided that the Party explains why (Decision, para 31d).

Interestingly, and worth further specific interpretation, in article 6 of the Agreement where the Joint Mitigation Mechanism is established, removals have not been included. It reads, *"A mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development is hereby established."* The omission is repeated in paragraph 38, where the rules, modalities and procedures for the mechanism are requested from the AWG-PA. The text of 38e reads: *"Verification and certification of emission reductions resulting from*

[3] Art 4.1.d of the convention: "Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gasses not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems."

mitigation activities by designated operational entities." There are no other supporting observations or indications to suggest concluding that this excludes joint mitigation on removals, however the absence of 'removals' attracts attention.

2.2.3.3 c) FMRL and review

There is no direct or indirect mention of the Forest Management Reference Level or any other particular practice or methodology concerning forests (except for REDD) in the PA, nor in the Decision itself. This is not per se an indication that the FMRL or another forest reference level cannot continue, as an Agreement between parties may not be the proper place to include such sector specific and technical matters. Rather, this is partly inherent to the flexible approach of the PA, which implies a less specific treatment of such technical matters than the KP.

Concerning what is mentioned on the MPGs to be developed or elaborated for NDCs information or accounting, para 31 of the Decision is the centrepiece again. It refers to *"methodologies and common metrics assessed by the Intergovernmental Panel on Climate Change and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement"*. The FMRL is included in the IPCC 2013 Revised KP supplementary GPG (for CP2) (see section 2.3.8). The method of setting up an FMRL is stated in Decision 2/CMP.7 (Durban LULUCF decision). That means, that the AWG-PA could consider continuing the FMRL or similar land based accounting approach not necessarily limited to management aspects, but it would need an adoption by the CMP of the PA (as would any other accounting rule).

The fact that the Kyoto Protocol in article 3, paragraphs three and four, elaborates on how specific forest related emissions and removals shall be included, illustrates by comparison the level of specificity that an overall legal agreement can include. In other words, the lack of such detail in the Agreement, and indeed the Decision, introduces uncertainty on practices for accounting post-2020 that could have been avoided. This could be interpreted as an indication that it will be difficult to agree on such rules and/or that the current practice (FMRL) does not have enough support to be continued post 2020. In any case, as no mandate is given to the AWG-PA to develop certain practices or methodologies, it will be difficult for a non-political, technical AWG-PA sub-group to radically change the approaches found in the existing material. This indicates either that post-2020 will allow for a lot of freedom or that existing approaches will end up guiding future approaches quite a lot. Taking into consideration the constant focus on flexibility, the first interpretation seems probable, in which case the EU can choose to consolidate its approach. There is no indication of one uniform approach by all parties to accounting for forests post 2020.

The review of FMRLs is a separate matter. The FMRLs for CP2 under KP were submitted in 2011 and assessed thereafter in a technical assessment, but not in a review process like it is done with annual KP submissions and submissions of the initial reports. The technical assessment could only provide recommendations for corrections, but in contrast to the annual reviews could not demand such corrections or apply an adjustment to the FMRL.

The 2013 supplementary guidelines for KP reporting identify requirements for technical corrections to the FMRL if methodological inconsistencies occur between the GHG reporting and the FMRL. The technical corrections of the FMRL should ensure consistency in methods and data between the FMRL and reported emissions and removals. Since these technical corrections are to be reported in the National Inventory report they will be reviewed as part of the annual UNFCCC review cycle of the NIR.

As there are no decisive provisions on the practice concerning accounting for the contribution of forests under PA, it will be difficult to set clear rules for the review of their role in NDCs, let alone to request the AWG-PA to develop recommendations. Indeed, no text in the decision or the PA has been found to give indications of whether or not, and if so how, contributions from LULUCF and agriculture are to be reviewed.

2.2.3.4 d) REDD+, and drivers of deforestation

REDD+ and drivers of deforestation are included implicitly in several sections of the Decision. REDD+ also seems the only land and forest based mechanism that is addressed directly in the Decision and PA (Art. 5.2).

The preamble of the draft Decision -/CP21 acknowledges *"the need to promote universal access to sustainable energy in developing countries, in particular Africa, through the enhanced deployment of renewable energy".* Given the fact that in large parts of Africa fuel wood is the main energy source and also among the biggest drivers of deforestation and forest degradation this mentioning hints to an important mitigation action to be taken in developing countries. Although in principle fuel wood could be considered to be a renewable source of energy, in practice it is mined in large parts of Africa, subsequently leading to degradation of the landscape.

While Article 5.1 of the PA in principle concerns all sinks, i.e. both forest and non-forest based, para 2 is specific to forests in developing countries. It covers two topics, namely:

- reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+); and
- alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests

Para two sets the frame for policy approaches and positive incentives, but does not include any firm obligations to create such incentives. The wording "*Parties are encouraged to take action ...*", suggests that it essentially leaves action voluntary. Nevertheless, overall the text appears to support and recognise the previous advances made in the REDD+ mechanism, including financial arrangements and results based payments as indicated in paragraph 55 of the decision. Moreover Art. 5.2 of the PA explicitly calls attention to the "*existing framework*", referring to the Warsaw Framework for REDD+[4] as agreed on in decisions 9/CP.19 through 15/CP.19.

This Warsaw framework, together with previous and subsequent COP decisions provide an elaborate guidance on many REDD+ issues, including environmental safeguards, reference levels, and national monitoring, reporting and verification systems. Including a specific article on REDD+ therefore can be seen as a strong support to the REDD+ approach, and indicates the continuation of this work and agreed principles etc. The main observation is that REDD+ continues.

By referring to both 'result based payments' and 'non-carbon benefits', the paragraph mirrors the ongoing debate in the REDD+ community on the scope and approach of the mechanism. The wording in the agreement is not conclusive on any of these discussions.

The lack of text in the Decision referring to and implementing article 5 of the Agreement leave very little material for a detailed assessment of the treatment of forest or land carbon in the mechanism(s), i.e. there is no indication of reporting and accounting principles. However, this is already covered by the existing framework and related decisions, particularly decision 11/CP/19 on modalities for national forest monitoring systems and 13/CP/19 on Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels.

It is expected that since removals should be included in NIRs, and NIRs are to be produced and submitted by developing country parties, any REDD+ activity in the territory of a party to the agreement would be reported. However, since the accounting rules for LULUCF and agriculture (in relation to NDC commitments) remain unknown, no conclusion can be made based on the agreement on how transferable mitigation outcome (credits and debits) from REDD+ activities can be calculated, issued, transferred and used. Any linkages between this

[4] http://unfccc.int/land_use_and_climate_change/redd/items/8180.php

mechanism (or the sustainable management of forests) and accounting for forests in developed country parties (such as the EU) is thus difficult to connect.

2.2.4 Summary: Main observations with relevance for EU policies

Taking from the above assessments, a number of observations with potential implications have been identified. These are listed in the table below and are treated in more depth in the following chapters.

Table 2.3 Main observations of implications of PA for EU policies

Observation	EU policy implication
General	
1) Introduces the aim of achieving balanced emissions and removals after 2050. Carbon neutrality aim to be met based on reported data (i.e. land based approach) before any accounting rules are applied.	The implication is a least two-fold: 1. A 50-year EU strategy for GHG emissions may be worthwhile considering, in order to scope how the Union will develop towards a carbon neutral economy 2. Neutrality based on reported data implies that actual emission and actual removals (incl. CCS) needs to balance. This will require a significant effort, not only reducing emission to a minimum, but increasing removals (and preserving sinks) as well.
2) Global stocktaking introduced, meaning pressure for enhanced ambition every five years	Link to EU policy cycle, GS in Q4 2023 and enhanced contribution submitted Q1 2025.
3) Backsliding in terms of lowered ambition is not possible. However, backsliding on stringency of Modalities, Procedures and Guidelines (MPGs) is indeed possible, but much dependent on the interpreters view, i.e. not black and white. Changing rules and practices may be fortunate for some, but a disadvantage for others. Whether it is backsliding will depend on the view of the affected. E.g. the fate of the rules concerning calculation of background levels for FMRLs may lead to a variety of practices, some of which may lead to more carbon sequestration being accounted for. A number of such cases could be termed backsliding.	For EU the implication of loss of or loosening of certain rules and practices (for LULUCF and agriculture in particular) can lead to less emissions (debit) or more removals (credits) entering accounts for individual MS or all MS. This can in turn mean that the 2030 emission reduction target becomes easier (cheaper) to meet. Some MS have taken a stand against this, but in practice, it will be very difficult to detect and prevent. Furthermore, a uniform and all-inclusive EU standpoint on backsliding is not realistic. It is difficult to pin point EU implications other than trying to avoid such backsliding on a case-by-case basis in the negotiations in the context of the AWG-PA for the years to come.
4) Early ratification by major emitters may lead to a situation where the first COP-PA is able to adopt decisions, e.g. on the system of transparency, with a long list of parties only mandated as observers.	Early EU ratification is the most effective safeguard against this situation, but may not be feasible for a number of reasons not linked to the PA itself.
Reporting, accounting and review	
5) The obligation to submit information to allow for review of progress towards NDC pledges apply to all parties (called NDC accounting in the above), also developing country parties that had no (NIR or Accounting) obligation under KP. Thus 'global' coverage reporting and accounting is now in principle provided for, although the flexibility given to new parties may mean that only in a couple of decades will this in actual fact be the case.	One notable implication among several possible is that emissions related to food, feed and products entering the EU from third countries would, in principle, have been accounted for. This includes biomass used for energy purposes, that currently are rendered zero-rated in e.g. the ETS on the grounds that emissions resulting from the combustion of the biomass have been accounted for in the LULUCF-sector in the producing country, thus avoiding potential double counting.
6) The texts are suggesting that NDC and	This finding in combination with the interpretation of

reporting should follow same principles and be consistent. This indicate support for land based accounting. The interpretation is further supported by the call for the COP to adopt common MPGs for the system of transparency of action and support, i.e. all reporting and accounting obligations for all parties.	the balanced emissions aim (#1), could support EU working towards a land based accounting approach.
7) New Modalities, Procedures and Guidelines (MPGs) for the System of Transparency will apply to the second and subsequent nationally determined contributions. For EU (and other parties submitting ten year NDCs) this means by 2030, and for other parties (such as US and China) submitting five year NDCs this means 2025.	This flexibility allows EU to continue whatever practice chosen for the entire duration of the EU 2030 package commitments. This leaves amble time to prepare and adapt to and new MPGs that would come out of the various AWG-PA work streams and be adopted during the coming 5-7 COPs.
8) The review mandate given post-2020 is currently vague and does not include all aspects of NDC or NIRs. Notably, no review report is mentioned and the KP principle of submitting the Assessment Report to the secretariat and later for the COP for consideration is not carried forward. More detail on reviews may be given in the development of MPGs (under AWG-PA) but it is unlikely that the AWG propose a stronger review process than its mandate indicates.	While it is unlikely that the international review will be abandoned in its entirety, it seems likely that it will be vaguer. In particular the omission of the assessment report and the role of the secretariat means that the transparency and consistency elements of TACCC is at risk. This again means that the global stocktake can be difficult, and hence that EU cannot (easily) benchmark its own effort and commitments with that of other comparable parties (e.g. US, CAN, AUS, JPN). Two possible ways to address this, either individually or in combination, could be: 1. Make sure EUs (MSs) NDCs are reviewed by an internal process that follows TACCC 2. Invest significant political capital in the development of strong MPGs with a broad ERT mandate
LULUCF and agriculture	
9) Removals, reservoirs and sinks are mentioned several times throughout the PA and the decision, including in the list of information that should be included in the NDCs. This shows a clear recognition of the role of carbon sequestration, but the formulation on NDCs (*"may include... as appropriate, removals"*) indicate that it is not mandatory as of now.	In order to mirror the 'global' focus on removals, EU climate action post 2020 could benefit from including removals and sinks under the 2030 target. The EU INDC does indicate that this will be the case.
10) There is no mentioning of the FMRL or other forest reference level- directly or indirectly - and compared to KP the PA and the decision is less technical and less specific. In 3.4 of the KP and later decisions, accounting rules for forests are set out, but no similar rules are found in the PA or the decision. This "loss of detail" can either indicate more flexibility on choice of methodologies or indicate that it is increasingly difficult to find common ground on the treatment of forest carbon.	In the absence of any steer, it should be possible for EU to continue the current forest accounting practice based on FMRLs or modify it slightly e.g. to follow land based accounting not focused on management. No indication of a new exclusive approach is found. In light of the new bottom-up approach (e.g. symbolised by NDCs), and bearing in mind that even under KP CP2 three approaches to FM accounting was available to parties, the conclusion is that it will increasingly be left to parties to decide how to account, as long as they comply with TACCC principles.
11) No text in the decision or the PA has been found to give indications of whether or not, and if so how, contributions from forest, or the LULUCF and agriculture in general, is to be reviewed.	EU would have to consider options for review of forest accounting (forest reference levels), if 1. No international process is in place at all or in due time 2. The international review is insufficient

12) REDD+ continues after 2020. Also, it is expected that since removals should be included in NIRs, and NIRs are to be produced and submitted by developing country parties, any REDD+ activity in the territory of a party to the agreement would be reported – at least in later submission.	No immediate implication, however EU action on forests, not least in terms of reporting, accounting, review may guide the practice of developing countries for the years to come. To that end, EU could consider capacity-building initiatives on GHG reporting and accounting in developing countries.

In the table below an overview of continued, discontinued and new elements in the PA relative to the KP, is given. The table is not exhaustive, but includes observations found to be relevant for the topic and scope of this report.

Table 2.4 Summary of continued, discontinued and new elements of the PA

	Continued	Discontinued	New	Not confirmed/ subject to AWG-PA work
General	• A target consisting of a desired maximum temperature rise by the turn of the century	• A global agreement holding negotiated commitments for developed parties only • The principle of global commitment periods	• Submitted individual NDCs as basis for commitments • Carbon neutrality aim • Global Stocktake process • Wording on avoiding backsliding	
Reporting	• TACCC principles • NIRs and NCs • Current reporting MPGs (IPCC GPG)			• BR and BURs
Accounting	• TACCC principles	• KP NIR LULUCF supplement • A KP style decision text on land use accounting (KP 3.3 and 3.4), incl. • (Supposedly) Net-net and gross-net accounting based on a subset of activity data.	• NDC accounting: *"Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4"*	• Land based accounting • FMRL accounting practice • The *lex australia* (KP article 3(7) *bis*)
Review	• The TER based on TACCC			• The ERT Assessment Report • Dedicated FMRL review
Land (Incl. forests)	• REDD+ mechanism		• alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests	

3 Potential contribution of LULUCF and agriculture

3.1 Relevant findings from the Paris Agreement analysis

The introduction of the commitment to 2 degrees and an aspiration for 1.5 degrees warming above pre-industrial levels shows recognition that current level of ambition, and thus the aggregate effect of the submitted NDCs, is not sufficient, and that action should be scaled up. The long-term need to balance emissions and removals requires withdrawal of CO_2 from the atmosphere, as there will always be some non-CO_2 GHG emissions as well as some non-anthropogenic emissions. This indicates that more action is required, even before 2030, and consequently that higher GHG reductions targets are needed.

Against the backdrop of the facilitative dialogue in 2018 and even more so the 2023 global stocktake, the establishment of a mid-century plan highlights the need to think long term and to consider the maximum 2^oC increase more explicitly in NDCs. Although no review or commitments are linked to this plan, it is expected that these plans will create a more solid platform for an increase in ambition in the 2020/2025 submissions and updates. This might have consequences for the current reduction targets in the 2030 climate and energy framework. The analysis of the PA for this study also made clear that there is a stronger emphasis on the sink function of forests.

Removals, reservoirs and sinks are mentioned several times throughout the PA and the decision, including in the list of information that should be included in the NDCs. This shows a clear recognition of the role of carbon sequestration, of which soils and forests are the main sinks, besides carbon capture and storage (CCS) based approaches. Neutrality based on reported data implies that actual emission and actual removals (including CCS) need to balance. This will require a significant effort, not only reducing emission to a minimum, but increasing removals and preserving sinks as well.

Bioenergy coupled with CO_2 Capture and Storage (BECCS) can mitigate climate change through negative emissions if CCS can be successfully deployed. In global long-run mitigation scenario studies BECCS features prominently for two reasons: (i) The potential for negative emissions may allow shifting emissions in time; and (ii) Negative emissions from BECCS can compensate for residual emissions in other sectors (most importantly transport) in the second half of the 21st century. BECCS is markedly different than fossil CCS because it not only reduces CO_2 emissions by storing C in long term geological sinks, but it can continually sequesters CO_2 from the air through regeneration of the biomass resource feedstock (Creutzig et al., 2015). In respect to the achievement of balanced emissions and removals after 2050, BECCS is likely to provide an important contribution.

The current EU 2050 roadmap and the projections behind it foresee an 85-90% reduction of emissions by 2050 but do not project when if at all a balance is to be achieved. In addition, they do not include LULUCF and agriculture, either in terms of emissions or removals. A more long term vision of the role of LULUCF and agriculture in emission reductions and especially removals is needed. In this respect the potential for removals differs strongly per MS, which would require flexibility among MS. This flexibility is already one of the main points of discussion among MS within the wider framework of how to include land use, land use change and forestry into the 2030 greenhouse gas mitigation framework.

3.2 Overview of current and projected LULUCF emissions and removals

The EU28 LULUCF sector is at present a carbon sink as it sequesters more carbon than it emits. The EU LULUCF reported net sink in the UNFCCC inventory was estimated at 330 Mt CO_2 in 2013, with Forest land having a sink of 448 Mt CO_2, and the other land use categories being sources: Cropland 69 Mt CO_2, Grassland 5 Mt CO_2, Wetland 15 Mt CO_2, Settlement 50 Mt CO_2 and Other land 0.5 Mt CO_2.

Several studies with projections of trends in emissions and removals from the LULUCF sector are available. The main study currently used by the European Commission is the "EU energy, transport and GHG emissions, trends to 2050" study, based on the Reference scenario 2013 (EC, 2014). New projections have been made (Reference 2015), but these are not yet publically available. In the EC (2014) study the current and future CO_2 emissions from the LULUCF sector have been estimated using the Global Biosphere Management Model (GLOBIOM) and the Global Forest Model (G4M). Basic drivers, such as: GDP, population development, energy demand, biomass energy supply and productivity changes are generated by PRIMES and GEM-E3 energy models or provided by global databases. These drivers are then used by the economic bottom-up land use model GLOBIOM.

The LULUCF sink is expected to be maintained until 2050, even though it is projected to decline from about -244 Mt CO_2 in 2010, to -214 Mt CO_2 in 2030 and -196 Mt CO_2 in 2050 in the Reference scenario. This decline is the result of changes in different land use activities of which the forest sector changes are the most important. Figure 3.1 shows the projection of the total EU28 LULUCF sink in the Reference scenario until 2050 and the contribution from different activities.

The significant decline in the managed forests carbon sink (FM) is explained by the growing demand for wood for products (such as furniture or paper) and bioenergy, which results in increased harvesting removals and decline of the carbon forest sink. This is also in line with Bottcher et al. (2013), who project a significant decline of the sink until 2030 in the baseline scenario of about 25–40% compared to the models' 2010 estimate. However, this decline can be partially compensated by a rising carbon sink from afforestation, a decrease in deforestation and increasing carbon storage in harvested wood products. Since part of the harvested biomass is processed to final wood products which have a lifespan of several years, the carbon sink from harvested wood products increases.

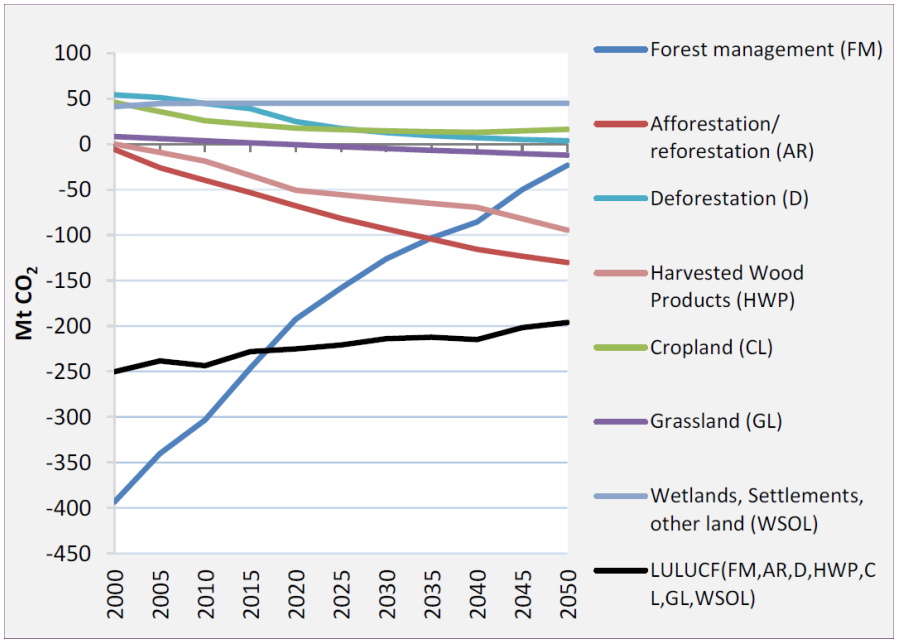

Figure 3.1 Projected EU28 LULUCF emissions until 2050 in Mt CO_2 for the reference scenario (EC, 2014)

3.3 Potential of the forestry sector

Forests can sequester carbon, preserve carbon stocks and provide biomass for materials and bioenergy. However, changes in forest management to prioritize one of these functions will lead to trade-offs in the carbon balance. Changes in the management of forests to provide biomass for energy can result in both losses and gains in forest carbon stocks, which are determined by the dynamics of management operations and natural biotic and abiotic forces. Forest biomass that would otherwise be burned without energy recovery, rapidly decomposing residues and organic wastes can produce close to immediate GHG savings when used for bioenergy, similarly to increasing the biomass outtake from forests affected by high mortality rates. However, when slowly decomposing residues are used and when changes in forest management to provide biomass for energy causes reductions in forest carbon stocks or carbon sink strength, the GHG mitigation benefits are delayed, sometimes many decades. Conversely, when management changes in response to bioenergy demand so as to enhance the sink strength in the forest landscape, this improves the GHG mitigation benefit (Creutzig et al., 2015).

A recent study by the European Forest Institute (Nabuurs et al., 2015) estimated that EU forests and the forest sector currently produce an overall climate mitigation impact that amounts to about 13% of the total EU emissions. This comprises both the action of forests and harvested wood products as a carbon sink and carbon stock, and the substitution effect of forest products for fossil-based raw materials and products.

The study found that the mitigation potential of the EU forest is underutilised and, if adequately incentivised, Member States could achieve a combined additional effect of as much as 400 Mt CO_2/yr by 2030 on top of the existing sink and substitution. This amount is comprised of the following sources:

- Forest resource projections with alternative management and policy assumptions indicate that forest carbon storage in EU forests could continue to increase from 2010 to 2030 by around 20%, providing additional sequestration of up to 170 Mt CO_2 /yr by 2050 (Eggers et al., 2008).
- A study on farmland in the EU revealed that potentially about 15 million ha of farmland could be abandoned by 2030, and if this area were afforested, it could provide an additional sink of almost 70 Mt CO_2/yr (Keenleyside & Tucker, 2010).
- EU domestic woody biomass/residues/low-quality thinning wood could probably cover about 4% of total EU energy needs, which is an avoidance of about 180 Mt CO_2/yr.

However, reaching these increased removals would require significant investments in the forest sector and it is unclear to what extent these numbers would be included in the accounting for the LULUCF sector, as part of the emission savings are accounted for in the energy sector. In any case, the Nabuurs (2015) study regards simply the outcomes as the atmosphere would see them, as additions to how the baseline may develop; and all of the savings were assigned to the forest sector.

The modelled EU baseline forming the FMRL assumed no major change in forest management, but assumed a continuation of the same (low) level of intensity and low level of harvesting, as well as the current level of disturbances and deforestation. Due to ageing of the forest the sink saturates rather quickly in the FMRL baseline.

National level studies confirm the EU picture that was given in Nabuurs et al. (2015) where through a large effort a change is made in forest management and in the way abandoned land is treated and in the way wood products are used. Examples of national level studies:

- Graudal et al. (2015) state that for Denmark a parallel growth in the carbon store of the forests, implies that the annual displacement of fossil carbon and build-up of carbon in the forests and forest products may grow from a level below 5 million tonnes of CO_2 per year to 6 million tonnes in 2020, 7-9 million tonnes in 2015, and 10-13 million tonnes in 2100, corresponding to an increase from less than 10% to more than 20% of the current annual Danish emission of CO_2 (level 2011).

- Read et al. (2009) project that for the UK's quickly saturating sink, an enhanced programme of afforestation, stopping deforestation, and increased productivity and use of wood products would enhance the climate mitigation effects of the UK forests (incl. substitution) with an additional 11.2 Mton CO_2/yr
- Miranda et al. (1994) calculate that when forest fires in Portugal would be stopped, the emissions would come down with some 2 Mton CO_2/yr
- Kallio et al. (2013) foresee that Finnish forest sink could increase from current 35 Mt CO_2 to 70 Mt CO_2 by 2035.

Other EU level studies like IIASA, PBL, Ecofys study (Den Elzen et al., 2015) also regard the land use sector in a multisector approach. Their model mostly responds to land use changes in e.g. Brazil and Indonesia. However their land use model is much less responsive to management changes in the forest, forest dynamics and HWP. Therefore, for the EU land emissions, they find almost zero changes until 2030.Changes in carbon stocks can happen both within the forest pools (living biomass, dead wood, litter and soil) and in the harvested wood products (HWP) pool.

Increasing the HWP pool, e.g. by substituting materials with wood products can also be considered an effective mitigation strategy. Pilli et al. (2015) estimated emissions and removals from HWP from 1990 to 2030 in EU-28 countries with three future harvest scenarios (constant historical average, and +/−20% in 2030). Maintaining a constant historical harvest, the HWP sink will slowly tend to saturate, i.e. to approach zero in the long term. With additional harvest and application in long lived products an additional 21 Mt CO_2/yr could be sequestered. However, this will tend to reduce the current sink in forest biomass, at least in the short term. Their results suggest that there is limited potential for additional HWP sink in the EU and it should be analysed in conjunction with other mitigation components related to the forestry sector.

3.4 Carbon sequestration in agricultural soils

Soil carbon sequestration is effective in reducing or slowing the build-up of CO_2 in the atmosphere. Management of soils has a large impact on soil carbon stores in both the short and long term. IPCC AR4 estimated the total technical and biophysical mitigation potential in Europe (all practices and all GHGs) by 2030 at 750 Mt CO_2 yr^{-1} (Smith *et al*., 2007a). For soil carbon management in the agriculture sector the technical mitigation potential was estimated at about 200 Mt CO_2 yr^{-1} (Smith *et al.*, 2000). However, the realization of the potential would be difficult due to low cost-effectiveness of some of the measures, uncertainties in the estimates of the mitigation potentials, negative impacts of some measures on agricultural production, with consequences for land use and emissions associated with land elsewhere.

Since then several studies have appeared, which show lower potentials, as the previous estimates are considered high and unlikely to be achieved at EU level because some of the measures have been implemented already, whilst other constraints (e.g. water constraints) limit applicability, and some of the measures are not accepted by farmers due socio-economic and cultural reasons (Frelih-Larsen *et al.*, 2008). Also the effectiveness of some of the measures has been questioned. For example, the carbon sequestration potential of reduced and zero tillage is currently debated, as these measures would lead to a redistribution of carbon in the soil (more in the topsoil, but less in the subsoil) rather than net carbon sequestration (e.g. Powlson et al., 2014), although the effect is likely to be regionally different depending on climate.

Two recent modelling studies that assessed the soil carbon sequestration potential of cropland are Lugato et al. (2014) and Frank et al. (2015). Lugato et al. (2014) simulated several alternative management practices, using the Century model, aimed at carbon sequestration for Europe. The measures included consisted of the conversion of arable land to grassland (and vice versa), straw incorporation, reduced tillage, straw incorporation combined with reduced tillage, ley cropping system and cover crops. The conversion into grassland showed the highest soil organic carbon (SOC) sequestration rates, ranging

between 0.4 and 0.8 t C ha^{-1} yr^{-1}. Among the other practices, ley cropping systems and cover crops gave better performances than straw incorporation and reduced tillage. The allocation of 28% of the European arable land to different combinations of alternative management practices resulted in a potential SOC sequestration about 34 Mt CO_2 per year by 2050.

Frank et al. (2015) simulated soil organic carbon dynamics for the EU in a global bottom-up recursive dynamic partial equilibrium model (GLOBIOM-EU) using carbon response functions simulated with a biophysical process-based model (EPIC). The current CO_2 emissions from cropland are projected to decrease by 40% from 64 $MtCO_2$ in 2010 to about 39 $MtCO_2$ in 2050 mainly due to saturation effect when soils converge toward their equilibrium after management, crop rotation, or land use change. In addition, they estimated a SOC mitigation potential for cropland between 9 and 38 $MtCO_2$ per year until 2050. SOC sequestration could compensate 7% of total emissions from agriculture within the EU.

Both studies find limited SOC mitigation potential in cropland soils, however, only a limited set of mitigation options was assessed. Restoration of degraded lands might have higher carbon sequestration potentials, but a study providing a good overview of the potential for the EU is lacking. Also conversion of cropland to perennial biomass crops might have a significant mitigation potential, as perennial crops store more carbon in the soil through their root system.

According to Herrero et al. (2016) and Henderson et al. (2015) the potential for carbon sequestration in grasslands through improved grazing land management is low in Europe, in most areas less than 10 kg CO_2/ha/yr, as most grasslands are already intensively managed with relatively high inputs compared to other parts in the world. However, sowing legumes in grassland would have a significant mitigation potential through additional carbon sequestration in Western Europe, estimated at a net mitigation effect of 46 Mton CO_2-eq/ha/yr (Henderson et al., 2015).

3.5 Summary

The Paris Agreement increases the challenge to reduce GHG emissions and increase removals, with its higher ambition to reduce maximum global temperature increase and the long-term need to balance emissions and removals after 2050. This might have consequences for the current reduction targets in the 2030 climate and energy framework and requires at least a long-term strategy on how the EU will develop towards a carbon neutral economy. The PA also puts stronger emphasis on the sink function of forests.

Current projections under a business as usual scenario project a decrease of the current sink in the LULUCF sector for the EU. This is mainly caused by a decrease of the sink in forest management due to increased harvest and ageing of the European forests. However, the mitigation potential of the EU forest is underutilised and, if adequately incentivised, Member States could increase the existing forest sink, but this would require significant investments in the forest sector. Increasing the harvested wood products sink is an option, but the potential is limited in the EU and it should be analysed in conjunction with other mitigation components related to the forestry sector.

Carbon sequestration in agricultural soils through improved management can be effective and offer in theory a large potential. However, recent studies provide lower estimates of the mitigation potential compared to the previous IPCC AR4 potential estimates. Without large scale land use changes, not much more than a mitigation potential of 100 Mton CO_2/year can be expected in agricultural soils in the EU. Large scale restoration of degraded land and introduction of perennial biomass crops might increase this mitigation potential, but studies underpinning this potential for the EU are still lacking.

The aim of balanced emissions and removals after 2050 will be very challenging to reach within the EU with only removals in the LULUCF sector. It is likely that bioenergy coupled with CO_2 Capture and Storage (BECCS) will be needed, in addition to CCS from fossil sources, as some of fossil CO_2 emissions (e.g. in transport) and non-CO_2 emissions from

especially agriculture will occur, and the LULUCF sink is probably not sufficient to compensate, particularly on the longer time scale due to saturation of the sink in forests and soils.

4 Analysis of other INDCs

The PA does not elaborate on a number of critical issues, such as the specific MPGs on LULUCF and agriculture, notably the fate of the FMRL and accounting for LUC involving agricultural land. Both of these items may have profound effect on the accountable amount of debits or credits for a range of parties, both developing economies (where agriculture makes up a large share of the GHG profile) and in developed country parties (where the relative importance of LULUCF and agriculture net-emissions is expected to increase in the coming decades). Against this backdrop, a screening of the Intended Nationally-Determined Contributions (INDCs) of other countries with respect to LULUCF and agriculture can be helpful in signalling the direction that future international policy developments and negotiations may take.

The 161 submitted INDCs of parties to the Convention contains a wealth of information, in many cases both on mitigation and adaptation. This chapter presents information found in 14 INDCs by major developed and developing country partners. In light of the focus of the study, information has been extracted and structured under a number of topics:

1. Sector coverage;
2. Agriculture and food security;
3. Forestry;
4. Measures and action; and
5. Accounting (see Section 5.6).

The chapter provides an overview of the broad coverage of LULUCF and agriculture with regard to the first four of the above topics. A review of accounting aspects of the INDCs is presented in Section 5.6 of the chapter on accounting, below.

4.1 Coverage of the various sectors in the INDCs

All 14 parties except India and the Republic of Korea include the five above sectors in their INDCs. In the INDCs of India sector coverage is not mentioned specifically, and it hence remains unclear what coverage the INDC has. For the Republic of Korea, it is stated that the inclusion of LULUCF will be decided later.

The US INDC covers all of the IPCC sectors, while it does not specifically mention the different sectors with the exception of the land-use sector. For China, sectoral coverage is not explicitly stated, but the discussion text implies action across a wide range of sectors, including agriculture and forestry (Table 4.1).

Table 4.1 Overview of mentions of LULUCF and agriculture related topics, accounting principles and specific measures. An X means that the given topic is mentioned explicitly, while a blank cell means that no direct mention of the given area is provided. An (X) means that an indirect reference to the topic is given.

Parties	Agriculture	Food Security	Forestry	Land Sector (general)	Accounting principles	LULUCF and agriculture specific measures
Australia					X	
Brazil	X		X	X	X	X
Canada					X	(X)
China	X	X	X	X		X
India	X	X	X			X
Indonesia	X	X	X			

Japan	X		X	X	X	X
Mexico	X	X	X			
New Zealand	X	X	X	X	X	
Norway				X	X	X
Republic of Korea				X		(X)
Russia			X	X	X	X
United States of America				(X)	X	
Switzerland	X		X	X	X	

From the above selected sample, it can be seen that most developing country parties (as well as Japan and New Zealand) cover agriculture, food security and forestry, while Australia, Canada and USA do not. Accounting principles seem to be important to most developed country parties, while Mexico, China, India and Indonesia do not mention them.

In terms of LULUCF and agriculture measures, it is worth noting that the INDCs of three parties - Australia, New Zealand and Indonesia – do not mention any specific measures. These three countries have important land (agriculture and forestry) sectors and have so far played important roles in negotiating and developing LULUCF and agriculture policies and concepts in the context of UNFCCC. On the other hand, it is positive that both Brazil and China, important as they are in the negotiations, both mention such measures. More detail on these measures is given in later sections.

4.2 Agriculture and food security

Most of the INDCs analysed mention the role of agriculture, specifically in the context of adaptation, while in some INDCs it features prominently, largely due to the role of the sector in either contributing to total emissions (as in the case of New Zealand) or the importance of maintaining a viable food production system (e.g. China).

China mentions agriculture, noting the goal to promote low-carbon development in agriculture and a 'recyclable' agricultural system (which is phrased in the notion of resource efficiency), while also emphasizing the need to adapt the agricultural system to climate change. "Actively push forward the appropriate scale production and industrialization of agriculture in Major Agricultural Production Zones". What this means for GHG emission in the short run (before 2025 or 2030) is not clear.

The need to adapt agriculture to climate change is also specifically mentioned in India's INDC. Furthermore, the National Mission on Sustainable Agriculture (NMSA) aims at enhancing food security and protection of resources such as land, water, biodiversity and genetics, which seems to confirm the adaptation focus.

Indonesia mentions the need to improve agriculture and fisheries productivity, and underscores the "to fulfil the needs of a growing young population for food, water and energy," meaning that food security is a priority. This argument is also implicitly featured in the Chinese and Indian INDC. The Indonesian INDC gives no further detail on how this fits with mitigation in agriculture and thus what trends in emissions are expected, i.e. what role agriculture will play in reducing emissions.

New Zealand places special emphasis on the role of its agricultural sector, which is in line with the dominance of agriculture both in the economy and in the emission profile. Although acknowledging that the sector contributes almost half of its total emissions, it also emphasizes that it produces significant amount of food for export (around 74 percent of New Zealand's exports come from the agriculture sector).

Japan provides emissions reduction targets for the agricultural sector for 2030, specifying the need to introduce measures to reduce emissions from paddy rice fields (CH_4) and from agricultural soils (N_2O), and furthermore specifies that the LULUCF sector is expected to

contribute to emission reductions through cropland management, grazing land management and revegetation.

The remaining INDCs either mention agriculture in the context of water use (e.g. Mexico) or do not mention agriculture at all (e.g. Russia, US, Norway).

4.3 Forestry

Forests and the role of these in mitigating climate change, as well as providing services and livelihoods is mentioned in a number of the INDCs, mostly in the form of a target to reduce deforestation (either conditionally or unconditionally) (e.g. Mexico and Indonesia) or through the promotion of afforestation programmes (e.g. China and India). The LULUCF sector is thus expected to contribute to either reducing emissions (i.e. a reduction in deforestation in countries where this is prominent, e.g. Indonesia) or to increase the land sink (i.e. an increase in forest area and thus sequestration of carbon in forests) (e.g. China, India and Mexico). Both of which can help countries achieve lower net emissions, while avoiding cuts in other areas.

Mexico intends to achieve zero deforestation by 2030, and to reforest watersheds with special attention to riparian zones. This will have positive impact on emissions, but no further information is given in the INDC.

For Brazil, “specifically concerning the forest sector, the implementation of REDD+ activities and the permanence of results achieved require the provision, on a continuous basis, of adequate and predictable results-based payments in accordance with the relevant COP decisions.” (Brazilian INDC, p. 4).

India also mentions forestry, noting the role of afforestation, and has put in place a number of initiatives to increase forest cover. The goal of the Indian INDC is explicitly stated as creating “an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030” (Indian INDC, p. 29).

Indonesia acknowledges its role in combating climate change due to its vast forests, but also notes that it is vulnerable to climate change, thus placing special emphasis on integrated mitigation and adaptation efforts. It further notes that most emissions are due to land use change and peat and forest fires, and has pledged to reduce emissions by 26% (against BAU) by 2020, conditionally 41%, depending on international support, with these numbers rising to 29% (against BAU, unconditionally) by 2030.

China notes that it intends to “increase its forest carbon sinks, with a view to efficiently mitigating greenhouse gas emissions” and to “vigorously enhance afforestation,” along with several other measures on forestry, such as restoring grassland and protecting natural forests. Concrete numbers are provided (these were given in 2009), with an expected increase in forest area of 40 Mha and an increase in stock of 1.3 billion m^3, with the second already being achieved. It can thus be expected that China will use reforestation and the forest sector to contribute to greenhouse gas mitigation. It also notes the need to utilize forestry wastes, meaning that bioenergy could be employed to reduce emissions.

Russia states the importance of the Russian boreal forests for mitigating climate change, protecting water resources, preventing soil erosion and conserving biodiversity. Russia accounts for 70% of boreal forests and 25% of the world's forest resources and sustainable forest management is mentioned as one of the most important elements of the Russian policy to reduce GHG emissions. Their determined contribution is subject to the maximum possible account of absorbing capacity of forests (70-75% of 1990 levels by the year 2030).

New Zealand places special emphasis on the role of forests, and states that harvest cycles also have a significant impact on New Zealand's (net) emissions. Due to age-class structures NZ expect periods of high emission and high level of removals respectively over the coming decades, and this puts a strain on the country's ability to manage emissions in view of a target. While not reflected in the INDC, this means NZ expectedly will favour

accounting rules that either allow for longer time frames, transfer between "periods" or access to transfer between sectors.

Japan emphasizes the need to promote GHG removals through forest management and forest industry, as well as revegetation, though it is not specified what approach is taken to revegetation, but reforestation is likely a part of this. Specific removal targets for the given sectors (forest management and revegetation) are given for 2030.

There is no specific mention of the forest sector in the INDC of the US, Australia, Canada or Norway.

4.4 Measures

A number of initiatives and measures are mentioned in the INDCs. Those measures covering LULUCF and agriculture, either through a focus on agriculture and food security, or through a focus on forestry, are listed below. Other measures are included where relevant. The measures and initiatives are largely presented to demonstrate that the countries are taking action on the given topic, and do not include detailed descriptions of how these are to be achieved, but are mostly only generally described. The measures focus on mitigation and adaptation, though most feature adaptation and fewer examples of mitigation were found.

Brazil explicitly states the three laws under which the measures and policies are to be carried out, and furthermore states that “measures and actions to achieve this contribution will be implemented without prejudice to the use of the financial mechanism of the Convention or of any other modalities of international cooperation and support, with a view to enhance effectiveness and/or anticipate implementation. The implementation of Brazil’s INDC is not contingent upon international support, yet it welcomes support from developed countries with a view to generate global benefits.”

In the Chinese INDC, a separate chapter on policies and measures to implement enhanced action on climate change can be found. This focuses on national and regional strategies alike, as well as strategies to build a low-carbon energy and industrial system, control emissions from building and transport sectors, promote a low-carbon lifestyle, achieve low-carbon development, enhance overall climate resilience, among others. In this context, the most relevant strategy is to increase carbon sinks. All of the strategies contain goals, e.g. in the case of carbon sinks a goal is “to vigorously enhance afforestation,” but contains no description of measures to achieve these goals. It also outlines strategies to increase financial and policy support, and to promote a carbon emissions trading market, as well as improve statistical and accounting systems.

Russia presents forest management (rational use, protection, maintenance and forest reproduction) as one of the most important elements of the Russian policy to reduce GHG emissions.

The Republic of Korea presents in its INDC a number of measures for mitigation of climate change, including the 2015 Emissions Trading Scheme and the obligation on power generators to supply from renewable sources. The latter is expected to increase demand for renewable resources, such as wood pellets, but no direct reference to LULUCF and agriculture measures is made.

The Japanese INDC introduces the need to implement measures to reduce emissions from agricultural soils, as well as measures to remove GHG through forest management and forest industry measures, along with a promotion of revegetation, but no concrete examples of specific measures to achieve these goals are introduced.

India presents a number of different measures to achieve GHG reduction in its INDC, some of which are related to LULUCF and agriculture. For instance, mangrove regrowth and conservation is encouraged with the dual purpose of emissions reduction and disaster risk reduction. A number of fiscal measures are also introduced, as is measures to use energy efficiently.

The Mexican INDC distinguishes between conditional and unconditional measures, and as the only INDC also includes a gender perspective, noting the importance to take account of women as important decision makers regarding energy consumption. It also emphasizes the need to foster mitigation measures that increase the adaptive capacity of natural systems, but provides no concrete examples.

The Canadian INDC provides a number of examples of policy measures, though only one, investment in renewable electricity generation, e.g. through the use of biomass, is related to LULUCF and agriculture. The INDC further notes that Canadian provinces and territories have "jurisdictional authorities over the fields of natural resources, energy, and many aspects of the environment," and that each province and territory "has its own legal framework, policies and measures in place to reduce greenhouse gas emissions," meaning that the measures used to meet the targets set out in the INDC will differ from province to province.

Norway's INDC states that the commitment on emissions reductions will include emissions and removals in LULUCF and agriculture, and notes that Norway will ensure "incentives to implement new measures in the sector as well as sustaining existing measures." No concrete examples are provided, but the list of policies and measures in Norway to reduce emissions are given in its sixth National Communication. None of the five priority areas are directly related to LULUCF and agriculture, though "Renewable Energy" and "CO_2 capture and storage" both indirectly relate to it.

In the U.S. INDC, no measures with relevance to LULUCF and agriculture are mentioned, while in the New Zealand INDC, no measures are mentioned. Finally, Switzerland has no specific mentions on measures, only that the proposed measures to achieve the commitments will build on existing measures and strategies.

Table 4.2 Summary of LULUCF relevant elements in INDCs

	Agriculture & Food security	Forestry	Other
Australia	Build climate resilience and support adaptation to climate change. Australia will develop a National Climate Resilience and Adaptation Strategy during 2015		Promote the deployment of renewable energy and improve energy efficiency
Brazil	Increase the share of biofuels to 18% by 2030 Strengthen the Low Carbon Emission Agriculture Program (ABC), including restoring 15 Mha	"strengthening and enforcing the implementation of the Forest Code" (p. 3). Strengthening policies to achieve zero illegal deforestation by 2030 Restoring and reforesting 12 Mha of forests, restoring an additional 15 million hectares of degraded pasturelands and enhancing 5 Mha of integrated cropland-livestock-forestry systems (ICLFS) by 2030. Strengthening policies and measures with a view to achieve, in the Brazilian Amazonia, zero illegal deforestation by 2030 and compensating for greenhouse gas emissions from legal suppression of vegetation by 2030.	45 % renewables in energy mix by 2030. Achieving 10% efficiency gains in the electricity sector by 2030 Promote new standards of clean technology and further enhance energy efficiency measures and low carbon infrastructure
Canada	Investments to encourage the generation of electricity from		

	renewable energy sources such as wind, low-impact hydro, biomass, photovoltaic and geothermal energy		
China	To continue to restore grassland from grazing land, to prevent grassland degradation, to restore vegetation of grassland and improve carbon storage of soil.	To strengthen forest disaster prevention and forest resource protection and to reduce deforestation-related emissions Enhance afforestation, protecting natural forests, restoring forest and grassland from farmland, planting shelter belt, strengthening forest tending and management and increasing the forest carbon sink.	Implementation of the National Strategy for Climate Adaptation and National Program on Climate Change
Japan	Promotion of soil management leading to the increase of carbon stock in cropland. Promotion of revegetation.	Promote measures for GHG removals through the promotion of forest management and forestry industry measures.	
Republic of Korea			Nation-wide Emissions Trading Scheme
Indonesia		A number of initiatives to reduce emissions from deforestation and forest degradation.	
India	National Agroforestry Policy (NAP) of India aims at encouraging and expanding tree plantation in complementarity and integrated manner with crops and livestock	Initiatives like Green India Mission (GIM) and National Afforestation Programme aim to further increase the forest and tree cover	
Russia		Rational use, protection, maintenance and forest reproduction, i.e. forest management, is one of the most important elements of the Russian policy to reduce GHG emissions.	Raising the level of energy efficiency, reducing energy intensity of the economy and increasing share of renewables in the Russian energy balance.

4.5 Summary

In summary, the first and foremost observation is that none of the selected INDCs contain concrete measures, accounting principles or indeed (sketches of) solutions that can serve as input for negotiations on MPGs. This may be due to the nature of the documents, and the fact that they were prepared in advance of the Paris COP, i.e. not having the PA text and its principles to build on. At the time of drafting, no party, particularly those distant from the negotiation process, knew what would come out of Paris, and thus these merely serve as political declarations of intent.

That said, as summarised in the tables above, there are a number of relevant observations. Some parties (China, Australia) seem to prioritise achieving climate change adaptation and mitigation driven by national strategies and plans. Most parties, however, seem to prioritise concrete initiatives or programmes giving incentives to land owners (India, Indonesia, Japan, Canada). Brazil is the only party mentioning concrete targets, thereby setting a different approach.

The screening gives an overview of what information parties have chosen to disclose, and highlights the difference in approaches and proposed actions. This very much leaves open

what can be expected from the ongoing work in the AWG-PA and indeed the future COP meetings.

5 Implications of the PA for LULUCF accounting

5.1 Implications on LULUCF accounting from the Paris Agreement

The analysis of the PA in Chapter 2 above suggests that both reporting and accounting will continue under the PA. While it is rather clearly indicated in the PA that reporting will follow to a large extent the way of GHG inventories under the convention, the modes of accounting are not defined at all. The PA itself does not define any rules on what aspects of LULUCF (i.e. what categories, activities, pools etc.) need to be accounted and how they are accounted (which methods are applied). Article 13/(7) says "*Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4*" (NDCs, *ed.*) shall be provided. Article 4 (13) reads "*Parties shall account for their nationally determined contributions*". So, the NDCs define what the MS should account and what information is needed to track the progress to reach the NDCs.

The AWG-PA will have to develop guidance for accounting for the NDCs by 2018 (para 31 of the draft decision). The detailed analysis of the PA for Task 1 of this contract suggests a very high likelihood that there will be only loose general rules and guidance, if any, relating to how and to what extent Parties should account for the LULUCF sector. Most likely, Parties will have a significant amount of control over how they design their accounting system for LULUCF emissions/removals. However, this system should correspond to their NDCs (see paragraph above) and avoid double counting (Article 4(13), para 31 (b) of the draft decision). According to Para 31(c) the guidance by AWG-PA should ensure that parties "*strive to include all categories of anthropogenic emissions or removals in their NDCs…"* Again, this indicates rather loose guidance, but the wish for completeness in the NDCs regarding the emission and removal categories. So, the guidance to be elaborated by the AWG-PA by 2018 may include some further details, but will also be applied by a large number of parties with differing circumstances and perceptions of accounting. Therefore, it is very likely that detailed and stringent guidance on accounting rules for LULUCF will not find broad agreement at the COP in 2019, as was also the case for the PA.

This suggests that the EU can design its LULUCF accounting system individually in the way that it likes as long as it is compatible with its NDC and the TACCC principles and consistent with agreed IPCC guidance.

However, the following general goals or decisions in the PA may have implications for the method of accounting for the NDCs and consequently also on future changes in the NDCs towards enhanced action to meet the temperature goal(s) as defined in the PA. Notably, the long-term target of balanced anthropogenic emissions and removals sometime in the second half of the century (Art. 4(1)) has some implications for accounting:

1) The long-term goal is a balance between anthropogenic "emissions" and "removals". An accurate balance in line with this target needs a consideration of emissions as emissions and removals as removals. KP LULUCF accounting also knows avoided/reduced emissions that are accounted similarly as removals and vice-versa, as well as the limited accounting of emissions and removals depending on the base-year emissions / removals or the FMRL (and further specific rules in that direction): For instance, if the base year or FMRL represent net emissions, a reduction in emissions in some LULUCF activities can be considered removals for accounting purposes, even though the atmosphere still sees net emissions. Other KP rules allow, for example, emissions from natural disturbances to be excluded from accounting under certain circumstances and conditions, implying that atmospheric uptake of emissions may again be higher than accounted for.

   Consequently, even if a party continues with the net approach for accounting of LULUCF under its NDC (assuming that there will be the individual freedom for the parties to do so under PA), an assessment of the NDC and its contribution to the global balance target of the PA requires gross emissions figures to be accurate. The

LULUCF GHG inventories to be reported under UN-FCCC represent such gross balances. So, the analysis of NDCs vis-à-vis the PA processes (global stocktake, increases of ambition) will be likely evaluated on the basis of the gross emission/removal figures instead of net accounting. A party which continues with net accounting will need to 1) define rules, in order to 2) set baselines or reference levels and to 3) later transfer these accounted net removals/emissions to gross figures. This is rather complicated, and may be also misleading and risky since LULUCF emissions and removals tallied under net methods do no indicate the "real world balance" of anthropogenic emissions and removals, i.e. what the atmosphere sees. The "simple" but rather clear long-term target in the PA requires the assessment of the "real world balance".

2) A complete global GHG balance between anthropogenic emissions and removals is needed to assess if the world's community is on track to reach the balance between anthropogenic emissions and removals and the temperature goals according to the PA. If not on track, updated NDCs with enhanced action will be needed. Such a global GHG balance can be created from the top down. The stocktaking process has been established for the purpose of evaluating and increasing ambition, but its implementation is not yet specified. Parties' accounting of anthropogenic emissions and removals trends (e.g. as reported on the basis of UNFCCC GHG inventories) against the NDC will be assessed, and the PA calls for such a process, although without further specifications of procedures. It can be expected that complete GHG balances and accounting will provide a better negotiation position in the NDC update process than will incomplete accounting, which may lead to suspicions of inaccuracies or of purposely incomplete data. While not explicitly required by the PA, a complete accounting of all anthropogenic sources and sinks also ensures the avoidance of unintended leakage and should be part of an environmentally integral accounting system. Furthermore, a complete accounting of all national emissions and removals will allow a wider spectrum of action than a limited consideration of some land categories or activities only.

3) The long-term balance goal of the PA addresses "anthropogenic" emissions and removals. This can be interpreted as "a balance between anthropogenic emissions and anthropogenic removals". This understanding would be similar to the decisions according to the Kyoto Protocol and is compatible to GHG reporting under the UNFCCC. However, the adjective "anthropogenic" could be also understood as related only to the word "emissions" with a broader understanding of "removals" including also non-anthropogenic ones. The PA agreement leaves room open for both interpretations which will have also implications for accounting towards the long-term balance target since the inclusion of non-anthropogenic removals may form part of it.

These three points above (together with some further text in the PA) also indicate why the GHG inventories according to UNFCCC will very likely play a significant role for the PA processes. An accounting system close to these GHG inventories for UNFCCC will therefore have several advantages as indicated above and below in this chapter.

Article 4(13) of the PA states that "In accounting…, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, in accordance with guidance adopted by the Conference of the Parties…". Accounting principles already addressed in the KP and its decisions are evidently to be promoted. However, "promoted" is not an ambitious expression. This exemplifies the implications of language in the PA that invokes experiences from the KP processes: any guidance developed under the PA will have limited possibilities of increasing stringency – e.g. changing "shall promote…" in this context to "shall apply… according to the guidance" – unless this is adequately changed by a further agreement or decision in the next years. Under these circumstances, even if guidance does become more stringent, it may not be followed by the parties, on the basis of the expression in the PA. Thus, the PA allows for a significantly higher freedom in accounting compared to the KP, which can be expected. On

the other hand, it is clear that a party aiming to lead on this issue should implement all the principles in Article 4(13) listed above in its accounting methods.

It is important to recognise that the PA is independent to the KP. Decisions under KP are not an integral part of the PA. This applies also to the methods of accounting for LULUCF under the PA. Thus, the opportunity exists for a thorough analysis of the existing systems in place under KP, as a basis for developing an improved and simpler accounting system for LULUCF for post 2020, especially with respect to various aspects addressed in this chapter.

5.2 The Paris Agreement requires consideration of experiences gained from the existing reporting and accounting system as a basis for future accounting

The PA references elements of the KP on several occasions and always in connection with provisions limiting their use for PA instruments. Para 31 of the decision indicates that guidance for accounting should take approaches of regulations under the convention and its legal instruments under consideration “as appropriate”. The wording in article 13 of the PA does leave room for quite substantial changes, as it is made clear that the new system should be developed taking into account, and in some case 'only' considering, “experience gained from the existing system. These limitations can be interpreted as a wish for a careful analysis of the advantages, disadvantages, problems and outcomes of the KP regimes. Elements which are in line with the PA and for which good experiences exist and which fit could be kept for the PA system while others which caused serious problems should not be repeated. This is also a unique opportunity to substantially improve the system of accounting of LULUCF emissions/removals, instead of continuing with a KP-like system. This requires first an analysis of the LULUCF accounting methods in place under the KP, and the EU could conduct such an assessment on its own. Such a task is not part of this contract, but a sketch of some elements, confirmations, lessons learned or experiences from the historic KP and GHG reporting years with respect to LULUCF accounting is provided in the Annex 2 and 3.

5.3 Accounting options for LULUCF

5.3.1 Accounting under the Kyoto Protocol

For the LULUCF sector, current reporting of anthropogenic greenhouse gas emissions and removals under the UNFCCC is different from its accounting under the Kyoto Protocol. Reporting under the UNFCCC serves as a means to monitor actual yearly emissions of greenhouse gasses to the atmosphere and removals of CO_2 into forests and soils. Accounting under the Kyoto Protocol is used to assess whether Parties have met their commitment in net emission reductions. Therefore for accounting purposes the emissions are usually compared with a baseline or reference situation. In accounting terms positive results will generate credits while negative results will result in debits. In the case of LULUCF, usually credits can be generated either by decreased emissions or increased removals, while similarly debits are the result of increased emissions and/or decreased removals.

Under the Kyoto Protocol LULUCF is treated differently from the other emission sectors. There were several reasons for this, including the possibility of removals, which does not occur in other sectors, uncertainties over magnitude, potential impacts of natural disturbances and the continued effect of past practices in forests and soils. Therefore in the negotiations to the KP it was decided to exclude LULUCF from the estimation of assigned amounts of each Party (the assigned amount is the allowed level of net emissions during the commitment period in CO_2-eq.), with an except for those Parties for which LULUCF constitutes a net source of GHG. These latter countries are allowed to add base year emissions from deforestation to their assigned amounts, which in fact means that those Parties account Deforestation according a net-net approach.

In the case of KP accounting of deforestation (D), and afforestation and reforestation (AR), these activities are related to the situation in 1990 (i.e. whether an area of land in 1990 was forest or not and whether it has changed from or to forest since that time). However in both KP commitment periods actual net emissions or removals in each year are accounted without a comparison to a base year (so called gross-net accounting). In the first commitment period FM was accounted gross-net with a cap on the credits and debits that could be generated with FM, while during the second commitment period (KP-2) FM is accounted against a reference level (Forest Management Reference Level – FMRL), see Annex 2 and 3.

5.3.2 Basic accounting options

The PA does not prescribe any accounting options for LULUCF. Nothing is mentioned or defined in that direction. Again, there is full freedom for the parties in choosing any of the accounting options listed in this chapter or parties may also introduce some newly developed accounting options. It is evident that the LULUCF accounting procedures as under the Kyoto Protocol can be completely changed. Baselines for accounting like the Forest Management Reference Level or any base year are not mentioned in the PA. The requirement of "additionality" for accounting (e.g. only removals beyond some baseline can be accounted) is not included in the PA. However, as elaborated in Section 5.1, a gross accounting of LULUCF categories and completeness regarding categories and pools is better compatible for the evaluation of the NDCs and for the tracking of their achievement against the overall GHG balance goal of the PA beyond 2050 (because this PA goal implies a gross balance for the removals and a net balance between emissions and removals). Any other system introduces the need for gap filling or the need to retranslate the accounted amounts towards the balance of emissions and removals.

The following basic accounting options for LULUCF exist:

- No accounting;
- Gross accounting;
- Net accounting against any kind of level; and
- Combinations of these types.

No accounting of LULUCF emissions/removals

The advantage of no accounting is that the highly uncertain, while significant LULUCF emissions and removals are completely left out of the system. Targets need to be reached in other sectors only, which raises incentives and the level of effort in these sectors. The following implications result from this approach:

- The LULUCF sector, which may significantly contribute to reaching the ambitious PA targets, is not used.
- This approach does not provide incentives for an enhancement of sinks.
- There is a risk of leakage in the sector if not included.
- There is a strong correlation of LULUCF with the GHG balance in other sectors. For instance, there may be a strong pressure to over-use forests when the related net-emissions are not accounted (e.g. excess annual harvest above the annual increment for the purpose of wood fuel use instead of fossil fuels).
- No extra resources or additional efforts for accounting would be required.

No accounting of net LULUCF removals, but accounting of net LULUCF emissions

This is a mix of accounting options. The advantages and disadvantages are almost the same as for the full no-accounting option described above. The only difference is that this option avoids the risk of leakage in the accounted LULUCF categories.

Gross accounting

This approach to accounting is used for the KP Article 3.3 activities on afforestation, reforestation, and deforestation (ARD) and was applied to Forest Management accounting in the first KP commitment period. Full LULUCF net emissions or net removals are included.

There are several advantages of this approach. It is fully compatible with the GHG balance that the atmosphere sees from land-uses or activities, treating emissions and removals equivalently regardless of circumstance. The quantity assessed can thus be correctly transferred to the overall GHG balance required to estimate progress towards the long-time goal of the PA (see Section 5.1). In addition, this approach is fully compatible with LULUCF GHG reporting methods under the UNFCCC, which will be an integral part of the PA instruments. This approach also reduces the additional MRV efforts compared to any of the net approaches as listed under the next chapter.

The disadvantage of this approach is that it does not incentivise higher ambition in removals, which must then be set by other means (e.g. CAP measures). However, the required emission reductions to reach the PA targets are already sufficient incentive for a LULUCF management system optimised for progress towards reaching the reduction targets.

Net accounting vs. specified level (e.g. historic base year, forest reference level)

In this approach the assessed emissions/removals are balanced against a level or target. The level may be the emissions/removals of a historic period (e.g. base year for KP) or those of a projection period (e.g. forest management reference level under the second KP commitment period). The level determines whether changes in the LULUCF carbon balance will be accounted for as debits or credits. When using a baseline or reference such debits and credits can be created in different ways. Compared to the reference both increased emissions and decreased removals may result in debits, while avoided emissions and increased removals may both lead to credits. Consequently such approach may lead to differences between accounting and actual emissions and removals to the atmosphere. If for instance the level represents an emission and the LULUCF GHG balance represents lower emissions credits will appear in accounting even though emissions are still ongoing. If the level represents a removal, any deterioration of the LULUCF GHG balance below that level will lead to accounted emissions, even when the real world balance still represents net removals.

This does not conform with the atmospheric balance of LULUCF, nor with the long-term GHG balance goal of the PA. Therefore, it requires the extra steps of transforming gross balances and projections to net accounts and targets, and reverse calculations of gross achievements from the net amounts. This is a substantial complication of the procedure. It may deteriorate assessments of progress towards the PA targets, and it may be also misleading.

Even more challenging is the need to define the level so that equity between the MS is preserved. The definition of one historic year (e.g. the base year) creates winners or losers depending on countries' specific situation in that year. In addition, the values of a single year are more uncertain than averages from a longer period, which is more robust, but something of a lottery, due to the lack of clarify surrounding questions such as who defines the period, which one is chosen, for which reasons and according to which criteria. A country may have had particularly high net removals in the period of accounting due to exogenous factors, such as a higher growth increment due to weather conditions or lower harvest rates due to major wind throws before, or the opposite. Alternatively, freedom for MS to select their own historic period for defining the level would likely lead to "cherry picking" the most convenient period.

In order to circumvent these problems, a future projection was agreed as the level for Forest Management accounting in the 2nd KP commitment period ("forest management reference level"). Projections of the forest management emissions/removals for the 2nd commitment period under a business-as-usual were carried out. This approach aims to balance out the

problems described above while it should ensure that only additional efforts can be accounted. The results for the 2nd KP, however, show some problems of a projection approach for net accounting (see also Annex 3): projections in LULUCF cannot be estimated straightforwardly. Many input parameters and sound historic data for these parameters are needed, which are often not available or do not have the needed quality and resolution. LULUCF projections also need trends of several economic, ecological and meteorological parameters to feed the models, as well as validated and verified models for the conditions of the country. Such models are not available for many MS; the task is challenging and requires sophisticated expertise in the field; and even the use of best practices leads to highly uncertain LULUCF projections. Variations in the trends of input parameters may also lead to significant deviations in the outcome.

There is also the need to define the framework conditions for the projections, for instance, the “measures and policies at a certain time” or the “business as usual at a certain time”. This is only possible with a high level of ambiguity in both definition and understanding. However, the definition/understanding of this starting point has major effects on the projections (see Annex 3). The comparisons in Annex 3 indicate that at the EU level the differences in the approaches can have important consequences for the FMRL level, especially in the shorter term (up to 2020), but that over longer time periods (up to 2030) the approaches tend to converge. This is probably due to increasing limitations posed by the age class structure of the forest resources on actual harvest potentials. The results also show that scenarios built on policy and economic projections for future wood harvesting do not necessarily project a smaller sink than scenarios based on extrapolations of management practices.

A measure in land management may be already under implementation, as a concept agreed at a high level, at the start of operationalisation, a draft of a law, etc. Any of these conditions could lead to a consideration in projections for an accounting level as “measures and policies” at the defined point of time. This is due to the ambiguity in definition and understanding of “measures and policies at a certain time”. The expected outcome of the measure will also play a role in its consideration for the projections. A party’s inclusion of such new measures in the projections for an accounting level is more likely if lower net removals in the future are expected by the measure (e.g. a future increase in wood harvest due to the measure). If the projected levels for accounting were estimated without inclusion of such new measures, higher removals levels for accounting will be the result, which leads to a higher risk of accounting “net emissions” in the future. In the end, the measure may not be implemented as expected with the consequence of e.g. higher accounted removals. This example indicates the basic problems of defining the framework for projections in the future as a baseline for accounting.

Any net approach in accounting also represents an incentive to manage the lands in order to exceed the level, in order to avoid creating net emissions. In other words, there is a higher likelihood that at least these levels of removals or emissions will be reached. This is an advantage of this type of accounting.

When using forest (management) reference levels there may be a risk of double counting of wood used as fuel in the ETS sector. Under KP woody bio-energy is not accounted in the ETS but under LULUCF. In principle this should be ok since wood harvested for energy will result in a decreased sink in forests and then should be accounted for using instantaneous oxidation instead of entering the HWP pool. Still double counting could occur if a future assumed demand and harvest for fuel wood is already included in the forest reference level. In such case the decreased sink in forest is already anticipated in the reference level, resulting in an omission of this decreased sink in the LULUCF sector. Guidelines under the PA therefore should specifically address this issue.

Another factor that will be of importance in considering the use of future forest reference levels is the use of a cap on net removals in forests as was used both in KP-1 and KP-2 (see Annex 3). Such cap was introduced to address issues of uncertainty and potential non-permanence associated with LULUCF emissions and removals and the potential for creating

false credits. However, by some Parties the cap is also considered as reducing the incentive for increased mitigation action in forests. Alternatively in future accounting under the PA, other approaches could be considered. For instance, instead of a applying a cap on the potential credits and debits one could also think of a percentage of the credits to be withheld, much like what is practiced in AR projects under the CDM and in voluntary AR and REDD+ projects. This would address the concerns regarding uncertainty and permanence, while at the same time increased mitigation action remains incentivised.

Combinations of these accounting types

Different accounting types may be applied for the various land-use types or activities. This is the case for the LULUCF activities under KP (Af-/Reforestation gross, Cropland and Grazing Land Management against a base year, Forest Management against a Forest Management Reference Level). Due to the inequity arguments described in Annex 2 such an approach is problematic.

5.3.3 Specific accounting options for LULUCF

Some further specific accounting options exist and are partly implemented by the Kyoto Protocol mechanisms. Again, the PA does not exclude, include or specifically mention any of the LULUCF categories (Forest Land, Cropland, Grassland, Wetlands, Settlements, Other Land, Harvested Wood Products) or pools (biomass, dead wood, litter, soil) and freedom in considering or not considering them in accounting exists.

All of the following approaches lead to incomplete GHG balances and have a risk of leakage, and there is at least the wish formulated in the PA that the parties should strive for complete balances in their NDCs (e.g. para 31(c) of the decision). This is the major disadvantage of all these approaches of reduced accounting and has been further explained in other parts of this chapter. The advantages are a reduction in the efforts for MRV of LULUCF.

Accounting of some pools

The C stock changes of certain pools can be assessed only with high uncertainty. Extreme efforts and long monitoring cycles are needed to confirm the estimated changes (e.g. for the soil C pool). For this reason such pools might be considered to be excluded from accounting. The KP routines have provided the possibility to rationalise such exclusions, in order to circumvent the inability to estimate its C stock change. However, with respect to the soil C pool, experiences from countries which estimated its changes suggest that such a sound “no-source” statement is impossible (see Annex 2).

In addition, C pools of certain land-use categories which have only insignificant contributions to the overall result, but require elaborate monitoring approaches for tracking the changes might be considered for exclusion from accounting.

Accounting of some land-use classes or activities

Current accounting under the KP proceeds under this framework. Only the activities with the assumed highest impact on the GHG balance and for which a risk of significant emissions exist are obligatory in accounting.

Exclusion of certain emissions and removals (e.g. from natural disturbances)

The KP decisions include various clauses for certain types of LULUCF emissions and removals which shall or can be excluded. These further complicated MRV for KP activities without having any substantial effect in most cases. An exception to some extent may be the natural disturbance decision, whereby emissions from natural disturbances may be excluded under certain circumstances, along with removals from the affected lands in subsequent years. However, a number of demanding MRV rules need to be followed. While such a possibility makes sense as insurance for unexpected substantial emissions endangering the fulfilment of the reduction target, more simple approaches are also possible. In Annex 3 such a method is proposed which also has the advantage of not leaving these natural disturbance

emissions out of the balance, as the atmosphere is affected by them and as a result, the impacts of climate change may become more substantial, therefore requiring higher efforts of emission reduction in other sectors.

5.3.4 Time of accounting

The KP decisions allow annual and post commitment period accounting for LULUCF. In both cases, emissions/removals up to the year two years before the reporting year need to be considered for accounting. This is very critical for LULUCF for reasons explained in Annex 2. The changes of certain pools for these years may still be under monitoring or not yet assessed (e.g. due to the cycles of forest inventories). There is a steady revision of LULUCF results due to better methods. In addition, some pools like soil require clearly longer time spans to confirm estimated C stock changes. A shift of the accounting time for LULUCF emissions/removals to a later year of reporting may help to significantly reduce these problems. In addition, it would have the advantage to allow more time for the development of a simple, sound, robust, fair and environmentally integral accounting system for LULUCF in line with the PA.

The PA does not further specify the time of accounting, but a transparent accounting of the GHG emissions and removals in sense of the NDC achievement is requested. If LULUCF represents a net sink (as for instance indicated by the annual GHG inventories to be further provided) there would be certainly no conflict with the PA if removals of e.g. the most recent years were not yet included in the accounting towards the NDC.

5.3.5 Limited accounting of LULUCF emissions/removals

The PA does not list any rules of a limited accounting that can or should be considered, but also does not exclude the possibility that parties introduce such approaches for their accounting under the PA. Nevertheless, it should be noted that evidence for the achievement of the GHG balance goal post 2050 of the PA will require the consideration of all anthropogenic emissions and removals. There are some approaches that involve limiting emissions/removals accounting for LULUCF under KP. Excluding certain emissions and removals due to e.g. unexpected natural disasters or other reasons was discussed above. The concept of a level for net accounting as described before represents also an instrument for reducing the accounting of LULUCF emissions/removals in some cases.

The KP decisions also introduced a cap on the amount of forest management net removals that can be accounted. The justifications for the cap are e.g. 1) reducing inequity in the starting conditions for emission reductions due to the excess availability of removals in some countries, 2) fostering the incentive for emission reductions in other sectors, and 3) introducing some compensation for features of LULUCF removals like reversibility and uncertainty. Experiences from the KP commitment periods show that all of these points of concern have their validity (see also Annex 2 and 3). A simple example may demonstrate the first two of the listed issues. Countries C1 and C2 may be equal countries, except that their population densities are completely different: country C1 has a ten times lower population density than C2. Per head GHG emissions are the same, so total GHG emissions of C1 are ten times lower than those of C2. Both have sustained an equal and high forest cover and the forests are in equal conditions of significant net removals. It is evident that country C1 with ten times lower population density will need much less effort to reach reduction targets in the emission sectors due to the significantly higher relative removal contribution of the forests to its total GHG balance if full accounting of the net removals was allowed. Real world situations show that the total net removals in some countries may represent significant percentages of the total GHG emissions.

5.4 Land-based vs. activity-based accounting of LULUCF

The PA does not specify accounting methods for LULUCF at all, including with respect to activity-based (emissions/removals of activities like Afforestation, Reforestation, Forest Management, etc.) or land-based accounting (emissions/removals on particular land types, such as forest or grazing land). This is a significant difference to the Kyoto-Protocol. Any such specification would require lengthy negotiations, which can be expected to have an unclear outcome and to create detailed extra rules (as past experiences around the KP show). The AWG-PA has the mandate to elaborate guidance until 2018, but it is not clear if it will specify the guidance in detail, since such details will not be broadly accepted at the COP in 2019. Therefore, there is a high likelihood that the selection of a land-based or an activity-based accounting approach will be up to the parties. Equal freedom regarding the choice of categories/activities in accounting can be expected. However, the approach needs to be compatible with the NDC. Currently, reporting under both systems is in place or needs to be further developed in the EU MS: land based as per the rules of the UNFCCC, and activity-based according to the KP 2nd CP decision and the EU 529 decision. UNFCCC also requires complete GHG reporting. As a consequence, any EU decision on land-based or activity-based accounting will be very likely compatible with the PA as long as it does not conflict with the NDC of the EU, which is not the case as the EU INDC states "*Comprehensive accounting framework, activity or land based approach, for emissions and removals from land use, land-use change and forestry*".

This may be used for a thorough consideration of experiences gained from the current reporting and accounting of LULUCF. Some examples with respect to the two systems include:

- Land based reporting is the basis for the GHG inventories under UNFCCC. It was established clearly before the KP. The reporting demands under UNFCCC will continue after the KP period (the PA is at several parts rather clear on that). Any further system (e.g. activity based) introduces significant additional work.
- The activity based reporting according to the KP is derived from the UNFCCC land based estimates which are transferred to activity based balances following several complicated rules. However, this is not completely inherent in the activity-based reporting but also the result of several specific decisions of the KP processes.
- Lands are the "activity data" in LULUCF reporting, for both approaches. So, land-based accounting represents the data more closely.
- The separation between lands under land-based accounting is much easier, as the risk of double accounting or overlooked lands is lower than for activity based reporting.
- It is difficult to define activities in a way that secures complete reporting/accounting of anthropogenic emissions and removals for all lands. However, complete reporting is needed for a sound evaluation of progress towards the PA long-term targets (a balance between anthropogenic emissions and removals and the associated reviews of the GHG inventories and NDCs).

Potential implications from a changing from activity based to a land based accounting

Land based reporting is the basis for UNFCCC reporting. All anthropogenic emissions / removals on all lands need to be reported. The IPCC managed land proxy (IPCC, 2010) is applied for both land based and activity based reporting. For the latter, factoring out the effects of climate change, N deposition, or CO_2 fertilisation is and will not be possible, so all emissions/removals at the managed lands under these subcategories or activities are accounted for. No major additional challenges for MS can be expected from a change to land-based accounting. The fact that certain sub-categories of land uses or some C pools are currently less accurate and incomplete is equally valid for an activity based approach, which would strive to include the related activities. Completeness, and complete balances that are independent of the accounting approach taken, are needed to avoid leakage and to

allow sound comparisons with emission reduction targets to reach temperature goals in line with the PA. The same current EU concept of a stepwise improvement and inclusion of LULUCF activities as implemented by the EU 529 decision could be continued and applied for the land based approach and for subcategories which are not yet sufficiently reported. It should be noted that emissions from land categories suffering degradation such as deforestation are already reported and checked at a high standard due to the KP obligation to account for deforestation emissions. EU decision 529 will improve the estimates for Cropland Management and Grazing Land Management in the MS, and thereby also improve estimates for the land-based Cropland and Grassland subcategories. Thus, a switch to land based reporting/accounting is also not in conflict with EU decision 529.

The different ways of accounting the same LULUCF activities under KP clearly have a larger effect on inconsistencies between the two accounting systems than the differences between the land-based and activity based approaches, also with respect to the additional efforts in MS.

The requirements for reporting for the 2nd KP commitment period are operationalised by the IPCC (2006) Guidelines and by the IPCC (2014a) Wetland Supplement, and those for LULUCF accounting by the IPCC (2014b) KP supplement. The KP supplement translates the decisions for the 2nd commitment period into methods. These decisions will likely continue not at all, or in a very limited manner beyond the KP period, and consequently the KP supplement will become meaningless with any new guidance on accounting for post-2020. The KP decisions and consequently the KP supplement introduced very complicated rules for MRV of LULUCF which clearly go beyond the ones in the IPCC (2006) Guidelines. The commitments for the PA will include a lot of countries which do not have the capabilities and data sources to report LULUCF at that level of detail. The IPCC (2006) Guidelines are designed to allow GHG estimates even on the basis of default values and with less sophisticated land-use assessment methods. Consequently, one can expect that the eventual additional MRV requirements and data needs for the PA agreement will not become more stringent than those for the UNFCCC reporting.

5.5 Targets for accounting as incentives for enhancing the net removals in LULUCF post 2020

The PA does not specify if or how targets for LULUCF are introduced in the NDCs. The emission vs. removal balance goal post 2050 in the PA is a net balance between emissions and removals which implies a gross balance for the LULUCF net emissions or net removals (i.e. an accounting against the zero line). So, any introduction of targets for LULUCF is not - per se - required by the PA. However, targets for LULUCF may be introduced to ensure that the NDCs in sense of the long term PA balance will be achieved.

It is not easy to foresee the success in future LULUCF GHG sequestration on the basis of accounting targets and other incentives. This is due to the nature of LULUCF and its dependency on factors beyond human control. In addition, exogenous influences are significant and may have a much higher impact on land management than any target or incentive to enhance the net removals in the landscape (e.g. income streams, the wood price, etc.). Clearly, there are competitive dynamics between all these influences which require a thorough analysis of which incentive instruments may be more and less successful. These aspects are elaborated in other chapters of the report. There is clear evidence that subsidy payments for environmental measures in agriculture through the CAP had a positive effect on the C sequestration in agricultural lands.

The positive stimulation of the C sequestration due to country-targets for accounting (like the FMRL) depends on several factors (about which sufficient detail is not yet known), e.g. how the targets are set. If stringent targets are expected to have a limited effect on net removals, this will provide less incentive for changes in management, particularly if not accompanied by compensation. It should be noted that in many countries most land managers are small-scale and not closely connected to decision makers. These land owners do not prioritise

national LULUCF targets, and decision makers are unable to transpose national targets to goals for the large number of small-scale managers, except through subsidy payments, other financial incentives for management methods connected with higher C sequestration, and other instruments (public relations, compensation measures in other fields, training, etc.). These measures are all related to costs and if the expected benefit is very limited (through for instance a very ambitious target) implementation will be very unlikely. Such an outcome can be expected both economically and politically. Investments will be shifted to measures with higher efficiency and less risk and uncertainty.

LULUCF levels for net accounting which represent a net emission require particular attention to this issue. The incentive in this case is to reduce emissions only (and if doing so, they can be accounted as "removals" – see section 5.3). This might have some justification when the country is close to C saturation in the landscape (i.e. a high C stock was sustained in the past) and e.g. population growth requires further lands for infrastructure. In such a situation net emissions from LULUCF cannot be circumvented. However, this is a very unlikely situation for any European country. In all other cases, an accounting level which represents net emissions is less stringent than a gross approach (where accounting is against zero emissions and removals) and leads to a higher accounting of achieved GHG improvements compared to the gross approach due to the previously less environmental friendly land management. This could be seen to be unfair.

5.6 LULUCF accounting approaches in other INDCs

In Chapter 4 information from 12 INDCs by major developed and developing country partners was presented. For comparison also the proposed accounting approaches of these INDCs were analysed (Table 5.1). Those of parties that explicitly mention accounting approaches for LULUCF sector are open to both a land-based and an activity-based accounting approach. Japan is the only party that explicitly mentions that it intends to follow an accounting approach in line with the Kyoto Protocol. Again, those parties that mention accounting for harvested wood products state that this will be on the basis of a production approach.

Table 5.1 Overview of LULUCF accounting approaches in other INDCs

Parties	LULUCF accounting approach
Australia	Australia intends to account based on UNFCCC inventory reporting categories using a net-net approach. Australia will apply IPCC guidance for treatment of natural disturbance and variation. Australia's INDC assumes that accounting provisions under the Paris agreement will preserve the integrity of the agreement by ensuring claimed emissions reductions are genuine and are not double counted; and recognise emissions reductions from all sectors.
Brazil	Brazil intends to use inventory based approach for estimating and accounting anthropogenic greenhouse gas emissions (p. 2)
Canada	Canada intends to account for LULUCF sectorusing a net-net approach, and to use a "production approach" to account for harvested wood products. Canada will exclude emissions from natural disturbances
China	No specific mention of LULUCF accounting approach. However, it is noted that improved GHG statistics on areas including energy activity, industrial process, agriculture, land-use change, forestry and waste treatment is needed.
India	No specific mention of LULUCF accounting approach.
Indonesia	No specific mention of LULUCF accounting approach
Japan	Removals by LULUCF sector are accounted in line with approaches equivalent to those under the Kyoto Protocol. Japan includes removals by LULUCF in their total emissions reduction, noting that removals correspond to a 2.6% reduction of total emissions.

Mexico	No specific mention of LULUCF accounting approach.
New Zealand	Accounting will be land or activity-based, recognise permanent and additional carbon stock changes, and include provisions to address natural disturbance, permanence, land-use flexibility, legacy and non-anthropogenic effects. Harvested wood products accounting will be on the basis of a production approach.
Norway	Norway will work towards a common framework for LULUCF accounting, for all Parties. Norway does not currently have a final position on the content and structure of such a framework. In the event that Norway will implement the commitment individually, the final approach to accounting for LULUCF will be decided upon later, but methodological changes in calculating emissions and removals from LULUCF shall not affect Norway's ambition.
Republic of Korea	LULUCF and agriculture specifically mentioned in Korean INDC, stating that "a decision will be made at a later stage on whether to include greenhouse gas emissions and sinks of LULUCF and agriculture, as well the method for doing so." (Korean INDC, p. 2).
Russia	No specific mention of LULUCF accounting approach, only reference to IPCC 2006 and 2013 guidance
USA	The United States intends to include all categories of emissions by sources and removals by sinks, and all pools and gases, as reported in the Inventory of United States Greenhouse Gas Emissions and Sinks; to account for the LULUCF sector using a net-net approach; and to use a "production approach" to account for harvested wood products consistent with IPCC guidance. The United States may also exclude emissions from natural disturbances, consistent with available IPCC guidance (p. 4).
Switzerland	Switzerland will use a land based approach for the LULUCF sector. The same IPCC methodology as used to account for forest management in the second commitment period under the Kyoto Protocol will be applied. The reference level for forest land will include living and dead biomass and harvested wood products (HWP). Anticipated accountable emissions/removals from forest land in target year: 0. Switzerland supports that reference levels, when based on a projection, are subject to a technical assessment or review process. Extraordinary events in forest land will be excluded from the accounting.

5.7 Incentivising action in the forest sector

Ellison et al. (2011) identify a significant 'Incentive Gap' (IG) in the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol (KP) and European Union (EU) carbon reporting and accounting frameworks for land use, land-use change, and forestry (LULUCF). Because the carbon stored in omitted carbon pools, managed forests, and harvested wood products (HWP) is not adequately accounted under current carbon accounting practices, strong incentives for increased carbon sequestration and the balanced and efficient use of forest resources are not in place. Accounting practices under the UNFCCC, KP, EU, and other national-level emission reduction schemes thus fail to adequately mobilize the LULUCF sector for climate change mitigation.

Furthermore, the manner in which land use (and Forest Management) is taken up in the accounting creates a gradually increasing land base that will be accounted under KP. Thus gradually we are moving to net accounting, but capped, creating no incentive. In addition, bits and pieces of land that fall under the KP criteria need to be monitored making it expensive.

Also the trend line of the FMRLs now displaying a saturating sink towards 2030 (modelled with the models EFISCEN and G4M), creating worries amongst NGOs. They claimed a saturating sink was displayed simply to be able to claim easy credits afterwards. Thus the trend line itself is also under scrutiny.

Is there a way out of this? The Paris agreement leaves decisions very much open and does not state that the same approaches as under KP need to be followed. Since the KP land area is gradually increasing and has a large share of land covered already (with FM, CM, GM), now is maybe the right moment to consider full land based accounting stimulating especially those measures specific per MS that make the most sense; a Climate Smart Forestry. This would need to be accompanied by a move away from FMRLs and caps, but giving forestry its own target as well.

This requires that sustainable adaptation and mitigation of climate change should be mainstreamed in forestry policy and forest management in Europe, with specific attention paid to regional circumstances, opportunities and challenges. A wide variety of policy measures tailored to these regional circumstances can be implemented, to provide incentives to better reap the climate mitigation potential of the EU forest sector. As much as possible, these measures should be in synergy with other policy targets for the EU forest sector, such as developing the bio-economy and preserving biodiversity. Some of these measures could be interpreted as introducing elements from the carbon pricing principle.

'Climate Smart Forestry'[5] is an approach that mainstreams climate mitigation by using forests and the forest sector and related policies in a way that utilises the different regional characteristics and circumstances of the EU Member States as well as possible. A 'one-size-fits all' policy is unlikely to achieve this. In addition, different polices impacting on the forest sector, such as rural policies, industrial policies, energy policies and biodiversity policies, should be set in such a way that the synergies with climate mitigation targets are achieved as far as possible (Box 5.1).

Incentives will often have to be economic incentives. One challenge for forest owners is the very expensive regeneration phase in the forest. The costly regeneration often prevents them from carrying out fellings. An incentive could be to provide access to subsidised new and better planting material and provenances. Also provision of planting machinery can help.

Another challenge is the fragmented ownership in many regions. Still in every region there are larger owners (often state or communal). These larger owners can be initiators in the region. When larger owners carry out thinnings or fellings, they could take smaller lots along, bringing larger quantities on the markets, providing better prices.

For regions where the terrain is too steep or sensitive from biodiversity point of view, establishing reserves is an option. This process of transition (maybe with multiple owners) could also be supported by state outreach agencies and possibly some financial regulation. In regions that are under fire risk, different choices of tree species, reducing fuel load etc. can make a big difference. Capacity building in this area as well providing machinery and planting material will be a big incentive.

Very often small private owners don't even know where their forest is located, or don't know what tree species there are. Schooling, training, capacity building can make a big difference. And there are many more measures one can think of, also on the local demand side.

Although the EU does not have direct competency on forest matters, the rural development programmes and possible new CAP measures after 2020 could be geared much more towards forest related measures with examples as above. Also MS themselves could rethink their forest programmes with an eye on climate mitigation.

[5] Nabuurs, G.-J., P. Delacote, D. Ellison, M. Hanewinkel,M. Lindner, M. Nesbit, M. Ollikainen and A. Savaresi. 2015. *A new role for forests and the forest sector in the EU post-2020 climate targets.* From Science to Policy 2. European Forest Institute.

Box 5.1. Examples of mainstreaming climate change in forest policy and forestry, see Nabuurs, G.-J., P. Delacote, D. Ellison, M. Hanewinkel,M. Lindner, M. Nesbit, M. Ollikainen and A. Savaresi. 2015. A new role for forests and the forest sector in the EU post-2020 climate targets. From Science to Policy 2. European Forest Institute.

A high forest stocked central European country

In this country, multi-purpose forestry is high on the agenda, and strong demands for increased biodiversity protection co-exist with climate policy targets. Increasing the share of **strictly protected forests** would maximise sinks in forest biomass (in the medium term before disturbance). In other **areas with a high growing stock,** the growing stock can be reduced (producing new types of products), at the same time **reducing the storm risk**. For some time, such a region may be a carbon source, but new and better **adapted species**, for example to droughts, can be introduced.

An industrial forestry-oriented country

This is a country with a relatively low felling/increment ratio, for example, of 70%, which aims to **increase resource utilisation** rates and target the bioeconomy – particularly the production of new and additional products which were formerly dependent on non-renewable resources (i.e. a focus on substitution). Some resource intensification is needed in certain rural areas to create jobs and income, while in other more marginal growth areas policies should be geared towards **forest reserves** and **preserving peat carbon**.

A fire-prone country

This is a country with a poorly developed forest industry and strongly affected by fire disturbances. The best carbon mitigation strategy here needs to target **fire risk management** and possibly the local use of forest biomass, in conjunction with regeneration with drought-resistant species. In the long term, the better adapted species will sequester more carbon and offer a landscape which is more attractive for tourism.

An eastern European country

In this country, there are large areas of **Norway spruce vulnerable to drought** and beetles. Here, Climate Smart Forestry should be geared towards gradual conversion to locally better adapted species, mixtures, etc. The conversion decades can give a boost to the local use of the timber in construction.

6 Implications of the PA for data needs

6.1 Key principles

The Paris Agreement establishes one 'enhanced transparency system' with two compartments, namely one for action (concerning mitigation as set out in NDCs) and one for support (mostly finance, technology transfer, capacity building). In the Kyoto Protocol, transparency was to be ensured via the Monitoring, Reporting and Verification (MRV) system. This change may indicate an increased focus on the importance of reporting and accounting systems and as such require improved and possibly increased data needs.

The UNFCCC has created the TACCC basic principles to which every reported GHG emission and removal should meet. The TACCC principles are a set of qualitative indicators for estimates. In general the principles state that estimates should be transparent, consistent, comparable, complete and accurate:

- **Transparency** means that the data sources, assumptions and methodologies used for each estimate should be clearly explained, in order to facilitate the replication and assessment
- **Accuracy** means that emission and removal estimates should be accurate, in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable.
- **Completeness** means that an estimate has full spatial/geographical and time/annual coverage;
- **Consistency** means that an estimate is internally consistent for all reported years in all its elements.
- **Comparability** means that estimates of emissions and removals reported for each category by each country being transparent, complete, consistent and accurate, having been prepared according with IPCC good practices, are also comparable.

A more strict application of the TACCC principles might have consequences for LULUCF and agriculture in terms of data needs. Especially issues regarding completeness, for full spatial coverage and annual reporting and possibly accounting, and accuracy, might require improvements in the current data collection for many Member States. Also regarding comparability, improvements can be made as currently quite different approaches are used in the LULUCF reporting by the different member states, as described in the sections below.

For monitoring of emissions and removals from the LULUCF sector three main monitoring systems are required, i.e. land use / land use change monitoring, forest monitoring and soil carbon monitoring. In the sections below we discuss for these three monitoring categories how Member States currently make use of available monitoring systems for their GHG reporting and accounting and to what extent this could be improved. It should be noted that the focus in this chapter is specifically on MRV of carbon in soil (all land types) and in forest biomass, as these two carbon pools constitute the essential contributions to LULUCF carbon stocks and associated GHG removals and emissions.

6.2 Land use / land use change monitoring

6.2.1 Overview of current monitoring approaches of land categories

IPCC (2006) distinguishes three approaches that may be used to represent areas of land use as presented below in order of increasing information content. Approach 1 identifies the total change in area for each individual land-use category within a country, but does not provide information on the nature and area of conversions between land uses. Approach 2 introduces tracking of land use conversions between categories (but is not spatially explicit). Approach 3 extends Approach 2 by allowing land use conversions to be tracked on a spatially explicit basis.

An overview of the different approaches for representing land use and land use change used by the MS is presented in Table 6.1. This Table is based on a review of the latest available NIRs (i.e. 2015 submissions). We distinguished three main methods, one based on statistics, which can be considered IPCC approach 1, one based on land use sampling (IPCC approach 2) and one based on grid maps (IPCC approach 3).

Table 6.1 Overview of methods and data used for representing land use and land use change in LULUCF reporting (data derived from latest 2015 NIR)

Country	Method	Wall to wall	Main data sources
Austria	Sample based	No	NFI, FSS and LPIS
Belgium	Sample based	No	NFI and agricultural statistics
Bulgaria	Sample based	No	NFI and agricultural statistics
Croatia	Grid based	No	CORINE and statistics
Cyprus	Grid based	Yes	CORINE
Czech Republic	Sample based / statistics	No	Cadastral information
Denmark	Sample based	No	Satellite images and NFI
Estonia	Sample based	No	NFI
Finland	Sample based	No	NFI, LPIS, Aerial photographs
France	Sample based	No	Land survey
Germany	Sample based	No	NFI, CIR data (derived from detailed aerial photographs), CORINE and
Greece	Statistics	No	Statistics
Hungary	Grid based	Yes partly	CORINE and Statistics
Ireland	Combination grid and sample based	Yes partly	CORINE, LPIS and NFI
Italy	Sample based	No	Land use survey, NFI and statistics
Latvia	Sample based	No	NFI and statistics
Lithuania	Sample based	Yes	NFI, geographic maps, CORINE, statistics
Luxembourg	Grid based	Yes	CORINE, satellite images
Malta	Grid based	Yes	CORINE and statistics
Netherlands	Grid based	Yes	Topographical maps
Poland	Statistics	No	Statistics and NFI
Portugal	Grid based	Yes	CORINE and NFI
Romania	Sample based	No	NFI and military topographic maps
Slovakia	Statistics	No	Statistics
Spain	Grid based	Yes	CORINE and several other maps
Sweden	Sample based	No	NFI
United Kingdom	Sample based	No	NFI and statistics

Usually data used for estimating land use changes are statistics from in situ surveys, especially for forests (i.e. data from the National Forest Inventory), but some MS also use remote sensing based techniques, such as aerial photographs and satellite images. For grassland and cropland, many MS use data from the Farm Structure Survey (FSS) and the

EU Land Parcel Identification System (LPIS), as well other agricultural data collected in the framework of the CAP EU. The CORINE land cover database is used by several MS.

Most MS have used an approach based on land use sampling, in which fixed points are revisited (in the field, as done in the LUCAS survey) or using aerial photographs, and changes in land use can be determined. Often the National Forest Inventory sample points are used. The benefit of the approach is that the observed land use change has a low uncertainty, which in a grid based approach is not always the case, as grids might have been classified differently among two maps in time. However, for a good coverage of the total area of a country, many sample points are required.

6.2.2 CORINE and other land cover maps

The CORINE (CO-oRdination of INformation on the Environment) programme was initiated by the EU in 1985. A number of databases were created within this framework with the aim to give information on the status and changes of the environment. One of these databases is the CORINE Land Cover database (CLC). Up to now four maps have been produced (1990, 2000, 2006 and 2012). Feranec et al. (2012) presented an overview of land cover and its change in Europe for the period 1990-2006 based on the CLC maps.

Table 6.2 Evolution CORINE Land Cover projects (Büttner et al., 2012).

Parameter	CLC 1990	CLC 2000	CLC 2006
Main satellite data	Landsat-4&5 MSS/TM single date	Landsat-7 ETM single date	SPOT-4/5 and IRS P6 LISS III dual date
Time consistency	1986-1998	2000 +/- 1 year	2006+/- 1 year
Geometric accuracy satellite images	≤ 50 m	≤ 25 m	≤ 25 m
CLC mapping min. mapping unit/width	25 ha/ 100m	25 ha/ 100m	25 ha/ 100m
Geometric accuracy CLC data	100 m	better than 100 m	better than 100 m
Thematic accuracy	≥ 85% (probably not achieved)	≥ 85% (achieved [6])	≥ 85% (not checked)
Change mapping	not implemented	boundary displacement min. 100 m; change area for existing polygons ≥ 5 ha; for isolated changes ≥ 25 ha	boundary displacement min.100 m; all changes > 5 ha are to be mapped
Production time	10 years	4 years	planned: 1.5 years realised: 3.0 years
Documentation	incomplete metadata	standard metadata	standard metadata
Access to the data	unclear dissemination policy	dissemination policy agreed from the start	free access for all kinds of users (CLC data)
Number of European countries involved	26	30	38

A comparison of the different parameters for the CLC 1990, 2000 and 2006 version is provided in Table 6.2. The final CLC database consists of a geographical database describing land cover/use in 44 classes grouped into a three level hierarchical structure. The CORINE land cover nomenclature has 5 major categories at the first level, 15 land cover categories at the second level and 44 categories at the third level.

Several countries already use the CORINE land cover maps for their inventory, often in combination with other data sources. However, other countries consider its resolution (100

m) and the quality (especially the 1990 map) as insufficient for the basis of their LULUCF inventory. Also the time it takes to create a new version of the land cover map is considered too long, e.g. the 2012 map took three years to finalize. EEA is making plans for more frequent and quicker updates of the CORINE maps. Nevertheless, the CORINE maps provide a consistent representation of land cover over time for all MS and could be used as a verification or quality check of MS specific approaches for representing land use and land use change.

Besides the European CORINE land cover map, there are also several global land cover products based on satellite images, such as the GlobCover maps. Hansen et al. (2013) examined global Landsat data at a 30-meter spatial resolution to characterize forest extent, loss, and gain from 2000 to 2012. These high resolution maps could be used as source for verification of trends in deforestation and afforestation, however definitions used for forest land for the UNFCCC reporting are often different compared to the definition used in this kind of products, which makes it difficult to compare absolute values.

Within the Copernicus Programme[6], a European system for monitoring the Earth, also other geo-information products, besides CORINE land cover, are being developed that can be relevant for monitoring and reporting in the LULUCF sector. The Pan-European High Resolution Layers (HRL) provide information on specific land cover characteristics, and are complementary to land cover / land use mapping such as in the CORINE land cover (CLC) datasets. The HRLs are produced from 20 m resolution satellite imagery through a combination of automatic processing and interactive rule based classification, and are available as pan-European wall-to-wall products that cover the EEA39 countries. Currently products for five themes have been developed: soil sealing (imperviousness), tree cover density and forest type, (semi-) natural grasslands, wetlands and permanent water bodies. So far, most of these products are still under development and require validation, but these maps can be used to improve land use data quality in the future.

INSPIRE

Directive 2007/2/EC established an Infrastructure for Spatial Information in the European Community (INSPIRE) to support Community environmental policies, and policies or activities which may have an impact on the environment. INSPIRE is based on the infrastructures for spatial information that are created and maintained by the Member States. To support the establishment of a European infrastructure, Implementing Rules addressing metadata, interoperability of spatial data sets and spatial data services, network services, data and service sharing, and monitoring and reporting procedures have been specified. INSPIRE does not require collection of new data. However, after the period specified in the Directive Member States have to make their data available according to the Implementing Rules.

INSPIRE is based on a number of common principles:

- Data should be collected only once and kept where it can be maintained most effectively.
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

Relevant INSPIRE themes for LULUCF are land cover, land use, soil, habitats and biotopes and area management. The benefits of INSPIRE in terms of reporting are the improved transparency, harmonisation of data and availability of relevant data sets.

[6] http://land.copernicus.eu/

6.2.3 Land Parcel Identification System (LPIS)

The land parcel information system (LPIS) is the spatial register within the Integrated Administration and Control System (IACS). The IACS ensures that payments of the EU Common Agricultural Policy (CAP) are made correctly. LPIS identifies and quantifies agriculture land for the purpose of targeting CAP payments. The CAP payments can only be targeted to agricultural land which is 'eligible'. Therefore the CAP Regulation defines agricultural area and categorizes land for "eligible hectares".

Each Member State is obliged to maintain a reference layer for the LPIS data, in that way the parcel information can be cross-checked. Each Member State is free to choose the approach for the reference layer, so there exist differences in the quality check. Although in general LPIS follows a framework of requirements laid down in the Regulations, LPIS cannot be considered standardised across Member States. The land cover codes used by the different Member States vary considerably. The Joint Research Centre (JRC) of the European Commission has reviewed all of the codes used and produced a list of ten standardised codes that are the most used. However, 70% of all the LPIS systems in the EU apply more codes than these 10 standardised codes[7].

LPIS would be a good source for especially agricultural land use changes, and possible also some land management changes, as it is recorded annual and it has a high spatial accuracy. However, not all countries have all agricultural land included in LPIS, as it is only required for eligible CAP subsidy hectares. On the other hand, some countries also included forest land in LPIS. Due to the lack of full coverage of land, the use of LPIS for reporting all land use and land use changes for National Inventory Reporting and accounting is currently limited, but for reporting of Cropland Management and Grazing land Management, LPIS can be a valuable source of information.

6.2.4 Land management activity data

The EU LULUCF decision (529/2013/EU) requires Member States to prepare actions to increase removals and decrease emissions of GHG from activities related to forestry and agriculture and the legislation also requires MS to include grassland management and cropland management in their accounts. In this respect also activity data on land management is required, at least if a MS would account for changes in emissions due to implementation of land management practices.

Currently at EU level the main source of information is the Survey on Agricultural Production Methods (SAPM)[8], Council regulation (EC) No 1166/2008, which was held together with the Farm System Survey in 2010. The Survey on agricultural production methods was a one off survey to collect farm level data on agri-environmental measures to support monitoring of the relevant European Union policies. The survey collected information on the following characteristics relevant for LULUCF and agriculture: soil cover and tillage practices, crop rotation, manure application, grazing and landscape features. This database provides a useful starting point with activity data relevant for CM and GM, but so far no new survey has been planned.

Also the LUCAS land use database provides some information on land management (e.g. soil cover, tillage and irrigation), however, this data are less useful, since land management cannot be well observed from a single visit by the surveyor. For example, in the Netherlands many of the point data suggested that no tillage was applied in arable fields, however, zero tillage is hardly implemented yet, and most likely the time of observation did not allow a good visual assessment whether the soil was ploughed or not.

[7] http://www.efncp.org/download/hungen2012/devos.pdf

[8] http://ec.europa.eu/eurostat/statistics-explained/index.php/Survey_on_agricultural_production_methods

6.3 Forest monitoring

6.3.1 Overview of current NFI systems

For the reporting and accounting of emissions and removals from forest land, almost all countries make use of data from a National Forest Inventory (NFI). A National Forest Inventory is a systematic sampling scheme to monitor the state of the forest. Sample plots are laid out over the country with a certain sampling density. The plots can be located in a regular grid or based on (semi) random sampling. Plots are usually circular, with either fixed size or with a radius depending on the density of the plot. Some countries use 2 or 3 circles with different radius with a different tree-diameter threshold. This is done to avoid over-sampling of small trees. For the same reason, some countries do not use a circular plot but use an angle-count system instead. Trees are included in the sample or not based on a combination of their distance to the plot centre and their diameter. Also more complicated sample forms exist. In some NFIs, plots are clustered to optimise labour investment and reducing travel costs. Plots can be temporary or permanent. In the latter case, the plot is re-measured in the next NFI cycle. For all trees is recorded if they died or were harvested, and if still alive how much their diameter increased. This requires an exact recording of both the plot and the trees within the plot, which takes more time than a temporary plot. However, temporary plots only provide a picture of the current state of the forest, while permanent plots enable an estimation of growth, mortality and harvest.

Most NFIs record tree species, diameter at breast height (DBH) and some measure of height per tree (usually only for selected tally trees). A whole range of other variables can be measured at the plot or tree level, such as presence of regeneration, damage to trees (for example browsing), distance to the nearest road, potential sawlog quality, soil characteristics, etc. Exact variables included per NFI differ considerably per country. NFIs readily produce aggregate statistics on volume of the growing stock and several other characteristics, such as tree species distribution. By using relationships between DBH and biomass, total biomass can be estimated and used in national carbon accounting.

Table 6.3 Overview of National Forest Inventories, more NFI characteristics can be found in Annex 5.

Country	NFI/SFI	NFI since	last NFI	last NFI number	next NFI expected	Frequency (years)	continuous/event-based
Austria	NFI	1961	2007-2009	NFI7	2018	~7	event-based
Belgium (Wallonia)	NFI	1984	2008-2018	RFI4	-	~10	event-based
Bulgaria							
Croatia	SFI						continuous
Cyprus	some inventories were done, but no systematic coverage						
Czech Republic	NFI	2001	2001-2004	NFI1	?	~10	event-based
Denmark	NFI	2002	2007-2011	NFI2	?	5-10	event-based?
Estonia	NFI	1999	2009-2013	NFI3	2014-2018	5	continuous
Finland	NFI	1921	2009-2013	NFI11	2014-2018	5	continuous
France	NFI	1960	2004	NFI4	-	5	continuous
Germany	NFI	1986	2011-2012	NFI3	2021-2022?	10	event-based

Greece	NFI	1963	1963-1991	NFI1	-	-	event-based
Hungary	SFI	1935?				10	continuous
Ireland	NFI	2004	2009-2012	NFI2	?	5?	event-based
Italy	NFI	1983	2005-2007	NFI2	?		event-based
Latvia	NFI	2004	2009-2013?	NFI2?	?	5	continuous
Lithuania	NFI	1998	2008-2012	NFI3	?	5	continuous
Luxembourg	NFI	1999	2008-2010	NFI2	?	~10	event-based
Malta	-						
Netherlands	NFI	2001	2012-2013		2017 continuous?	irregular	event-based
Poland	NFI	2005	2005-2009	NFI1	?	5	continuous
Portugal	NFI	1965	2005-2006	NFI5	in progress?	planned 4	event-based
Romania	NFI	2006		NFI1	?	5	continuous
Slovenia	NFI	2000	2007		?		event-based
Slovak Republic	NFI	2005	2005-2006	NFI1	?	7-10	event-based
Spain	NFI	1965	1997-2007	NFI4	2008-2018	10-12	event-based
Sweden	NFI	1923	2008-2012	NFI9	2013-2018	5	continuous
United Kingdom	NFI	2009	2009-2014	NFI1	?	5?	continuous

Most countries in Eastern Europe employed a Standwise Forest Inventory (SFI). In an SFI, all forest stands in a country are visited in a 10 year cycle. For each stand, characteristics as wood volume and tree species composition are estimated or measured (in various ways). Such an inventory was part of the preparation of management plans. National numbers are a simple aggregation of the individual stand-wise inventories. Although they have a larger sample base, these inventories are sensitive to bias, since it was also the basis for management plans and consecutive assessment of performance of the local foresters. Nowadays, most countries have introduced an NFI next to the existing SFI systems, or are shifting from SFI to NFI systems.

Table 6.3 provides an overview of the NFI systems in the EU Member States, based on Tomppo et al. (2010) and updated wherever possible with information from internet. Most MS have an NFI system in place. About half of them are continuous and half are event-based. Regardless of the system, the intended frequency is usually 5-10 years. For most countries, the last completed inventory cycle was 4-10 years ago, but the information is not up-to-date for all countries. However, it is clear that some countries have difficulties starting a next NFI cycle. This might be due to financial reasons, but also political reasons can play a role. In this respect, a continuous system would give more security since it would be less dependent on the actual political and financial situation.

Only few countries have a soil monitoring programme, integrated into the NFI or somehow connected. Remote sensing is in many countries used for photo-interpretation in the preparation phase, but not often during the data acquisition phase. Some countries more or less routinely employ remote sensing methods to prepare country-wide maps using the NFI results. Only Finland and Austria report serious efforts to include more remote sensing as part of the data acquisition phase.

6.3.2 Frequency of monitoring in terms of accounting

NFIs used to be events that were repeated more or less regularly. A cycle usually consisted of a preparation phase (mapping, measurement design), a measurement phase (usually several years) and a data analysis phase (taking at least one year, but usually more). More and more countries are shifting to a continuous system, where every year a certain portion of the plots is measured. When all plots have been measured the first cycle is completed and a

report can be issued. Measurements for the next cycle are started immediately. Advantage is that the workload and budget is more evenly distributed, and that there is always up-to-date information for at least a portion of the forest. However, for another portion of the forest the information is quite old, depending on the length of the cycle. By the time reports are written, the corresponding information is usually on average already 5 years old.

Annual accounting fits well with the continuous system, but the uncertainty in reporting might be quite large. If measurements are done in a 10 year cycle, the annual reporting will be done on a sample that is only 10% of the usual sample size. The uncertainty is much larger, and there is the risk that outcomes are treated as "real", while they are in reality caused by the measurement system. Ideally, a continuous system would randomly allocate the plots that need to be measured to years within the cycle. However, for practical purposes the country may be divided in zones. The measurements are then more clustered in space and travel time between plots can be minimised. However, this might cause biases in annual reporting, relating to different conditions in different zones. Most of the countries reviewed seem to use a random approach.

Periodic reporting fits well with both the event-based as well with the continuous system. However, the frequency and timing of event-based NFI cycles might not in all cases fit well with the carbon accounting periods.

6.3.3 New technologies

Currently, remote sensing is used in NFIs in two ways. In the mapping phase, remote sensing is used to delineate the forest and forest stands, and sometimes to characterise the types of forest. Furthermore, remote sensing is used when the measurements are completed to produce interpolated maps for a certain variable (for example forest age). The measurement data are used as a training dataset on which the remote sensing signal is calibrated.

Remote sensing cannot replace ground-based measurements completely. Certain variables are very difficult to assess from the air, such as diameter of a stem. However, it could be used to stratify the forest beforehand, so measurements could be allocated more efficiently (certain number of measurements per strata rather than a fixed sampling scheme). This would mean fewer measurements, but the same accuracy. The same stratification could also be used to calculate outcomes with more accuracy from a fixed sampling scheme than just based on the measurements themselves. Thus, the same number of measurements can give more accuracy (because the size of strata is known).

A problem with current (optical) sensors is that the signal is saturated quite quickly. The wood volume map by Gallaun et al. (2010) does not distinguish classes over 300 m^3/ha, while most Central European countries have an average stock of 250-350 m^3/ha. Radar penetrates more deeply in the canopy and could potentially distinguish also in more dense forests. Ground-based Lidar can be used to augment NFI measurements. Ground-based Lidar can take much more measurements than a person possibly could do, and the measurements can be stored for decades for later (retrospective) analyses.

Remote sensing can play an important role in the future development of National Forest Inventories. The recently started networking project CARISMA aims at increasing co-operation across Nordic countries and increasing the use of remote sensing data and improving the level of expertise in NFIs. Remote sensing is seen as the way to improve the information content, timeliness, accuracy and cost-efficiency of forest inventory. In the recent years an important shift has taken place from 2D data to 3D data such as photogrammetric aerial photo and laser scanning point clouds. In the future new possibilities will be available as radar satellite 3D point cloud data will be available as well. Some countries, e.g. Finland, already start utilizing new technology providing 3D data also in the field work, namely digital cameras and terrestrial laser scanning data. The aim is to markedly improve the information content of the data, especially concerning the measurements of biomass and quality of the timber.

Several EU initiatives are ongoing to come to European wide harmonised data and information on forests. The recently started EU project DIABOLO[9] aims to develop new methods and models to produce European wide harmonised data and information such as growing stock, biomass and carbon, based on NFI field data and high-resolution remote sensing data and to produce an innovative multi-source system for providing up-to-date estimates on the state and changes in European forest ecosystem. Also the European National Forest Inventory Network (ENFIN)[10] aims to promote NFIs as comprehensive monitoring systems by collecting harmonised information on forest ecosystems by enhancing co-operation between national forest inventory organisations.

In short, the continuation of NFI measurements is not guaranteed in all countries, and some countries do not have an NFI system (such as Greece). The NFI remains the responsibility of the countries, and is until now not part of the EU mandate. NFI cycles are not clearly aligned on the Kyoto commitment periods. However, continuous systems are always able to report based on at least a smaller sample, or based on somewhat older data. Remote sensing still seems a promising method to increase the accuracy and/or decrease the costs, but only few countries seriously experiment with the technology. Development takes time and money, and only countries with a serious forestry industry are willing to do these investments. Here, the EU could perhaps play a role by stimulating the development and exchange of technology.

6.4 Soil monitoring

6.4.1 Overview of current soil monitoring systems used for National Inventory Reporting

An assessment of European, national and regional soil monitoring networks (Arrouays and Morvan, 2008) concluded that soil organic carbon (SOC) concentration is one of the most widely available indicators in Europe. However, SOC have been determined by different methods in the studies available and topsoil depth and sampling depth are not well defined. This makes an assessment of C-stocks across EU Member States problematic (Schils et al., 2008).

Besides the LUCAS soil monitoring, which has recently been set up by the European Commission, see Section 6.4.2, only for European forest soils a harmonised monitoring has been set up by the ICP Forests programme[11], which is the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests operating under the UNECE Convention on Long-range Transboundary Air Pollution. More than 5000 ICP Forests Level I plots were monitored in two forest soil surveys across Europe. The first took place between 1986 and 1996 and the second between 2004 and 2008 under the Forest Focus Regulation (EC No. 2152/2003).

An overview of the different approaches and soil monitoring characteristics used for soil carbon reporting was made based on the latest available NIRs (i.e. 2015 submissions) (Table 6.4). This review shows that most member states have some kind of monitoring scheme for soils implemented. However, major differences in monitoring activities exist both between MS and within MS, with different monitoring schemes in place among different regions or only for a specific land use (e.g. forests). Many of these monitoring schemes have not been designed and implemented for monitoring organic matter or organic carbon in soils. So far only a few countries have systematically taken measurements on more than one occasion at a national scale.

[9] http://diabolo-project.eu/

[10] http://enfin.info/

[11] http://icp-forests.net/

Table 6.4 Overview of approaches and characteristics of soil monitoring for NIR

Country	IPCC tier approach	Nr. of sample locations	Monitoring frequency	Soil depth (cm)	Soil depth for NIR (cm)	Bulk density	Source SOC monitoring for NIR
Austria	Tier 2	10000	1x	50 (3 layers)	50?	Measured and pedotransfer function	BORIS (soil information system)
Belgium	Tier 2		2x for part of the plots	30	30		National Soil Survey (NSS)
Bulgaria							Unclear, reference to "empirical data"
Croatia	Tier 2?	2571	1x	20	20		Scientific research program named “Geological Maps of Croatia”
Cyprus							
Czech Republic	Tier ½			30	30		no sampling scheme
Denmark	Tier 2/3	600	3x for part of the plots	100		Pedotransfer function	Danish Agricultural grid
Estonia	Tier 2	751	2x?			For 10% of the samples	Soil databases PEDON and CATENA
Finland	Tier 2		1x				Unclear
France	Tier 2	1561	2x	30	30		Réseau de mesure de la qualité des sols, RMQS (although not clear to what extent this is used)
Germany	Tier 2		1x				no soil C sampling used in NIR
Greece	Mostly Tier 1		1x for forest soils				not included in NIR.
Hungary							not included in NIR (only forest, D)
Ireland	Tier 1		1x				no soil C sampling used in NIR, default values used
Italy	Tier ½		Not used				no soil C sampling used in NIR, default values used
Latvia	Tier 1						no soil C sampling used in NIR, default values IPCC
Lithuania	Tier ½						no soil C sampling used in NIR, default values IPCC
Luxembourg	Tier 1						no soil C sampling used in NIR, default values IPCC
Malta	Tier 1?						no soil C sampling used in NIR
Netherlands	Tier 2	1400	1x	120 (5 layers)	30	Pedotransfer function	LSK, a national sample survey of soil map units
Poland	Tier 1?						no soil C sampling used in NIR
Portugal	Tier 2	208	1x (2x for forests)	40 (2 layers)	40		Project BioSoil (1999); LUCAS soil assessment (2009)
Romania	Tier 1						no soil C sampling used in NIR
Slovakia	Tier 2	314	1x				Data used from several studies and soil survey
Slovenia	Tier ½	50	1x	40	40		Soil samples, source unclear
Spain	Tier ½	748		30	30		Compiled soil profile database (Rovira et al., 2007; BALANGEIS 2007-2010)
Sweden	Tier 2	6000?	NFI, but unclear is soils are resampled	100?			National Forest Inventory (NFI)
United Kingdom	Tier 2		2x (not for	100 (2	30	Pedotransfer	Compilation of several

Country	IPCC tier approach	Nr. of sample locations	Monitoring frequency	Soil depth (cm)	Soil depth for NIR (cm)	Bulk density	Source SOC monitoring for NIR
			all sample plots)	layers)		function	databases (surveys)

The review of the NIRs on information regarding soil sampling and monitoring programmes showed that MS do not always provide enough details on the source and type of soil data, which makes it difficult to do a proper assessment of the quality of the reporting of carbon stock changes in mineral and organic soils. If soil carbon becomes more important in future accounting, significant improvements are needed to ensure compliance with the transparency principle.

Another observation is that only a few countries have a soil sampling scheme really focused on soil carbon and reporting for UNFCCC and KP (e.g. Denmark), but the majority of the MS use soil data from available databases often developed for other purposes. Only one country (Portugal) mentions that soil data obtained from a European survey (LUCAS and BioSoil) is used. Most new Member States still use the IPCC tier 1 default values for their soil carbon stocks. Many countries have more elaborated data on forests compared to the other land use categories. This is probably related to the fact that forests in most countries are to a large extent governed by public national bodies, with national forest inventories, whereas the soil quality of croplands and grasslands is often only the concern of individual farmers.

Information on soil bulk density is required to calculate soil carbon stocks based on the carbon content of the soil. However, in many surveys bulk density is not measures, as this is more time consuming. Often pedotransfer functions, which are predictive functions of certain soil properties using data from soil surveys, are used to estimate the bulk density (e.g. based on soil texture and organic carbon content). However, use of these pedotransfer functions increases the uncertainty in the soil carbon stocks. Related to this is the soil depth for which the carbon stocks are estimated. The IPCC good practice guidance recommends to use a topsoil depth of 30 cm, but in many soil surveys other depths are used, which makes it difficult to compare amongst countries.

6.4.2 LUCAS soil monitoring

LUCAS (Land Use/Cover Area frame statistical Survey) is a harmonised survey across all Member States to gather information on land cover and land use. Estimates of the area occupied by different land use or land cover types are computed on the basis of observations taken at more than 250,000 sample points throughout the EU. In 2009, the European Commission extended the periodic LUCAS survey to sample and analyse the main topsoil properties in 23 Member States of the EU. This topsoil survey represents the first attempt to build a consistent spatial database of the soil cover across the EU based on standard sampling and analytical procedures, with the analysis of all soil samples being carried out in a single laboratory. Approximately 20,000 points were selected out of the main LUCAS grid for the collection of soil samples. A standardised sampling procedure was used to collect around 0.5 kg of topsoil (0-20 cm). The samples were sent to an accredited laboratory where a range of chemical and physical soil properties were analysed. SOC content (g C kg^{-1}) was measured by dry combustion (ISO 10694:1995). More details about the survey and the data can be found in Tóth et al. (2013) and Panagos et al. (2013). In 2012 also samples from Romania and Bulgaria were collected. A new monitoring survey including a resampling of soils is currently ongoing (2015-2016). The benefit of LUCAS data is that it is recently observed data and there is a clear link to land use.

The benefit of the LUCAS soil monitoring is that it is applied in (almost) all EU Member States following the same design and sampling and analytical procedures, which is a clear improvement in terms of comparability. Also the direct link to land use and land use change observations is an important benefit. Although the number of soil samples is quite impressive, for an individual MS it can still be a rather small data set, which is too small to be used in the estimation of carbon stock changes, e.g. for the Netherlands only about 200

sample plots are available. Another drawback of LUCAS soil data is the lack of bulk density measurements. This can be estimated using pedotransfer functions, but this increases the increases the uncertainty significantly. Finally, the soil depth for which the samples have been taken is rather limited with the top 20 cm, as IPCC default values are based on the top 30 cm, but also in the subsoil significant amounts of carbon can be stored.

6.4.3 Recommendations for improvement of soil monitoring

Jandl et al. (2014) point out several important issues when monitoring soil carbon; for instance, they highlight the need for establishing a universal metric for SOC, as so far it is often the case that the total SOC pool is calculated based on total C concentrations, as those data are more available. They point out that, in that case, when estimating SOC based on total Carbon, it is necessary to have measured data on soil bulk density and the content of rock fragments. Further, Jandl et al. (2014) comment on the need for a standardized approach to the reported soil depth for SOC pool estimations; as well the importance of the data on C pool of deeper soil horizons, as the effect of land use changes on deep C stocks has been poorly addressed. Subsoil horizon has to be included also when the objective is to measure the entire SOC pool.

Finally, Jandl et al. (2014) point out that the understanding of SOC stabilization processes is not yet complete, and that no agreement on soil C fractionation methods to estimate the degree of stabilization exist. Regarding the usage of mechanistic SOC simulation models in the estimation of temporal trends in the SOC pool, they consider that those are not yet adequate for the extrapolation of existing soil data over space and time.

Soil is a fairly stable medium, with detectable changes occurring only over long time spans; but it is spatially heterogeneous, hence variability in sampling and measurements is often many times larger than variability over time, making stringent standardisation and quality assurance/quality control (QA/QC) procedures mandatory (Schils et al., 2008).

7 Implications of the PA for EU policies

7.1 Main elements of the PA with relevance to EU policies

The EU's 2015 INDC targets a 40% GHG reduction by 2030, and the current EU 2050 roadmap and the projections behind it foresee an 85-90% reduction of emissions by 2050. Although neither projects when, if at all, a balance is to be achieved, they create a baseline for the contribution of LULUCF and agriculture to meeting the mitigation target.

This contribution can be expected to increase as the EU's targets themselves progress in accordance with the goals of the Paris Agreement, which:

- Signals a need to scale up current levels of ambition with respect to climate goals, particularly through the aspiration to limit global temperature rise to 1.5 degrees;
- Includes an aim to balance emissions and removals after 2050, requiring action both with respect to carbon sequestration and mitigation efforts;
- Introduces a new process of 'Global Stocktaking', which is to take place for the first time in 2023 and every five years thereafter, creating a platform to further increase global ambition;
- Makes several mentions of role of removals, reservoirs and sinks, again emphasising the future role of carbon sequestration.

These developments therefore imply that the EU and its Member States will need to increase climate mitigation efforts across all sectors, including LULUCF. In addition, the need to balance emissions and removals has particular implications for LULUCF, given its role in carbon sequestration. The manner in which LULUCF is integrated into the 2030 Framework – i.e. in a separate 'LULUCF' pillar or directly into the ESD – will also affect the level and extent of its contributions.

EU and Member State policies for the land-related sectors including agriculture, forestry and nature can have significant effects on emissions and removals. The development and implementation of these policies over time will play an important role in climate action at EU level, within the new framework set by the PA.

The following sections consider the implications of the PA with respect to the following EU land-related policies:

- The Common Agricultural Policy;
- The EU Forest Strategy;
- Biomass, Bio-energy and RED
- Nature and biodiversity policy; and
- International forest policies.

7.2 Common Agricultural Policy (CAP)

7.2.1 The Paris Agreement and the CAP post 2020

The Paris Agreement is not very explicit about the role of LULUCF and agriculture, apart from mentioning food security and the frequent, but more generic reference to removals, reservoirs and sinks. Nevertheless, it is quite clear that over time all sectors shall contribute ('economy-wide') to mitigation, and be accounted for.

The CAP has a profound influence on climate action with respect to agriculture and LULUCF, through its funding, incentives and associated delivery rules, which combine to affect patterns of food production, cropping and livestock regimes, land use change, afforestation and forest management, and the management of soil and ecosystems.

In this section, we briefly examine how the existing CAP instruments are being used to support climate mitigation, and assess how the increased level of ambition – and the accounting obligation – may warrant changes to the CAP and its implementation post-2020.

7.2.2 Assessment of current policy framework

The CAP is a key funding instrument for climate action in agriculture and rural areas, offering various opportunities to advance climate action in the agriculture and LULUCF sector.

The ability of the policy to achieve its potential with respect to climate action depends not only on the design of a suitable policy framework and tools at EU level, but also on the full and effective use of those tools at Member State and regional level, as well as the adequate systems of monitoring, data collection and review. The full potential of the CAP to deliver on climate has thus far not been realised, in part because of how the measures are designed and implemented at MS level, the level of funding allocated explicitly to climate objectives, as well as limited capacity available in MS to directly and comprehensively address climate objectives in rural development programmes.

It is important to note that the LULUCF sector does not include non-CO_2 emissions from agriculture (i.e. N_2O and CH_4 emissions). The management of agricultural CO_2 emissions (both in terms of protection of existing stocks and sequestration) entails close interaction, either in terms of synergies or trade-offs with non-CO_2 emissions, with non-CO_2 emissions. Thus, a holistic and integrated approach is required to incentivise climate action at agricultural holding, farming system and regional level. The LULUCF technical options for mitigation need to also be evaluated and pursued, keeping in mind other environmental (water, soil, biodiversity) and food security objectives. This requires safeguards to be put in place to ensure these interactions are fully considered.

In the current CAP framework, several elements are already available that, if fully implemented and further developed, could accommodate increased ambition:

- **Greening payments** under Pillar 1 include payments for agricultural practices that benefit environment and climate: crop diversification, the maintenance of permanent grassland, and Ecological Focus areas (EFA). MS have significant flexibility in how they implement these measures, and their design and contributions can therefore vary considerably across the EU. In principle, these measures can contribute to climate objectives. There is currently insufficient evidence on the actual choices and implementation of the measures at MS level to enable an assessment of the contribution that they are making. The overall criticism raised against the greening measures has been that the considerable flexibility given to MS to define them at national level will allow them to decrease their ambition. The studies commissioned by DG Agriculture on mapping of the different CAP elements across the MS will deliver overviews of implementation across the EU in the course of 2016, which can provide a baseline to review progress.
- **The cross-compliance mechanism** attached to Pillar 1 payments specifies the environmental baseline for farmers to observe, i.e. the mandatory requirements that farmers need to follow in order to be eligible for direct payments. Under the mechanism, several Good Agricultural and Environmental Condition (GAEC) standards are in place, such as for soil management, and for increasing biomass stocks above ground. The analysis of these is ongoing, and so it is difficult to judge their effectiveness at this point.
- **Rural Development Programmes** under Pillar 2 of the CAP offer a wide range of possible measures to fund climate actions. The types of measures available to Member States are diverse and enable the funding of different technical actions, as well as cooperative and monitoring activities. The limiting factor tends to be the funding available for RDPs, and the funding allocated more specifically for climate action objectives. Although the overarching and valuable objective is for all action to support climate change mitigation and adaptation, the RDPs' contribution could be quite indirect and may only be realised as a side-effect of addressing other priorities such as biodiversity, water,

and soil. Another limiting factor is knowledge and experience regarding ways in which climate mitigation and adaptation actions could be supported by rural development programmes. The study on 'Mainstreaming climate change in rural development policy post-2013' developed related guidance by providing suggestions and guidance on how to design RDP measures for climate action.

In addition to the measure design, the targeting of priority and risk areas for climate (i.e. areas where there is significant mitigation or adaptation potential) is an important aspect of improving the CAP's contribution to climate. The lack of national and regional capacity to design effective climate measures for the respective regions, to conduct monitoring and risk mapping, and the absence of available data on land management activities have been limiting factors in the current period. Action to strengthen evidence and capacity in these areas could contribute significantly to the effectiveness of climate action post-2020. Another priority will be to raise awareness of climate actions in agriculture, both among the advisory delivery services and at farm holding level.

Currently, there is no overview available of ways in which MS are using RDPs for climate action. This could be addressed by monitoring and evaluation of the implementation of the CAP in the current programming period, which would help to provide evidence to enhance current implementation and the development of future policy post 2020.

In terms of the types of measures that have the most significant potential to contribute to LULUCF targets, forestry management and afforestation, protection of carbon rich soils, and increased usage of perennial crops are important technical actions. The RDPs include measures that can fund all of these actions. The extent to which they are currently delivered is not yet understood, and requires mapping across the RDPs.

Soil management, in particular the protection of carbon rich soils, as well as carbon sequestration in mineral arable soils can make a valuable contribution to climate and LULUCF objectives. An overview of 14 national and regional RDPs conducted in the SmartSOIL Project identified a lack of coherence and targeting with respect to soil management, and suggested that this needs to be further addressed and improved for the current programming period. It is likely that coherence with regard to climate objectives (mitigation, adaptation) and the application by Member States of climate proofing criteria more broadly also needs to be improved.

7.2.3 Implications for integration into the 2030 framework

As concerns the 2030 package, and the integration of LULUCF and agriculture therein, non-coordinated policy timelines may pose a significant challenge. As neither the exact accounting rules (under the PA) nor the regulatory infrastructure and incentives driving LULUCF and agriculture contributions (under the CAP) will be settled by the time of the presentation or negotiation of the 2030 framework, there is a great deal of uncertainty around design of realistic options, in particular with respect to potential contributions. Notwithstanding this, existing modelling and experiences learned and studies conducted can inform feasible policy options and ways forward.

The consequences of this uncertainty can be at least two-fold: First, MS will find it difficult to commit to targets and actions, and second, any rules or principles decided on in the framework may end up being inconsistent with PA or CAP rules or principles, and hence require revision or amendment.

7.2.4 Implications for policy development and mainstreaming

The CAP will most likely remain a central policy instrument for agriculture and rural areas after 2020. Increasing its contribution to climate action can be achieved by:

- Improved data and processes for monitoring and evaluation of existing measures, in order to inform future action;
- Improving and extending the use of existing tools under both Pillar 1 and Pillar 2;

- Future changes to the CAP to enhance to tools available to promote climate action.

The specifics of CAP policy development are unclear and difficult to predict, and the context for the CAP post-2020 might change considerably (e.g. due to public perceptions or budgetary constraints) within the coming few years. The interaction between the LULUCF process and CAP reform will be central to how both policy areas unfold. Targets set for LULUCF within the 2030 framework could provide an important driver for climate action within the CAP, yet experience to date suggests that significantly increasing climate ambition within the CAP may face strong opposition from some quarters. Some observations are made below on how ambition could be increased in a step-wise manner.

If the current pillared CAP structure were to continue, a shift in the allocation of resources towards more payments for ecosystem services (PES) and improved integration of environmental concerns in general will both directly and indirectly benefit climate action. The broad elements of this could involve increasing the share of the Pillar 1 budget for greening measures and adding more climate conditions to their definitions, as well as making the GAEC standards stricter and inclusive of the protection of carbon stocks. A more ambitious approach would remove the pillared structure, and refocus all payments towards PES.

Within the CAP one of the key priorities should be the maintenance of soil organic matter and carbon stocks, both in soils with already high carbon content as well as in mineral soils with lower levels of organic matter, since maintaining carbon stocks and SOM levels is significantly easier and less costly than rebuilding these levels. In particular, carbon stocks in peatlands and wetlands are a significant source of GHG emissions. The carbon content of these soils can be protected through a basic GAEC standard – although this initiative was previously eliminated from the CAP reform proposal – and/or targeted measures under Rural Development Programmes.

Although additional carbon sequestration in mineral arable soils has relatively limited potential in the LULUCF sector compared to savings from carbon rich soils, afforestation, forestry and perennial crops, SOM levels in mineral soils are of high importance for maintaining agricultural productivity, delivering benefits for improved nitrogen and phosphorous efficiency, improved water retention and water use, improved soil structure and soil biodiversity. Continued loss of soil organic matter in arable mineral soils is a critical issue from an adaptation perspective as well as due to the need to secure stable yields and food security, and thus should be addressed systematically and ambitiously.

Measures to protect carbon stocks in soils could focus on soil organic matter preservation and improvement, for example through adapted crop rotations, residue retention, manure application and cover crops, and combinations of these with reduced or no-tillage practices). Moreover, CAP can also protect and enhance carbon stocks in above ground biomass through measures supporting buffer strips, or planting of perennial crops in marginal areas, and afforestation. All three elements (greening measures, GAECs, and RDPs) can be used to support these measures.

Capturing the full benefits of land and soil management more broadly for LULUCF objectives requires management actions to be adapted to local biophysical conditions and region-specific farming systems. Management actions focused on preservation of carbon stocks or additional sequestration also require a long-term commitment, and their implications extend beyond each farm holding. Thus, they are also more effective when part of a strategic response at farm and regional level. This necessitates a systematic approach to improving the capacity of national and regional policy-makers to make strategic decisions on what types of technical and policy measures are most suitable, for mapping risks and priority areas as well as for targeting the best measures to these areas.

7.2.5 Implications for data needs

Systems are in place to monitor implementation of the CAP (IACS and LPIS), European land use and soils (LUCAS), and the characteristics of EU farms (FADN). However, EU and MS accounting for soil carbon and other pools and fluxes in the agricultural sector is still highly

uncertain and based on national modelling. Non-industrialized parties to the PA even more so face challenges in monitoring let alone accounting for soil carbon. A significant challenge therefore, in light of the increased level of ambition following from the Global Stocktake cycle in the PA and the implicit obligation to account for all sectors, will be for the EU and the CAP to be able to quantify and deliver emission reductions and removals in the agricultural sector. At the same time, it will be important to encourage non-EU parties to do the same, and to show developing country parties how it could be done.

Improved monitoring and mapping of carbon stocks and of management activities that affect these stocks at the MS and EU level can better inform policy design and targeting. The CAP entails several elements that could be expanded in order to support monitoring and accounting within the LULUCF framework and to target climate action within the CAP to areas at risk or areas with the highest potential for cost-effectiveness.

The administration system for the allocation of payments within CAP provides two possible entry points to build on. First, the Integrated Administrative and Control System (IACS) collects annual disaggregated data on activities and agricultural land use. This can be used to evaluate the effects of the CAP as well as to feed into the LULUCF accounting framework and to examine the targeting of measures. In the German federal state Schleswig-Holstein, the IACS includes a land register with landscape elements that can provide a valuable resource[12]. Such options would need to be screened, and the issue of data confidentiality addressed, given that the data is collected at a very disaggregated / farm holding level.

In general, the integration and harmonization of CAP data that can be used for LULUCF accounting and monitoring of activities needs to be addressed. This is further discussed in Section 6.

National and EU databases and surveys require a complementary representative sample of farm holding data. This implies cross-checking and integration with existing FADN surveys, along with the development of more targeted monitoring schemes and climate bookkeeping (carbon auditing) at farm level. Rural Development Programmes provide various opportunities to test new monitoring and bookkeeping approaches first as voluntary measures, with the aim of broad deployment as semi-obligatory or mandatory measures under CAP post-2020.

Support could be provided for pilot monitoring and bookkeeping at farm level in the form of balance sheets, preferably building on existing carbon calculators. The carbon audit would need to integrate all aspects of farm management (in particular nutrient management) and maximize the use of existing databases and data that farm holdings already supply (for example, data that is fed into the IACS as part of the annual direct payment applications). The carbon audit would help to increase awareness of climate issues among the farming population, as well as provide information that could aid the selection of appropriate management measures to optimize climate objectives. A representative sample of farms could feed into national databases, and over a 5-10 year period could establish a baseline to also feed into the LULUCF accounting framework. This might increase the administrative burden, hence RDPs could be used in the first instance to pilot and test, to minimize burden.

The sheer amount and variety of data to be collected, processed and quality assured makes this no small challenge. Furthermore, the rules, procedures and guidelines for reporting and accounting under PA will at best remain undecided until 2019. Therefore, if the CAP for the period Post-2020 is to deliver data and emission reductions that are compatible with the reporting and accounting systems and principles under the PA, the issue of non-synchronous policy processes will become ever more important.

The way forward therefore seems to be to allow sufficient openness in CAP design to accommodate the outcome of the AWG-PA work process. Specific rules on the management of the IACS or specific RDP measures could be left to implementing or delegated acts, or

[12] http://literatur.vti.bund.de/digbib_extern/bitv/dk042975.pdf

perhaps the managing authorities in the MS. In this latter case, all that could be needed would be a decision (or recital) confirming that IACS or other data issues should be implemented with PA compliant LULUCF and agriculture accounting in mind, and including hooks and/or processes whereby this could be detailed at a later stage.

Bearing in mind that instruments such as LPIS and LUCAS serve other purposes such as carbon monitoring and climate change reporting, the consistency and synergy between these and the CAP and LULUCF accounting should be ensured as well. This is not necessarily dependent on the forthcoming CAP negotiation, but can take place at the time of review or extension of these.

7.2.6 Linkages to other policies

Peatland and wetland protection has numerous synergies with biodiversity and water protection, and so improved implementation of legislation in these areas would also aid climate objectives. Similarly, afforestation on marginal land interacts positively with forestry policies. The Water Framework Directive is currently a key instrument for soil management and soil protection in the EU, including for the issue of soil organic matter protection and sequestration and above-ground biomass (e.g. woodland buffer strips). The status of soil structure, for example through increased soil compaction, affects water drainage, thus also the leaching and runoff of nutrients. Improved soil carbon content of soils can, together with other measures that reduce pressure on soil (e.g. machinery, timing of operations), improve soil structure and reduce compaction risk, thus also contributing to water objectives.

Moreover, although there is currently no overarching instrument for soil protection except the voluntary Soil Thematic Strategy, the maintenance and sequestration of soil carbon implies a close interaction between LULUCF and soil protection policies. Any activity related to soil protection needs to be investigated closely for this reason, and synergies pursued.

7.2.7 Potential impacts of policy change

Increasing climate ambition in the CAP would require improved capacities at Member State level (among the Managing Authorities and farm advisory services, as well as research to support the design of measures) to address climate objectives. The issues of data collection and monitoring related to LULUCF as a whole are addressed in Chapter 6. Here, it is important to stress that the harmonization of monitoring and data within the CAP framework (through IACS and/or FADN) would require some resources. Integrating climate objectives into the CAP does not necessarily imply an additional administrative burden, provided that climate considerations (and data needs) are integrated with other environmental objectives, and that existing tools (including IACS databases, FADN, and existing nutrient management tools) are built on, rather than creating a new carbon-focused approach.

7.2.8 Policy agenda and timetable

The CAP mid-term review is due to take place in 2018. It is likely to deliver only adjustments, rather than significant changes, to the core of the CAP framework. This milestone, however, can be used in at least two ways to support increased ambition in the current and future CAP.

First, the mapping and evaluation exercise should yield a critical screening of how existing measures are being used to support climate action, where gaps exist, and ways in which these could be addressed in the short term.

Secondly, new pilot initiatives and the improvement of existing ones could be actively pursued between the mid-term review and the end of 2014-2020 programming period. A dedicated budget could be allocated specifically for testing new approaches, piloting climate measures, and refining their design, as well as investigating how monitoring and information gathering within CAP could be improved for the purposes of the post-2020 period. If the CAP mid-term is used effectively to test new approaches, these can then be built into the new CAP structure post-2020.

The shortage of data on the current contribution of the CAP to climate action, as well as the uptake and effectiveness of existing measures, presents a significant challenge to the review and development of the policy, as do the uncertainties about the rules, procedures and guidelines for reporting and accounting under PA, which are likely to remain undecided until at least 2019.

A parallel process to take into account, and potentially benefit from, is the ongoing consultation with MS around a future EU soil protection policy. The Expert Group on Soil Protection, coordinated by DG Environment, is currently underway, with the aim to establish a baseline of action across MS on soil protection activities (including monitoring initiatives at MS level), and to examine what a future EU-wide initiative on soil protection could look like. The Expert Group will conclude its mandate at the end of 2016 with the possible proposal of a new initiative for EU-wide action.

7.3 EU Forest Strategy

7.3.1 Assessment of current policy framework

Although the Treaty on the Functioning the EU does not make specific provisions for an EU forest policy, the EU has long contributed through its policies to implementing sustainable forest management and to Member States' decisions on forests and forestry matters[13]. Thus, through the EU Forest Strategy, the EU can provide strategic guidance on forestry issues, and undertake supporting actions that may be of use to all MS.

The 2013 Forest Strategy calls for the maintenance and enhancement of MS forest carbon sinks. This is particularly salient in context of the need to increase removals so as to achieve net-zero emissions by mid-century, and forest management policies intended to preserve and increase the carbon stock, such as increased rotation lengths, improved silviculture, afforestation, and reforestation will be all the more important. However, forests will also need to be managed for ecological integrity, especially as the side effects of management practices may not be immediately understood. For example, Naudts et al. (2016) found that even though Europe's forest area has increased by 10% since 1750, forest management practices, including wood extraction and the conversion of deciduous into coniferous species for timber extraction and commercial forestry, have resulted in an estimated 3.1 Pg C carbon debt for Europe's forests.

The eight priorities of the current Strategy, to be guided by an overall emphasis on sustainable forest management, balancing of ecosystem services, and the bio-based economy, are as follows:

1. Supporting rural and urban communities;
2. Fostering the competitiveness and sustainability of the EU's Forest-based Industries, bio-energy, and the wider green economy;
3. Enhancing the resilience and adaptive capacity of forests in a changing climate;
4. Protecting forests and enhancing ecosystem services;
5. Strengthening the forest knowledge base to understand how forests are changing;
6. New and innovative forestry and added-value products;
7. Collaboration and cooperation to better manage and understand forests and to achieve policy coherence and consistency;
8. Combating deforestation internationally, and ensuring consistency between EU and MS international forest policies.

Several of these have direct relevance for climate, both directly and indirectly. Priority 3 involves increasing both mitigation potential and enhancing adaptive capacity and resilience. Both of these can be expected to closely parallel Priority 4 on protecting forests and enhancing ecosystem services. Priority 5, on improving the knowledge base, is key to

[13] EC (2013), *A New EU Forest Strategy: For Forests and the Forest-Based Sector*, COM(2013)659, Brussels.

improving the understanding of the effects of climate change on forests, and thereby to taking adaptive measures which will help to preserve or increase the carbon stock. Lastly, Priority 6, in conjunction with Priority 2, should encourage the development of wood products that allow for the long-term sequestration of carbon.

Lastly, Priority 8 includes both pan-Europe and international forest governance. Negotiations are ongoing to establish a legally binding agreement on forests in Europe, which, as of the most recent negotiation text, includes provisions for maintaining and increasing carbon sinks. If and when this agreement enters into force, it will further necessitate harmonisation of forest policies between the EU and MS, as well as with both MS and EU climate policies. Internationally, the EU is has taken a leading role in combating deforestation by promoting sustainable forest management, particularly through REDD+, FLEGT, and the EU Timber Regulation.

Tensions will likely arise between different priorities, such as Priorities 2 and 6 on one hand, and 3 and 4 on the other, embodied in the sequestration effect (implying maintenance of standing forests) and the substitution effect (implying increased harvesting to provide wood products to replace fossil fuel-based products). On the other hand, the two may coincide in some cases, such as where increasing carbon sequestration implies harvesting older forests to take advantage of carbon storage in wood products as well as to store more carbon in a newly planted young forest. However, even where this is the case, old age class forests are critical for the development and maintenance of biodiversity and the full provision of ecosystem services, and thus a different tension may arise. Landscape level and ecosystem-based management, in synergy with other EU policies on nature and biodiversity, will therefore be key to ensuring all values are maximised. Nabuurs et al. (2015) suggest that forests in regions with low accessibility or already high biodiversity values may be best suited to form carbon stock reserves.

The EU's Forest Strategy has called for MS to demonstrate how they intend to increase their forests' mitigation potential through increased removals and reduced emissions. Although this is a positive step, it is unlikely to be sufficient in light of the level of increased ambition required from all sectors to meet mid-century targets. Therefore, even though the Forest Strategy does not set binding targets, it could aim to maximise forest carbon stocks and removals by further encouraging MS actions under Priority 3 as well as 2, 5, and 6, where appropriate, and incentivise and support carbon sequestration in general, and mitigation and/or LULUCF sector targets specifically. Maximising forest carbon stocks and removals may require an adjustment of priorities in the forestry sector on the part of MS. This would be a major undertaking, but one which the Strategy could nevertheless encourage with sufficient efforts and resources, perhaps through the Standing Forestry Committee at the strategic level, through individual EU funds at the implementation level, and by guiding other policies such as the CAP. Landscape-level research could also be supported, to encourage individual MS to collaborate in large-scale forest and ecosystem management. The completion and entry into force of the legally binding agreement could also aid this reorientation of priorities, as it would require MS to uphold common standards.

The above could be accomplished through close linkages between the Forest Strategy and EU funding sources such as the Rural Development Regulation – which already provides more than 90% of EU forest funding – as well as LIFE+, the Structural Funds, Horizon 2020, the European Innovation Partnerships, and so forth. Through similar mechanisms, the EU could also incentivise and encourage research into resilience, adaptation, and the long-term trend of the carbon stock; explore the promotion of sustainably harvested wood products on the internal market; and encourage cross-border cooperation, in a similar manner to the Preparatory Action on harmonized forest information in Europe (Decision C(2012)3716).

7.3.2 Implications for policy development and mainstreaming

There are close connections between the Forest Strategy and the EU's climate strategy. Increasing the EU's forest carbon sink depends on the development of appropriate incentives in the MS and perhaps in the EU's climate framework as well, i.e. overall targets,

the method of integration of the forestry sector, and the associated economic incentives that may arise as a result of (for example) future emissions trading. The Strategy could continue to guide MS' decisions on forest issues, and convey a stronger need to increase ambition, in support of any targets for LULUCF mitigation for the EU and the MS in the 2030 Framework. It would thus also deliver the EU component of the expected legally binding agreement on forests.

Besides carbon sequestration, the Forest Strategy has called for an increased contribution from forests to economic development, notably through wood-based biomass industries; increases in resilience; enhancements in ecosystem services; new value-added products; and coordinated management approaches. These may all correlate to some extent with climate goals, especially with the Forest Strategy's emphasis on sustainable forest management and balanced delivery of benefits. For example, where forests are young and fast-growing, a strong emphasis on production could be maintained, allowing for the development of new wood products and a constant storage and replenishment of the carbon stock through sequestration in wood products and planting of new trees. Evidence suggests that providing wood products and energy correlate well with creating a carbon sink[14]. The Strategy could help to guide EU investments in the forest sector – for example through the European Structural Investment Funds (ESIFs) – which contribute to forest climate goals.

7.3.3 Implications for integration into the 2030 framework

The EU Forest Policy can guide MS' actions in realising the contribution of their forestry sectors to the targets of the 2030 Framework, even while MS continue to hold competence for forest emissions and removals. If LULUCF and agriculture are integrated into the ESD, or if a land-use pillar is eventually set up that allows trading of emissions reductions between EU MS, the overall level of ambition should be increased accordingly, to fully incentivize emissions reductions (or removals) across all sectors. .Second, in its current form, the Forest Strategy encourages sustainable use of forests as well as carbon sequestration. Its emphasis on carbon sequestration could be increased in the next revision, although it is not currently clear when that might take place. In the interim, the current text should be interpreted in light of the need to increase ambition going forward, and with the intent of supporting LULUCF integration into the 2030 Framework.

Lastly, forest-specific issues such as long timeframes and growth cycles are already reflected well in the Forest Strategy. The integration of forestry into the 2030 Framework should follow similar principles, to allow forest issues to be managed in the most appropriate way as well as to encourage coordination between climate and Forest Strategy goals.

7.3.4 Cross-policy analysis: linkages to other policies, where applicable.

As mentioned above, varied interactions may occur between the Forest Strategy and other environmental policies such as the Biodiversity Strategy, Natura 2000, and the Green Infrastructure Strategy. Estimates currently suggest that more than 50% of forest species and almost two-thirds of forest habitats are in unfavourable conservation status[15]. Opportunities thus exist for policy and programmatic linkages with the Nature Directives and the Natura 2000 network, as restoring the conservation status of these ecosystems will likely increase their sequestration capacity.

Similar concordance may occur for any of the above in cases where forests are to be maintained for their carbon values, especially where these are older forests managed for both carbon and ecosystem service values. However, in other cases, such as where the goal is to increase carbon sequestration by harvesting and then replanting a mature forest,

[14] Nabuurs, G-J., et al. (2015), "A new role for forests and the forest sector in the EU post-2020 climate targets", *From Science to Policy 2*, European Forest Institute.

[15] EC (2013), *Commission Staff Working Document accompanying the Communication on "A New EU Forest Strategy: For Forests and the Forest-Based Sector"*, SWD(2013)342, Brussels.

biodiversity and habitat goals may be in opposition to forestry and carbon goals. Each of these must be approached on a case-by-case basis, taking into account economic, social, and environmental concerns. Planning for the long-term future through initiatives such as the Green Infrastructure Strategy, with its emphasis on obtaining multiple benefits from land parcels, may aid in avoiding these conflicts.

Other EU funds may also be relevant. Both the LIFE+ sub-programme on climate action and the Rural Development funds can support forest management practices that limit emissions or increase removals. LIFE+ in particular can support forest management practices that limit emissions or increase net productivity[16], and, as mentioned above, Horizon 2020 and European Innovation Partnerships can encourage research and innovation[17].

7.3.5 Potential impacts of policy change

Because the EU Forest Strategy serves as a guiding framework and does not itself impose changes or direct significant budgetary sources, further developments as outlined above are unlikely to have significant direct costs or impacts. Indirect effects could be realised, for example by guiding or influencing the use of resources to support forest carbon goals in place of other activities. Using the Strategy to encourage a reorientation of MS forestry priorities, however, will require significant resources.

7.3.6 Policy agenda and timetable

The current EU Forest Strategy was adopted in 2013, 15 years after the previous one. The timetable for revising the Strategy in future is unknown. The current Strategy provides a broad general framework which allows the EU and its Member States to take the necessary actions domestically and internationally to pursue the increased ambitions for the sector implied by the PA. As with the CAP, improved monitoring and evaluation of progress in implementing the climate related components of the Strategy would assist in informing future review and development of policy.

7.4 Biomass, Bioenergy, and RED

7.4.1 Relevant PA findings

The relevant findings for EU policy development on Biomass & Bioenergy policy (including the RED post 2020) from task 1 has been identified as:

- Carbon neutrality post-2050 target
- Global accounting
- FMRL uncertainty

Each of these has implications for both existing policies outside of the 2030 package and for the potential regulation within the package.

In summary, the existing biomass and bioenergy relevant pieces of regulation (RED; 28/2009)[18] and the EU-ETS directive(s)[19] and associated guidance material establish a system in which biomass used for energy purposes is considered carbon neutral and thus

[16] EC (2013), *A New EU Forest Strategy: For Forests and the Forest-Based Sector*, COM(2013)659, Brussels.

[17] EC (2013), *Commission Staff Working Document accompanying the Communication on "A New EU Forest Strategy: For Forests and the Forest-Based Sector"*, SWD(2013)342, Brussels.

[18] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

[19] See http://ec.europa.eu/clima/policies/ets/documentation_en.htm

zero rated, meaning that the smokestack emissions from energy installations in the ETS and/or eligible to receive state aid (under RED), can be exempted from accounting towards their respective reduction commitment. The fate of this system in future policy making has implications for the achievement of the carbon neutrality post-2050 target in EU and globally.

7.4.2 Implications for Policy Development and mainstreaming: New biomass policy

Under the current RED (article 17), bio*fuels* (not explicitly solid biomass) are considered carbon neutral based on the assumption that growth cycles for the dominant feedstocks are annual (or short in terms of years) and thus that any emitted carbon at combustion is re-sequestered within an annual cycle. While the RED does not apply to solid biomass, The 2014 Communication on Solid Biomass[20] sets out that one option for addressing solid biomass is to extend the current RED principles for biofuels to solid biomass as well, thus rendering this carbon neutral (meaning the emission factor for the calculation method set out in the annex, should be zero). This however, is disputed by several stakeholder and researchers, although no conclusion or scientific agreement on the topic has been reached. In view of the debate, some MS are considering or already have (e.g. the Netherlands) implemented a biomass sustainability scheme under which certain types of solid biomass are no longer considered carbon neutral. The outcome of this debate and its eventual integration into the expected 'new biomass policy' for post-2020 can have important repercussions on the role of biomass in delivering the further emission reductions necessary to meet the increased level of ambition that the PA sets out.

The Commission expects to present a proposal for a new Renewable Energy Package, which should include provisions regulating the use of bioenergy in the context of the renewable energy target for the period up to 2030[21]. Effectively, this new regulation will govern what role, and what contribution, biomass can make, to achieving the EU's 2030 Renewable Energy target (at least 27% of EU energy consumption by 2030) - and indirectly – the emission reduction target (minus 40% below 1990 levels by 2030). If, on one hand, some currently used types of biomass or feedstocks are no longer considered carbon neutral, the distance to target for any 2030 target may increase in terms of the level of reductions required. On the other hand, if solid biomass *en bloc* remains carbon neutral (and available on the market) it may very well become a key contributor to the fulfilment of any 2030 target for some MS at least – and potentially for a number of other parties to the PA.

From 2020 onwards the use of solid biomass, chiefly wood pellets, for energy in the EU is expected to reach an annual amount in the range of 35-50 MT of solid wood[22], equalling 60-90 MT CO_2/year. This means that, at the start of the accounting period leading to 2030, the amount of biomass used in the energy system is equivalent to 11-16%[23] of the emission reductions that need to be achieved during the period. In other words, if some or all of this biomass is no longer deemed carbon neutral, and thus not exempted from accounting, then the actual 2030 target is significantly higher than anticipated. For comparison, in 2013 504 MT of CO_2 from combustion of biomass of all sorts in the energy sector was reported in the EU (2013 EU NIR).

It should be noted that there is no direct mention of this issue in the PA, nor any decision article that as such will promote one particular way forward. The relevance of the PA in this context is mostly related to the expected continuous pressure to increase the level of

[20] EC (2014): SWD (2014) 259: COMMISSION STAFF WORKING DOCUMENT State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU

[21] *State of the Energy Union* communications update (572/2015), November 2015, Annex

[22] Wood pellets or wood chips from stem wood, or tree logs. For estimates see Poyry (2015; Cocchi et al., 2011; AEBIOM)

[23] Applying a simple calculation that does not take into concern energy conversion, nor the emission profile of the substituted fossil fuel or the energy mix as such, and further assumes annual use for all years equal to the 2020 estimate,

ambition for all parties that further accentuates the importance of the contribution of bioenergy on solid biomass.

7.4.3 Implications for integration into 2030 framework: Unaccounted, imported biomass

In the ETS, the reasoning behind zero-rating is that any biomass would have been accounted for by the producer of that biomass at the time of harvest, hence in order to avoid double-accounting it should not be accounted for again at the stage of its use (and conversion into energy). This however, only holds true in principle for biomass produced in countries subject to a legally binding reduction target *AND* fulfilling reporting and accounting commitments similar to those under the Kyoto Protocol (CP2). For biomass used in the ETS, but originating from any producer not subject to such commitments, the actual emission of carbon dioxide at the combustion of the biomass has not been accounted for. In light of ambition of the PA to extend reporting and accounting to all parties, thus leading to eventual global accounting this issue may or may not at some point in time cease to be relevant. In the meantime there is a need to address it, bearing in mind its temporary nature and the eventual policy development at the international stage.

As mentioned, biomass imported into the EU from third parties not complying with the accounting towards INDC pledges, and used in the ETS, does not meet the basic criteria for zero rating: It has not been accounted for by the producer yet in reality the main source current of biomass imports into the EU would be covered. A fundamental principle of KP accounting, and expected to continue under the PA MPGs that are to be developed, is that the producer of a good or material accounts for the associated GHGs. Therefore, in the current RED regime in the EU, biomass used for energy is excluded from accounting and reported as a 'memo item', as it is assumed accounted for by the producer. For all biomass exporting third countries that are not subject to a legally binding emission reduction target, (which may include LULUCF and agriculture), this assumption does not hold true. If however, parties to the PA establish accounting for their INDC, then this assumption will hold true from the time of accounting. Following from the PA, all parties are to account for the commitments taken in the submitted INDC, and thus account for harvested biomass.

In the PA, parties that were not subject to an accounting obligation under KP are provided more flexibility and time to implement accounting systems. One key aspect, and a major challenge for many non-industrialized parties in particular, is forest monitoring and enforcement of forest laws. As a result, generating reference scenarios and the credible harvest statistics necessary for compliant accounting (and e.g. FMRL setting if this approach is used) may take years or even decades. This in turn could lead to a situation where accounting for biomass harvest is patchy and applies only to individual parties outside of the EU for years to come.

Further to the issue of incomplete FMRL, there is a number of technical issues with relevance for accounting of biomass. In the context of current FMRL rules, parties are free to apply stock-change (SC) or production based (PB) accounting. If any to parties (EU or non-EU) trade biomass but apply to different accounting principles (SC and PB) there is a risk of either double or no accounting of the harvest emissions from the biomass. On top of the before mentioned data issue, this may lead to lack of transparency in accounting.

Consequentially, the new Climate and Energy Framework should ideally devise a governance structure that can address the fact that some biomass producers account while other do not, in the period until full accounting takes place. In addition, the policy will minimize the risk of double or no accounting following from the use of two different accounting principles for FMRLs. One perceived outcome of the international process could be land based accounting principles (see accounting chapter later) and the application of the rules on reported data. This could mean a FRL based on Forest Land remaining Forest Land data but not changing the logic of the reference level approach. In such a case the above points would not be catered for. This point however, may pertain more to the position of the EU in the COP negotiations and in the AWG-PA in the years to come, than to EU internal policy making.

In any case, WTO rules will not allow for discrimination between producers on this basis alone, and this therefore becomes a regulatory challenge, for example for the ETS. Nevertheless, the current practice on memo item reporting and indeed zero-rating the ETS does not include an accounting qualifier – all biomass is considered accounted for. Thus, one option is to continue this practice, even if it leads to under-accounting, until the accounting systems are in place in all biomass producing and exporting parties.

7.4.4 Potential impacts of policy change

As briefly mentioned, the new biomass policy (the new post 2020 RED) will expectedly set out how bioenergy can contribute to the achievement of the 2030 RE target. If, as a consequence of the debate on the carbon neutrality of some types of solid biomass, the amount of available and eligible solid biomass is reduced via regulation, the supply of an important cost-efficient resource is reduced and this in turn can drive up compliance costs at MS or EU level. Either other RE sources will have to be promoted (expectedly at a higher cost) or simply the resource is more expensive, driving out other users, also outside of the EU. Also, indirect effects (ILUC, IWUC) could be expected from such a market shock.

7.4.5 Policy agenda and timetable

According to the annex of the State of the Energy Union Communication (80/2015), a new RED for 2030 is expected as a part of a new RE package, this year or in 2017. This would mean that the Impact Assessment process is underway or in preparation. It would be of high importance to have considerations on the effect of various approaches to carbon neutrality on RE and GHG target included in the analysis therein. This issue however is expectedly included in this work already.

In the case of the ETS post 2020, the Commission tabled a proposal for phase 4 in summer 2015[24]. While this proposal did not address carbon neutrality of solid biomass, and arguably was not the right place to do so, it initiated a process in which the clarification of the question of carbon neutrality of solid biomass is important to a number of stakeholders, chiefly major energy producers in the EU. The practical rules and procedures for solid biomass in the ETS are expected to be embedded in the guidance material for operators, which will only be concluded after the legal texts have been agreed. Thus, there is now a time window for considering and preparing ground for revision of these rules.

7.5 Biodiversity / Nature

7.5.1 Assessment of current policy framework

Nature and biodiversity policies support increased climate ambitions in LULUCF and agriculture through their contributions to carbon storage and healthy ecosystem functioning.

The six headline targets of the EU Biodiversity Strategy are to:

- Target 1 - Protect species and habitats, including through full implementation of the EU Birds and Habitats Directives. Ensure that 100% and 50% more habitat and species assessments (respectively) under the Habitats Directive report an improved status; to ensure that 50% more species assessments under the Birds Directive report a secure or improved status by 2020.
- Target 2 - Maintain and restore ecosystems. By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems.

[24] Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, COM/2015/0337 final/2 - 2015/0148 (COD) see http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:337:REV1

- Target 3 – Achieve more sustainable agriculture and forestry. By 2020, the conservation of species and habitats depending on or affected by agriculture and forestry, and the provision of their ecosystem services show measurable improvements.
- Target 4 – Make fishing more sustainable and seas healthier. Achieve maximum sustainable yield for fisheries by 2015, and healthy stocks by 2020.
- Target 5 – Combat invasive alien species. Identify and control invasive alien species, and prevent the introduction and establishment of new species.
- Target 6 – Help stop the global loss of biodiversity. Increase the EU's contribution to averting global biodiversity loss by 2020.

Targets 1, 2, and 3 are of direct relevance to LULUCF and agriculture. Target 6 is also relevant for international climate targets through the EU's support for REDD+.

In particular, ecosystem conservation and restoration can be important for maintaining and increasing carbon stocks. Although the specifics of each ecosystem will vary depending on its history and past management measures, in one case Naudts et al. (2016) found (through simulations) that carbon sequestration in living biomass, coarse woody debris, litter, and soil was 24, 43, 8, and 6% lower, respectively, in managed compared to unmanaged forests. Similarly, Diaz et al. (2009) found that high-productivity systems such as secondary forest or grassland may sequester a net lower amount of carbon than low-productivity systems such as boreal or old-growth rainforest. Biodiversity, including genetic, species, and landscape diversity, also confers ecosystem resilience – e.g. to forest fires or invasive species, thereby aiding in the maintenance of forest carbon stocks – and may also improve the ability of forests to sequester carbon, at least partially due to enhancements in tree growth and health (Hicks et al., 2014). Lastly, agricultural practices that improve agricultural biodiversity, such as the CAP's biodiversity-related agricultural measures, can improve carbon storage in soils and plant matter. The biodiversity strategy (particularly Target 2) emphasises the importance of restoring and conserving ecosystems and their services (which include climate regulation).

The Green Infrastructure Strategy and its emphasis on providing multiple benefits from a single area of land is also particularly relevant, as it aims to increase resilience and reduce climate vulnerability by supporting ecosystem services – including clean water, productive soil, and climate mitigation and adaptation – at the landscape level. In addition to direct benefits to carbon sequestration, this emphasis on combining multiple land uses also enhances resilience and any other carbon benefits of diverse and robust ecosystems by improving connectivity, landscape permeability, and overall landscape health within and between Natura 2000 sites.

It should also be noted that increased climate ambition in LULUCF and agriculture will impact nature and biodiversity. An increased emphasis on afforestation and reforestation to create a carbon sink may be beneficial for biodiversity, assuming that forest management practices appropriately emphasize ecological integrity. However, there may also be conflicts between proposed afforestation schemes and the conservation of open-ground habitats, and nature conservation designations may represent a constraint to afforestation in many areas, especially since the Natura 2000 network now accounts for more than 18% of EU land area.

EU biodiversity policy therefore plays an important role in maintaining and enhancing the EU's carbon sinks and removals. The EU biodiversity strategy to 2020 should contribute to this role by conserving and restoring ecosystems and green infrastructure, but only if implementation is successful. The Commission is currently undertaking a Fitness Check of the EU Nature Directives (i.e. Birds and Habitat Directives), which is due to report in 2016; preliminary findings indicate that they provide a good framework for addressing biodiversity loss, but that progress has been limited by a lack of funding and ineffective implementation. Similarly, the mid-term review of the Biodiversity Strategy has indicated that targets are not being effectively met: ecosystem degradation and biodiversity loss are continuing; many habitats, species, and Natura 2000 sites are in unfavourable status; and particularly of importance in the LULUCF context, the conservation status of forest habitats and species have not improved. Thus, only effective implementation will allow synergies between LULUCF and biodiversity and nature goals to be fully realised.

7.5.2 Implications for policy development and mainstreaming

Potential linkages exist between LULUCF, agriculture, and several nature and biodiversity initiatives. First, the Birds and Habitats Directives have resulted in 18% of the EU's land territory being protected in Natura 2000 sites. Targets 1 and 2 of the Biodiversity Strategy call for full implementation of the Natura 2000 network (to achieve favourable conservation status) as well as restoration of 15% of the EU's degraded ecosystems. As degraded habitats are unable to fully deliver ecosystem services, including carbon sequestration and climate regulation, achieving nature and biodiversity targets should support the mitigation goals of the LULUCF sector both directly (by providing land area that can sequester carbon) and indirectly (by maintaining healthy landscapes that support managed forests). Furthermore, as discussed above, biodiverse forests may also sequester more carbon than non-diverse forests.

EU nature and biodiversity objectives require that forests are managed to deliver a full range of ecosystem and diversity benefits, and not just carbon sequestration. At the landscape scale, the maintenance and restoration of protected areas and ecosystems contributes to their strength and resilience and the delivery of ecosystem services. With a greater emphasis on LULUCF and agriculture contributions to balancing emissions and removals post-2050, an increased focus on maintaining and restoring biodiversity and natural ecosystems is necessary, especially in context of a possible increased prevalence of managed forests.

Full implementation of the Biodiversity Strategy, the EU Nature Directives, and the Green Infrastructure Strategy – all of which are currently failing to meet targets – would help to take advantage of these synergies. This entails at the very least ensuring that sufficient funding is available, that protected areas are efficiently managed and restored, and that enforcement is effective.

The Biodiversity Strategy targets are applicable until 2020, at which point it can be expected that the strategy will be revised and new targets set for the future. However, any revision process will need to begin before 2020, and therefore may partially coincide with the process for integrating LULUCF and agriculture into the 2030 Framework. Identifying and building synergies between future biodiversity and climate strategies could be mutually beneficial for both. This will benefit from action to integrate climate objectives into nature and biodiversity initiatives, and vice versa.

Of note is also the provision in Articles 2 and 4 of the PA that the long-term goal must be achieved on the basis of equity and in the context of sustainable development, poverty eradication, and food security. This, along with the preambular note on safeguarding the integrity of ecosystems and biodiversity, should support well the goals of the Biodiversity Strategy, for example by discouraging the use of large-scale installations such as monoculture plantations.

As we move towards 2050, the importance of achieving balanced emissions and removals will increase. This will necessitate enhanced removals and maintenance of carbon stocks, and so the interaction between forest and land-use on one hand and biodiversity and nature policies on the other will also grow with time, not least due to the fact that degraded ecosystems often act as carbon sources. The timetables for these will likely coincide, as the long-term nature of forest management is well matched by the long-term nature of ecosystem restoration and maintenance.

Overall, the policy framework surrounding nature and biodiversity provides opportunities for cross-policy engagement that can aid in maintaining and perhaps even growing carbon stocks, but only if funding and implementation are effective.

7.5.3 Implications for integration into the 2030 framework

The 2030 Framework could emphasise the role and complementarity of climate action in forests and agriculture with biodiversity and ecosystem services through related policy

initiatives such as the Biodiversity Strategy and its targets, Natura 2000, the Green Infrastructure Strategy, and the second pillar of the CAP. This could include identification of the ways in which forests and agriculture can jointly support biodiversity and climate goals, as well as the ways in which biodiversity policies can support carbon sequestration and storage. Maintenance and preservation of biodiversity in forest and agricultural lands, surrounding and supporting ecosystems, and cases of potential land-use change – such as the 70 Mt of sequestration potentially available from abandoned and afforested farmland– could be emphasized through appropriate provisions, such as management plans and/or the CAP's agri-environment measures. The need for better implementation of relevant policies and strategies, including increased funding, resources, and commitment, in order to fully realise potential co-benefits needs to be emphasised.

7.5.4 Potential impacts of policy change

Achieving nature and biodiversity objectives will require significant additional investments. For example, full implementation of the Natura 2000 is estimated to require annual expenditures of EUR 5.8 billion in the EU (Gantioler et al., 2010), and there is currently a significant funding gap. The costs of achieving ecosystem restoration targets under Target 2 of the EU Biodiversity Strategy have been put at EUR 0.7 – 1.7 billion annually (Tucker et al, 2013). Meeting these targets will thus depend on increasing budgetary expenditures or diverting them from other activities, while delivering substantial benefits for biodiversity and ecosystem services.

7.5.5 Policy agenda and timetable

The current Fitness Check of the EU Nature Directives will be concluded in 2016 and is likely to lead to new recommendations for improved implementation.

The current EU Biodiversity Strategy runs to 2020 and it is likely that work to plan the next strategy beyond 2020 will begin in the next few years.

7.6 International forest policy (FLEGT, REDD+, etc.)

7.6.1 Assessment of current policy framework

The EU's international obligations – whether for climate, sustainable land use, biodiversity, or other issues – are not necessarily directly related to the 2030 framework, which focuses on the domestic LULUCF and agriculture sectors. This is especially true as the framework also precludes the trading of international carbon credits towards climate targets, even though this appears to be allowed by Article 6 of the Paris Agreement.

Nevertheless, the EU's international forest policies play a major strategic role in encouraging developing countries to reduce their deforestation-related emissions. In its 2008 Communication on "Addressing the challenges of deforestation and forest degradation to tackle climate change and biodiversity loss", the EU committed itself to reducing gross tropical deforestation by at least 50% by 2020, and to ending global forest cover loss by 2030 at the latest.

Currently, two main mechanisms for these efforts exist. REDD+ has the potential to mitigate 3 Gt CO2e annually by 2030[25], and, as the EU holds overall competence in trade, FLEGT is its preferred method of addressing illegal deforestation. Although FLEGT does not explicitly address climate issues, deforestation is a major contributor to emissions, and so FLEGT is worth considering in this context.

In addition to REDD+ and FLEGT, agriculture-related deforestation in developing countries is a major contributor to carbon emissions, and needs to be treated as such in the EU's

[25] EC (2013), *Commission Staff Working Document accompanying the Communication on "A New EU Forest Strategy: For Forests and the Forest-Based Sector"*, SWD(2013)342, Brussels.

international forest policies. In 2013, the EC published a study on the impact of EU consumption of imported food and non-food commodities on deforestation or forest degradation[26], which estimated that 53% of global deforestation between 1990 and 2008 was caused by agricultural expansion, while only 2% was due to logging. Other, similar studies have found that agriculture has been responsible for about 80% of deforestation between 2000 and 2010[27]; 71% of all tropical deforestation between 2000 and 2012[28]; and 80 per cent of global deforestation[29]. The 2013 EU study also found that from 1990 to 2008, the EU was the largest global net importer of embodied deforestation, accounting for almost 36% of embodied deforestation in traded crop and livestock products. The EU is considering the development of an action plan on deforestation to address these issues.

7.6.2 Implications for policy development and mainstreaming

Increased commitments to REDD+ programmes, FLEGT VPAs, and ending embodied deforestation will be needed to achieve balanced emissions. Proper funding and implementation is critical: FLEGT VPAs partner countries often find their efforts hindered by a lack of resources, training, and capacity, along with weak institutions and enforcement; the EU Timber Regulation has faced difficulties stemming from inadequate funding and control; and REDD+ programmes have been largely conducted on an ad hoc basis to date, although this last is at least partly due to their voluntary nature.

The EU has a major role to play in international forestry issues, as evidenced by its complicity in embodied deforestation through imports, and as acknowledged in its communication on deforestation, climate change, and biodiversity loss.

7.6.3 Implications for integration into the 2030 framework

The EU's international forest policy contains few implications for its domestic climate policy, beyond the need to increase international commitments.

7.6.4 Cross-policy analysis: linkages to other policies, where applicable.

In its communication on deforestation, climate change, and biodiversity loss, the EU committed itself to reducing gross tropical deforestation by at least 50% by 2020. International forest policies, including a potential deforestation action plan, are critical to this endeavour. Synergies can also be found with the EU's international commitments under the CBD and to the New York Declaration on Forests.

7.6.5 Potential impacts of policy change

Scaling up REDD+ programmes to the level needed to meet mid-century carbon sequestration goals will require increased funding and investments in capacity building and governance in developing countries. It should be noted, however, that from a domestic perspective, investments in the Forest Strategy, CAP, Natura 2000, and other internal policies will also create local co-benefits. Addressing the embodied deforestation of EU imports will involve similar efforts, as well as perhaps changing either product sources and/or consumer preferences within the EU. The Action Plan on Deforestation can therefore be expected to require extensive commitment both domestically and internationally, for example with respect to trade measures, economic incentives, and so forth.

[26] European Commission (2013), "The impact of EU consumption on deforestation", *Technical Report – 2013 – 063, 064, 065*, Brussels.

[27] Kissinger, G., M. Herold, and V. de Sy (2012), *Drivers of Deforestation and Degradation: A Synthesis Report for REDD+ Policy-Makers*, Lexeme Consulting.

[28] Lawson, S. et al. (2014), *Consumer Goods and Deforestation: An Analysis of the Extent and Nature of Illegality in Forest Conversion and Agriculture and Timber Plantations*, Forest Trends.

[29] Kissinger, G., M. Herold, and V. de Sy (2012), *Drivers of Deforestation and Degradation: A Synthesis Report for REDD+ Policy-Makers*, Lexeme Consulting.

7.6.6 Policy agenda and timetable

Work on a potential EU action plan on deforestation is underway.

A review of the EU Timber Regulation is forthcoming, which is expected to note that the Regulation has faced difficulties. A review of the FLEGT Action Plan is also forthcoming.

7.7 Summary of implications for EU policies

Given the increased levels of ambition for mitigation efforts in all sectors signalled by the PA, as well as the frequent mentions of removals and the ambition to balance emissions and removals after 2050, land use can be expected to play an increasing role in EU climate action post 2020. Ensuring that climate objectives are fully integrated into EU land use policies will therefore be important.

The above policies could all significantly contribute to this goal. Enhancing their contribution depends on improving the uptake and effectiveness of current tools as well as considering the need for further policy development, all of which requires enhanced data and evidence about the implementation and effectiveness of current policies and practice.

Most important in this respect is the CAP, given its profound influence on land use and land management (including forestry and habitat management as well as agriculture), the scale of financial resources devoted to it, and the fact that overall responsibility for the policy rests at EU level. Within the CAP, more ambitious efforts by the EU and MS to develop and implement climate provisions within the greening measures, cross compliance arrangements, and RDPs could all play a role, especially with respect to increasing the sink and reservoir capacity of agricultural and forested land. The need for a greater focus on soil management within the CAP has also been identified. Improved monitoring of the uptake and effects of these different elements of the CAP and their contribution to EU climate action is critical, to inform the implementation and development of policy. Adaptation of the IACS system to enable it to contribute to LULUCF monitoring and accounting would also be beneficial.

The mid-term review of the CAP may provide an opportunity to adjust the approach and perhaps to encourage and pilot new initiatives. However, the scope for significant change may be limited in the medium term and especially before the next expected significant reform in 2020. Any changes in the future would depend on work being undertaken urgently to review current progress and identify and appraise potential future options.

The Forest Strategy will have much less impact directly, but could be used to guide a reorientation of MS forest priorities, especially in context of the legally binding agreement on forests that is currently under negotiation. Full implementation of biodiversity and nature policies is dependent on enhanced resources and an upscaling of current action, but could deliver many co-benefits that would aid the sequestration ability of LULUCF and agriculture.

Biomass could be used similarly, but would require careful accounting of emissions and removals in light of its intrinsic linkage with forest carbon levels. International forest policies could also be scaled up to support global mitigation goals. In all cases, however, climate and co-benefits alike will only be realised by ensuring sufficient funding, resources, and efforts for implementation and management activities.

8 Conclusions

8.1 Main points of the Paris Agreement regarding LULUCF and agriculture

The Paris Agreement contains several significant implications for the treatment and integration of LULUCF and agriculture into the 2030 framework, and for long-term land-use policies.

The PA defines three long-term goals for the level of greenhouse gases in the atmosphere:

- Limiting global warming to below two degrees Celsius
- Aspiring to limit temperature rise to one-and-a-half degrees Celsius
- Aiming to balance (anthropogenic) global emissions and removals sometime after mid-century

The PA recognises that current ambition is insufficient and should be scaled up in order to meet the temperature goals, with a long-term need to balance emissions and removals and therefore to withdraw some CO_2 from the atmosphere, as there will always be some non-CO_2 GHG emissions as well as some non-anthropogenic emissions.

Emissions reductions commitments from 2020 forward will be made through (I)NDCs, which are to be updated every five years through a 'global stocktaking' process, the first of which will occur in 2023 after a preparatory 'facilitative dialogue' in 2018, with the intent of consistently scaling up ambition. This timeframe is not well synchronized with the EU's policy development processes, especially regarding the integration of LULUCF and agriculture into the 2030 framework.

Through their potential for sequestration, the LULUCF and agriculture together could become critical for achieving the mid-century net-zero status. Reporting and accounting for this sector will therefore be of primary importance, as the accounting rules adopted will significantly influence the calculation of the balance and thereby the sectoral policies that are appropriate.

There are few specific mentions of LULUCF and agriculture and their accounting in the PA, although this is in part by design. Forests are mentioned several times, in context of the importance of maintaining, if not increasing, carbon sinks in the coming years. However, the PA does not provide clear indications of how accounting for forests and other land uses should be elaborated, although the TACCC principles provide a degree of guidance.

8.2 Potential contribution of LULUCF and agriculture

The Paris Agreement increases the challenge to reduce GHG emissions and increase removals, with its higher ambition to reduce maximum global temperature increase and the long-term need to balance emissions and removals after 2050. This might have consequences for the current reduction targets in the 2030 climate and energy framework and requires at least a long-term strategy on how the EU will develop towards a carbon neutral economy. The PA also puts stronger emphasis on the sink function of forests.

Current projections under a business as usual scenario project a decrease of the current sink in the LULUCF sector for the EU. This is mainly caused by a decrease of the sink in forest management due to increased harvest and ageing of the European forests. However, the mitigation potential of the EU forest is underutilised and, if adequately incentivised, Member States could increase the existing forest sink, but this would require significant investments in the forest sector. Increasing the harvested wood products sink is an option, but the potential is limited in the EU and it should be analysed in conjunction with other mitigation components related to the forestry sector.

Carbon sequestration in agricultural soils through improved management can be effective and offer in theory a large potential. However, recent studies provide lower estimates of the mitigation potential compared to the previous IPCC AR4 potential estimates. Without large

scale land use changes, not much more than a mitigation potential of 100 Mton CO_2/year can be expected in agricultural soils in the EU. Large scale restoration of degraded land and introduction of perennial biomass crops might increase this the mitigation potential, but studies underpinning this potential for the EU are still lacking.

The aim of balanced emissions and removals after 2050 will be very challenging to reach within the EU with only removals in the LULUCF sector. It is likely that bioenergy coupled with CO_2 Capture and Storage (BECCS) will be needed, in addition to CCS from fossil sources, as some of fossil CO_2 emissions (e.g. in transport) and non-CO_2 emissions from especially agriculture will occur, and the LULUCF sink is probably not sufficient to compensate, particularly on the longer time scale due to saturation of the sink in forests and soils.

8.3 Implications for accounting

The PA does not provide clear definitions and rules with regard to accounting. The AWG PA will have to elaborate guidance by 2018 which may include some specifications for accounting. However, it is very likely that there will be a large degree of freedom for the parties in the design of their LULUCF accounting system as long as consistency with their NDC is secured. As the PA is independent to the KP, the opportunity exists for a thorough analysis of the existing systems in place under KP, as a basis for changing the current KP accounting systems for LULUCF to a much simpler system. For instance, such changes could facilitate the reporting of LULUCF, could correct conceptual inequities, could ensure higher robustness of the accounted LULUCF emissions/removals and could include elements for environmental integrity. Several ideas in that direction are proposed, e.g. the change to a land-based system, an equal treatment of all land-uses (or activities) in accounting, the use of caps for securing the achievements and reducing inequities and as incentives towards enhanced action

The past and ongoing discussions on accounting of forest management under KP-1 and KP-2 illustrate the challenge to get to an accounting mechanism that will satisfy all parties. Across Europe forests are widely heterogeneous in terms of forest types and distribution and are subject to very different forest management regimes, land use planning, and policy-making. Incentives for enhanced climate mitigation from forests in Europe should therefore also pay attention to regional circumstances, opportunities and challenges. Accounting for forests under the PA therefore should also take this into consideration. In case a cap on credits for FM is considered necessary, such a cap should – unlike the situation under KP1 and KP2 – be set in a way that it accommodates or supports incentives to increase the forest carbon sink.

8.4 Implications for data needs

The Paris Agreement establishes one 'enhanced transparency system' which increases the importance of reporting and accounting systems and as such require improved and possibly increased data needs. With the INSPIRE directive the EU already made good steps towards improved transparency and harmonisation of land use/cover and soil data sets, which is important regarding the TCCCA principles.

MS use a wide variety in data sources and approaches for reporting emissions and removals in the LULUCF sector. Data sources to estimate land use changes are often based on statistics from in situ surveys (e.g. land use survey, FSS, NFI), but also spatial data sets are used. National Forest Inventory is the responsibility of each MS and is so far not part of the EU mandate. Set up and frequency of NFIs differs largely amongst countries and continuation of NFI measurements is not guaranteed in all MS. Although most MS have soil data and maps available, only a few countries have a soil sampling scheme really focused on soil carbon and reporting for UNFCCC and KP. Most soil data sources cannot be considered as monitoring data sets, as they often were only sampled once. Furthermore

data on soil bulk density and soil depth is often not available, whereas can have a large impact on the estimation of soil carbon stocks.

EU wide data sources, such as CORINE land cover maps and LUCAS soil data are available, but often not used by MS. New data sets, often derived from remote sensing, can improve the data quality, but most are currently still in development and providing consistent data for the whole time series will be challenging when these new data sets are included in the inventory systems. Use of remote sensing in NFI seems a promising method to increase the accuracy and/or decrease the costs, but only a few countries seriously experiment with the technology.

8.5 Implications for EU policies

Given the increased levels of ambition for mitigation efforts in all sectors signalled by the PA, as well as the frequent mentions of removals and the ambition to balance emissions and removals by 2050, land use can be expected to play an increasing role in EU climate action post 2020. Ensuring that climate objectives are fully integrated into EU land use policies, and that land use policies in turn maximise their contribution to carbon sequestration and mitigation, will therefore be important.

This will necessitate a concerted effort across all land use policy areas. Within the CAP, more ambitious efforts to implement and further develop existing climate provisions within the greening measures, cross compliance arrangements and RDPs could all play a role. The need for a greater focus on soil management within the CAP has also been identified. In addition, it will be important to improve monitoring of the effects of these different elements of the CAP and their contribution to EU climate action.

The Forest Strategy could be used to guide a reorientation of MS forest priorities. Increased resources for implementation and support of biodiversity and nature policies could deliver many co-benefits that would aid the sequestration ability of LULUCF and agriculture. Biomass could be used similarly, but would require careful accounting of emissions and removals in light of its intrinsic linkage with forest carbon levels. Funding and support for international forest policies, including REDD+, FLEGT, and addressing embodied deforestation, will be key to supporting global mitigation goals. In all cases, climate and co-benefits alike will only be realised by ensuring sufficient funding, resources, and efforts for implementation and management activities.

Non-coordinated policy timelines are a major challenge in integrating climate provisions into LULUCF and agriculture policies. These relate to discrepancies between the schedules for reviews of policies such as the CAP or Biodiversity Strategy with those for the review of INDCs and the global stocktaking process. There is little that can be done to overcome these mismatches, beyond conducting reviews in the context of an expected increase in overall ambition and a necessary corresponding increase in ambition in individual policies. Overall, measures for the protection and promotion of land carbon pools should be prioritised, and synergies with other EU policies should be explored and developed.

References

Abad Viñas, R., Viorel Blujdea, Sandro Federici, Roland Hiederer, Roberto Pilli, Giacomo Grassi. 2014. LULUCF MRV. Analysis and proposals for enhancing Monitoring, Reporting and Verification of greenhouse gases from Land Use, Land Use Change and Forestry in the EU. JRC91414. JRC, Ispra, Italy.

Böttcher, H., Verkerk, P.J., Gusti, M., HavlÍk, P., Grassi, G., 2012. Projection of the future EU forest CO_2 sink as affected by recent bioenergy policies using two advanced forest management models. GCB Bioenergy 4, 773-783.EC. 2014. EU energy, transport and GHG emissions, trends to 2050 - Reference scenario 2013. http://ec.europa.eu/transport/media/publications/doc/trends-to-2050-update-2013.pdf

Creutzig, F., Ravindranath, N.H., Berndes, G., Bolwig, S., Bright, R., Cherubini, F., Chum, H., Corbera, E., Delucchi, M., Faaij, A., Fargione, J., Haberl, H., Heath, G., Lucon, O., Plevin, R., Popp, A., Robledo-Abad, C., Rose, S., Smith, P., Stromman, A., Suh, S., Masera, O., 2015. Bioenergy and climate change mitigation: an assessment. GCB Bioenergy 7, 916-944.

Den Elzen, M. et al. 2015. Enhanced policy scenarios for major emitting countries, The Hague, PBL Netherlands Environmental Assessment Agency.

Ellison, D., H. Petersson, M. Lundblad and P.-E. Wikberg. (2012). The incentive gap: LULUCF and the Kyoto mechanism before and after Durban. GCB Bioenergy, 5: 599–622.

Frank, S., Schmid, E., Havlík, P., Schneider, U.A., Böttcher, H., Balkovič, J., Obersteiner, M., 2015. The dynamic soil organic carbon mitigation potential of European cropland. Global Environmental Change 35, 269-278.

Frelih-Larsen, A., Leipprand, A., Naumann, A. and Beucher, O. (2008) *Climate change mitigation through agricultural techniques - Policy recommendations*. PICCMAT Deliverable D11.

Gallaun, H., Zanchi, G., Nabuurs, G.J., Hengeveld, G., Schardt, M. and Verkerk, P.J. 2010. EU-wide maps of growing stock and above-ground biomass in forests based on remote sensing and field measurements. Forest Ecology and Management, 260: 252–261.

Grassi, G. & Dentener, F. (2015): *Quantifying the contribution of the Land Use sector to the Paris Climate agreement: The LULUCF sector within the Intended Nationally Determined Contributions. JRC Science for Policy Report*. EC Joint Research Centre, Institute for Environment and Sustainability, November 2015.

Graudal et al. 2015. The contribution of Danish forestry to increase wood production and offset climate change 2010-2100. IEA Bioenergy Task 43 TR2016:01. 24 p.

Henderson, B.B., Gerber, P.J., Hilinski, T.E., Falcucci, A., Ojima, D.S., Salvatore, M., Conant, R.T., 2015. Greenhouse gas mitigation potential of the world's grazing lands: Modeling soil carbon and nitrogen fluxes of mitigation practices. Agriculture, Ecosystems & Environment 207, 91-100.

Herrero, M., Henderson, B., Havlik, P., Thornton, P.K., Conant, R.T., Smith, P., Wirsenius, S., Hristov, A.N., Gerber, P., Gill, M., Butterbach-Bahl, K., Valin, H., Garnett, T., Stehfest, E., 2016. Greenhouse gas mitigation potentials in the livestock sector, in press. 10.1038/NCLIMATE2925

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.

IPCC 2010: Revisiting the Use of Managed Land as a Proxy for Estimating National Anthropogenic Emissions and Removals, eds: Eggleston H.S., Srivastava N., Tanabe K., Baasansuren J. Meeting Report, 5 -7 May, 2009, INPE, São José dos Campos, Brazil, Pub. IGES, Japan 2010

IPCC 2014a: 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.

IPCC 2014b: 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.

Jandl, R., Rodeghiero, M., Martinez, C., Cotrufo, M.F., Bampa, F., van Wesemael, B., Harrison, R.B., Guerrini, I.A., Richter Jr, D.d., Rustad, L., Lorenz, K., Chabbi, A., Miglietta, F., 2014. Current status, uncertainty and future needs in soil organic carbon monitoring. Science of the Total Environment 468–469, 376-383.

Kallio, A.M.I., O. Salminen, R. Sievänen. 2013. Sequester or substitute - Consequences of increased production of wood based energy on the carbon balance in Finland. Journal of Forest Economics, 19: 402–415.

Keenleyside, C. and Tucker, G.M. 2010. Farmland Abandonment in the EU: an Assessment of Trends and Prospects. Report prepared for WWF. Institute for European Environmental Policy, London. 97 p.

Lundmark T., Bergh J., Hofer P., Lundström A., Nordin A., Poudel B.C., Sathre R., Taverna R., Werner F. 2014: Potential Roles of Swedish Forestry in the Context of Climate Change Mitigation. Forests 2014, 5, 557-578.

Miranada, A.I., M. Coutinho, and C Borrego. 1994. Forest fire emissions in Portugal – a contribution to climate change? Environmental Pollution, 83: 121-123.

Nabuurs, G.-J., P. Delacote, D. Ellison, M. Hanewinkel,M. Lindner, M. Nesbit, M. Ollikainen and A. Savaresi. 2015. A new role for forests and the forest sector in the EU post-2020 climate targets. From Science to Policy 2. European Forest Institute.

Nabuurs G-J, Lindner M, Verkerk PJ, Gunia K, Deda P, Michalak R, et al. 2013. First signs of carbon sink saturation in European forest biomass. Nature Climate Change, 3: 792–6.

Nesbit M, Paquel K, Illés A, Maréchal A, Allen B 2015: Designing a LULUCF pillar that works for forests and climate. Report and recommendations, Institute for European Environmental Policy, London.

Ortiz C.A., Liski J., Gärdenäs A.I., Lehtonen A. Lundblad M., Stendahl J. Ågren G.I., Karltun E. 2013: Soil organic carbon stock changes in Swedish forest soils – A comparison of uncertainties and their sources through a national inventory and two simulation models. Ecological Modelling 251 (2013), 221– 231.

Rantakari M., Lehtonen A., Linkosalo T., Tuomi M., Tamminen P., Heikkinen J., Liski J., Mäkipää R., Ilvesniemi H., Sievänen R. 2012: The Yasso07 soil carbon model – Testing against repeated soil carbon inventory. Forest Ecology and Management 286 (2012) 137–147.

Rüter S., Rock J., Köthke M., Dieter M. 2011: Wie viel Holznutzung ist gut fürs Klima? AFZ 15/2011, 19-21.

Panagos, P., Ballabio, C., Yigini, Y., Dunbar, M.B., 2013. Estimating the soil organic carbon content for European NUTS2 regions based on LUCAS data collection. Science of The Total Environment 442, 235-246.

PBL. 2015. Assessing Intended Nationally Determined Contributions to the Paris Climate Agreement – what are the projected global and national emission levels for 2025-2030? PBL Netherlands Environmental Assessment Agency.

Pilli, R., Fiorese, G., Grassi, G., 2015. EU mitigation potential of harvested wood products. Carbon Balance and Management 10, 1-16.

Powlson, D.S., Stirling, C.M., Jat, M.L., Gerard, B.G., Palm, C.A., Sanchez, P.A., Cassman, K.G., 2014. Limited potential of no-till agriculture for climate change mitigation. Nature Climate Change, 4: 678-683.

Read, D.J. et al. 2009. Combating climate change – a role for UK forests. An assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change. The Stationary Office, Edinburgh. 222 p.

Rogelj, Joeri., Luderer, Gunnar., Pietzcker, Robert C., Kriegler, Elmar., Schaeffer, Michiet., Krey, Volker., & Riahi, Keywan (2015): *Energy system transformations for limiting end-of-century warming below 1.5 degree Celsius*. Nature climate change. Published online: 21 May 2015, DOI:10.1038/NCLIMATE2572.

Schils, R., P. Kuikman, J. Liski, M. van Oijen, P. Smith, J. Webb, J. Alm, Z. Somogyi, J. van den Akker, M. Billett, B. Emmett, C. Evans, M. Lindner, T. Palosuo, P. Bellamy, R. Jandl and R. Hiederer. 2008. Review of existing information on the interrelations between soil and climate change. Final Report for EU DG-ENV. http://ec.europa.eu/environment/soil/pdf/climsoil_report_dec_2008.pdf

Taverna R., Hofer P., Werner F., Kaufmann E., Thürig E. 2007: CO_2-Effekte der Schweizer Wald- und Holzwirtschaft. Szenarien zukünftiger Beiträge zum Klimaschutz. Umwelt-Wissen Nr. 0739. Bundesamt für Umwelt, Bern. 102 S.

Tomppo et al. 2010. National forest Inventories, Pathways for Common reporting.

Tóth, G., Jones, A. and Montanarella, L. (eds). 2013. LUCAS topsoil survey - methodology, data and results. JRC, Ispra, Italy.

UNEP (2015): *The Emission Gap Report 2015*. UNEP Synthesis Report. United Nations Environment Programme (UNEP), Nairobi. http://uneplive.unep.org/media/docs/theme/13/EGR_2015_301115_lores.pdf

UNFCCC (2015): *Adoption of the Paris Agreement.* http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

Weiss P., Braschel N., Braun M., Büchsenmeister R., Freudenschuss A., Fritz D., Gschwantner T., Jandl R., Ledermann T., Neumann M., Pölz W., Schadauer K., Schmid C., Schwarzbauer P., Stern T. 2015: Treibhausgasbilanz der österreichischen Holzkette: Zusammenfassung der Ergebnisse aus drei KLIEN-Projekten. BFW Praxisinformation Nr. 38, 2105, 16-19, http://www.bfw.ac.at/webshop/index.php?id_product=315&controller=product

Annex 1 Table on land references in agreement and decision

Draft decision -/CP.21				
Article	Para	Target (INDCs; NDCs; stocktake; update of ambition)	Reporting and Accounting	Interpretation/Comment
Preamble				
I. Adoption of the agreement	2-4	2. *Requests* the Secretary-General of the United Nations to be the Depositary of the Agreement and to have it open for signature in New York, United States of America, from 22 April 2016 to 21 April 2017; 3. *Invites* the Secretary-General to convene a high-level signature ceremony for the Agreement on 22 April 2016; 4. *Also invites* all Parties to the Convention to sign the Agreement at the ceremony to be convened by the Secretary-General, or at their earliest opportunity, and to deposit their respective instruments		Indication that parties should ratify by April 2017, but para 4 leaves it open whether parties will delay this ("or at their earliest opportunity"). Lack of ratification will leave significant uncertainty in the system as concerns e.g. approaches to accounting in LULUCG and to the extent and in what way these sectors will be included in a NDC (if at all), see link to para 22. In the PA itself (para 1), the formulation is open for signature by the same dates, but open for accession hereafter. Unclear what the distinction is between signature and accession in practical terms, however the wording in the PA strongly supports signature in the abovementioned time window.
	7	*Decides* to establish the Ad Hoc Working Group on the Paris Agreement under the same arrangement, mutatis mutandis, as those concerning the election of officers to the Bureau of the Ad Hoc Working Group on the Durban Platform for Enhanced Action;		
II. Intended	17	*Notes* with concern that the estimated aggregate		More action is needed before 2030. The para recognizes and

Nationally Determined Contributions		greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2 °C scenarios but rather lead to a projected level of 55 gigatonnes in 2030, and also notes that much greater emission reduction efforts will be required than those associated with the intended nationally determined contributions in order to hold the increase in the global average temperature to below 2 °C above pre-industrial levels by reducing emissions to 40 gigatonnes or to 1.5 °C above pre-industrial levels by reducing to a level to be identified in the special report referred to in paragraph 21 below;		establishes a pressure to increase action (ambition), which will only build up towards the 2023 global stocktake and possibly already by the 2018 facilitative dialogue on progress (see para 20)
	20	*Decides* to convene a facilitative dialogue among Parties in 2018 to take stock of the collective efforts of Parties in relation to progress towards the long-term goal referred to in Article 4, paragraph 1, of the Agreement and to inform the preparation of nationally determined contributions pursuant to Article 4, paragraph 8, of the Agreement		Mandate of dialogue is supposedly weak, but not entirely clear. Could play a role in increasing ambition post-2020
III. Decisions to give effect to the Agreement				
Mitigation	22	*Invites* Parties to communicate their first nationally determined contribution no later than when the Party submits its respective instrument of ratification, accession, or approval of the Paris Agreement. If a Party has communicated an intended nationally determined contribution prior to joining the Agreement, that Party shall be considered to have satisfied this provision unless that Party decides otherwise;		Parties are *invited* to communicate NDC no later than when ratifying, i.e. room for delay. It is noteworthy If an INDC has been communicated, this invitation does not apply.

	23-24	23. *Urges* those Parties whose intended nationally determined contribution pursuant to decision 1/CP.20 contains a time frame up to 2025 to communicate by 2020 a new nationally determined contribution and to do so every five years thereafter pursuant to Article 4, paragraph 9, of the Agreement; 24. *Requests* those Parties whose intended nationally determined contribution pursuant to decision 1/CP.20 contains a time frame up to 2030 to communicate or update by 2020 these contributions and to do so every five years thereafter pursuant to Article 4, paragraph 9, of the Agreement;		Notwithstanding the commitment period chosen, all NDC's are to be updated by 2020 and every five years thereafter.
	25	25. *Decides* that Parties shall submit to the secretariat their nationally determined contributions referred to in Article 4 of the Agreement at least 9 to 12 months in advance of the relevant meeting of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement with a view to facilitating the clarity, transparency and understanding of these contributions, including through a synthesis report prepared by the secretariat;		Any update on NDC shall be submitted by February-March of year X+5, since last update, given that relevant Conference of the Parties serving as meeting of the parties to the Paris Agreement takes places in November-December of the same year. I.e. the 2020 update should be submitted in February-March of that same year.
	27		*Agrees* that the information to be provided by Parties communicating their nationally determined contributions, in order to facilitate clarity, transparency and understanding, may include, as appropriate, inter alia, quantifiable information on the reference point (including, as appropriate, a base year), time frames and/or periods for implementation, scope and coverage, planning processes, assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions **and, as appropriate, removals,** and how the	Overall message is that this para establishes obligation to provide information on accounting. Notably, inclusion of both base year and removals is voluntary. While both these exceptions mostly refer Developing parties, and both are further explained in later articles and paras, it does leave some room for manoeuvre also for developed parties. (underlining and **bold** by authors)

			Party considers that its nationally determined contribution is fair and ambitious, in the light of its national circumstances, and how it contributes towards achieving the objective of the Convention as set out in its Article 2;	
	28		*Requests* the Ad Hoc Working Group on the Paris Agreement to develop further guidance for the information to be provided by Parties in order to facilitate clarity, transparency and understanding of nationally determined contributions for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;	Content of NDCs still to be developed
	31		*Requests* the Ad Hoc Working Group on the Paris Agreement to elaborate, drawing from approaches established under the Convention and its related legal instruments as appropriate, guidance for accounting for Parties' nationally determined contributions, as referred to in Article 4, paragraph 13, of the Agreement, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, which ensures that: (a) Parties account for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the Intergovernmental Panel on Climate Change and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement; (b) Parties ensure methodological consistency, including on baselines, between the communication and implementation of nationally determined contributions; (c) Parties strive to include all categories of anthropogenic emissions or removals in their nationally determined contributions and,	Sets the stage for post 2020 accounting. The work of the AWG-PA can build on KP methodologies, but it is not decided that it shall. Thus there are some room for alternate approaches. Bullet a) however indicates that parties as a starting point account for both emissions and removals. Bullet c), first part, ease the obligation a bit, but this mainly concerns developing nations. It is noteworthy that this guidance is not required before the first session of the CP/PA, which is at earliest the year after entry into force, which can be anything from 2017 to 2021. Thus, there could be quite some uncertainty on accounting rules at the onset of the 2020-2030 period, but even more so at the 2018 facilitative dialogue.

			once a source, sink or activity is included, continue to include it; (d) Parties shall provide an explanation of why any categories of anthropogenic emissions or removals are excluded;	
	32		*Decides* that Parties shall apply the guidance mentioned in paragraph 31 above to the second and subsequent nationally determined contributions and that Parties may elect to apply such guidance to their first nationally determined contribution;	The above rules only apply as of the second NDC, which raises the interpretive question of when the INDC becomes a NDC: For the case of EU, the INDC submitted in 2015 becomes an NDC once the PA is ratified (according to para 22). As this concerns the period 2020-2030, the second NDC could be the one submitted for the period 2030-2040, as the five year NDC cycle referred to in para 24 could include an *update* only. Indeed, it is essential to clarify how NDCs relate to periods, and whether an updated NDC constitutes a second/new NDC in the understanding of para 32. An alternative interpretation of para 32 could be that parties (such as EU), from 2025 onwards shall apply these rules. If so, an updated NDC submitted in Q1 of 2025 will be considered the second NDC.
	36	*Invites* Parties to communicate, by 2020, to the secretariat mid-century, long-term low greenhouse gas emission development strategies in accordance with Article 4, paragraph 19, of the Agreement, and requests the secretariat to publish on the UNFCCC website Parties' low greenhouse gas emission development strategies as communicated;		Against the backdrop of the facilitative dialogue in 2018 and even more so the 2023 global stocktake, the establishment of a mid-century plan highlights the need to think in long terms and to consider the maximum 2°C increase more explicitly in NDCs. Although no review or commitments are linked to this plan, and it is not *request* or *shall*, it is expected that these plans will create more burning platform for increase in ambition in the 2020/2025 submissions and updates.
	37		*Requests* the Subsidiary Body for Scientific and Technological Advice to develop and recommend the guidance referred to under Article 6, paragraph 2, of the Agreement for adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, including guidance	To the extent that land based, cooperative mitigation outcomes will be allowed to count towards contributions included in NDC's, the rules developed by SBSTA becomes relevant in light of TACCC principles. Linkages between this work, and the work of AWG-PA under para 31, is thus pertinent.

			to ensure that double counting is avoided on the basis of a corresponding adjustment by Parties for both anthropogenic emissions by sources and removals by sinks covered by their nationally determined contributions under the Agreement;	
	38-39		*Recommends* that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement adopt rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Agreement on the basis of: (a) Voluntary participation authorized by each Party involved; (b) Real, measurable, and long-term **benefits** related to the mitigation of climate change; (c) Specific scopes of activities; (d) Reductions in emissions that are additional to any that would otherwise occur; (e) Verification and certification of **emission reductions** resulting from mitigation activities by designated operational entities; (f) Experience gained with and lessons learned from existing mechanisms and approaches adopted under the Convention and its related legal instruments; 39. *Requests* the Subsidiary Body for Scientific and Technological Advice to develop and recommend rules, modalities and procedures for the mechanism referred to in	Of minor importance for this work, but possibly relevant in a broader context, it is noteworthy that rules, modalities and procedures so far only concerns benefits and not least emission reductions. Removals, sinks or reservoirs are not mentioned.

			paragraph 38 above for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;	
Adaptation	42		*Request*s the Adaptation Committee and the Least Developed Countries Expert Group to jointly develop modalities to recognize the adaptation efforts of developing country Parties, as referred to in Article 7, paragraph 3, of the Agreement, and make recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;	Could be interpreted as a first step towards a system for accounting for adaptation efforts. Any EU approach under the EU adaptation strategy, and in CAP Pillar two funding of measures and actions, could be worthwhile as potential input to this process.
Loss and damage				
Finance	55	Recognizes the importance of adequate and predictable financial resources, including for results-based payments, as appropriate, for the implementation of policy approaches and positive incentives for reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks; as well as alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests; while reaffirming the importance of non-carbon benefits associated with such		Not directly relevant for this study, however result based payments, increasing ambition (para 17) and accounting principles of para 41 and the associated rules, modalities and procedures, in combination point towards a quantifiable role of forests towards 2030. While REDD+ is explicitly mentioned, the link to developed country parties approach to forests is quite interesting.

		approaches; encouraging the coordination of support from, inter alia, public and private, bilateral and multilateral sources, such as the Green Climate Fund, and alternative sources in accordance with relevant decisions by the Conference of the Parties;		
Tech development and transfer				
Capacity building				
Transparency of action and support	85-86		*Decides* to establish a Capacity-building Initiative for Transparency in order to build Institutional and technical capacity, both pre- and post-2020. This initiative will support developing country Parties, upon request, in meeting enhanced transparency requirements as defined in Article 13 of the Agreement in a timely manner; *Also decides* that the Capacity-building Initiative for Transparency will aim: (a) To strengthen national institutions for transparency-related activities in line with national priorities; (b) To provide relevant tools, training and assistance for meeting the provisions stipulated in Article 13 of the Agreement;	Note taken. EU could extend its support to capacity building in view of accounting.

			(c) To assist in the improvement of transparency over time;	
	92 + 97-98		92. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop recommendations for modalities, procedures and guidelines [read MPG, *ed.*] in accordance with Article 13, paragraph 13, of the Agreement, and to define the year of their first and subsequent review and update, as appropriate, at regular intervals, for consideration by the Conference of the Parties, at its twenty-fourth session, with a view to forwarding them to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for adoption at its first session; 97. *Further requests* the Ad Hoc Working Group on the Paris Agreement to report on the progress of work on the modalities, procedures and guidelines referred to in paragraph 92 above to future sessions of the Conference of the Parties, and that this work be concluded no later than 2018; 98. *Decides* that the modalities, procedures and guidelines developed under paragraph 92 above, shall be applied upon the entry into force of the Paris Agreement;	A process for new MPGs is established, and work should be reported by 2018 (COP24). That leaves 3 years to develop these MPGs. Should be adopted at first CPA sessions, the date of which is to be decided. It is noteworthy, that this particular AWG-KP request concerns reporting and not accounting (dealt with under *mitigation*) As this work is undertaken at the level of the AWG-PA and should build on the existing Convention system for transparency (Para 94, and PA, art 13(13)), there is room for changing the substance of the existing *reporting* setup, developed around the NIRs. If minor/technical changes were to be envisioned, then a SBSTA work process would have been sufficient. Given this setup, uncertainty is introduced into the process. As concerns the work programme and entry in to force, these rules shall be considered at future COPs, be concluded before 2019 and enter into force with the agreement. As this enters into force when the conditions in PA article 21(1) is fulfilled, the MPGs shall be applied upon at any time after 22 may 2016, depending on the speed of the ratification process. If so, any 2020 NDC update must rely on these rules. It is noted, that if this work is postponed/delayed only one year (COP25, 2019), it will be difficult for parties to apply rules to February/march 2020 updates (see para 23-25).
	93		*Also requests* the Ad Hoc Working Group on the Paris Agreement in developing the recommendations for the modalities, procedures and guidelines referred to in paragraph 92 above to **take into account, inter alia**: (a) The importance of facilitating improved reporting and	These are the principles that should guide the new reporting setup. Relative to the list in para 95, the list in this para is the most important. As such, the principles allow for no backsliding, but the interpretation of environmental integrity is very much open.

			transparency over time; (b) The need to provide flexibility to those developing country Parties that need it in the light of their capacities; (c) The need to promote transparency, accuracy, completeness, consistency, and comparability; (d) The need to avoid duplication as well as undue burden on Parties and the secretariat; (e) The need to ensure that Parties maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention; (f) The need to ensure that double counting is avoided; (g) The need to ensure environmental integrity;	
	94+99		94. *Further requests* the Ad Hoc Working Group on the Paris Agreement, when developing the modalities, procedures and guidelines referred to in paragraph 92 above, to draw on the experiences from and take into account other on-going relevant processes under the Convention; 99. *Also decides* that the modalities, procedures and guidelines of this transparency framework shall build upon and eventually supersede the measurement, reporting and	The new reporting setup should build on the convention setup (see also article 13, para 4 of the agreement), but the relative lower importance than any of the principles listed in para 93 is in itself noteworthy. Reading by the letter, this could mean that quite some room for modification of the existing system is foreseen. In particular as the phrasing in the agreement (art 13(13)), is "building on experiences from the arrangements related to transparency under the convention". This is very open, and by no means an obligation to include one or more parts as they are applied currently. On the other hand, para 99 points to specific Cancun (COP18) and Durban (COP19) decisions which the new system should "build on", and eventually replace. This means that some degree on continuation can be expected, but mainly concerning

			verification system established by decision 1/CP.16, paragraphs 40 to 47 and 60 to 64, and decision 2/CP.17, paragraphs 12 to 62, immediately following the submission of the final biennial reports and biennial update reports;	XXXX The new rules shall apply after the submission of the final biennial update reports, meaning in 2020 (full report in 2014 and again in 2018, meaning updates in 2016 and 2020, see 2/CP.17, para 13). In practice this means parties is not obliged to apply the new rules in their 2020 biennial update report. It is not clear if biennial reports are to continue under the PA.
	95		*Requests* the Ad Hoc Working Group on the Paris Agreement, when developing modalities, procedures and guidelines referred to in paragraph 92 above, **to consider, inter** **alia**: (a) The types of flexibility available to those developing countries that need it on the basis of their capacities; (b) The consistency between the methodology communicated in the nationally determined contribution and the methodology for reporting on progress made towards achieving individual Parties' respective nationally determined contribution; (c) That Parties report information on adaptation action and planning including, if appropriate, their national adaptation plans, with a view to collectively exchanging information and sharing lessons learned; (d) Support provided, enhancing delivery of support for both adaptation and mitigation through, inter alia, the common tabular formats for	In comparison with para 93, the AWG-PA should only "consider" these points. Relative to para 93 points, these can be considered less important. That said, the new MPG's should allow for a flexible approach for developing countries, but equally important and introducing uncertainty on the future setup, is bullet b). This bullet could be understood as an bottom up approach to accounting, as the methodologies applied by parties in their NDC's should inform the future MPG's. If this means the methodologies applied in the INDCs should be allowed to continue to be used, then resulting MPG must be made very general and comparison between parties becomes difficult (just as TACCC could be challenged). A less critical interpretation could be that the MPGs must ensure (and facilitate) that parties provide consistent information in their NDC and in the reporting on progress towards the contribution. Notwithstanding the above, the "methodology for reporting on progress…" is included as a requirement for all parties (PA, article 13 (7), litra B), but is at best known by end 2018 (see para 97).

			reporting support, and taking into account issues considered by the Subsidiary Body for Scientific and Technological Advice on methodologies for reporting on financial information, and enhancing the reporting by developing countries on support received, including the use, impact and estimated results thereof; (e) Information in the biennial assessments and other reports of the Standing Committee on Finance and other relevant bodies under the Convention; (f) Information on the social and economic impact of response measures;	
Global Stocktake	102		102. *Further requests* the Ad Hoc Working Group on the Paris Agreement to develop modalities for the global stocktake referred to in Article 14 of the Agreement and to report to the Conference of the Parties, with a view to making a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session;	In developing the modalities, it is essential what mandate the global stocktake will be given, i.e. how the COP as a result of the GS can request or oblige parties to increase ambition, if at all. The EU – and other parties – should follow this work closely; however, it seems unlikely that strong mandates will be given to the COP.
Facilitating Implementation and compliance				
Procedural and				

Inst. provisions				

Annex 2 Experiences gained from the existing reporting and accounting system as a basis for future accounting

As elaborated in Chapter 2 and the Task 1 Report (ICF 2016) the PA agreement suggests to include experiences from the past when drafting a reporting and accounting system for the PA. Below, a rough overview of some experiences from the KP reporting periods are listed which might be considered when developing an accounting system for LULUCF under the PA. It should be noted that none of these elements are directly addressed in the PA – as indicated in Chapter 2 and the Task 1 Report (ICF 2016) there is large freedom for the parties in developing their accounting system.

Uncertainty of LULUCF emissions/removals

LULUCF emissions and removals are very uncertain, and since LULUCF's contribution to the overall GHG balance is significant, so is its share of uncertainty. Relative uncertainty is (depending on the C pool and subcategory) two to three orders of magnitude higher than for total emissions of the other sectors. Highly uncertain pools like soils are not fully included in these uncertainty figures, because they are not estimated by many countries; as a consequence, the real uncertainty is significantly higher than those for the LULUCF GHG balances suggested by many parties. LULUCF uncertainty cannot necessarily be circumvented by using higher Tier methods, because it is inherent in the nature of some pools as well as the limited possibilities of assessing their C stock changes. The application of three independent Tier 3 methods in Sweden and Finland (two models and a country-wide soil monitoring project) did not provide clear results for the short-term soil C stock changes (Rantakari et al. 2012, Ortiz et al. 2013). Outputs of all three methods included both emissions and removals across time, but country-wide soil C stock changes cannot be measured in the short term due to the destructive nature of soil sampling (preventing re-assessment of the same soil cores) and to the high variability of the C stocks per site. A distinct and accurate result for soil needs a few decades of time between the re-assessments, as well as an extremely high number of samples. Soil models can only partly solve this problem, because they are usually developed and validated on the basis of results from experimental monitoring plots. A conclusive validation of model results would require soil inventories to be re-assessed.

As a result, an achievement of reduction targets would be highly uncertain when the totals of LULUCF net removals are accounted without any cap.

Reversibility of LULUCF C-stocks and high exogenous influences

Natural disasters in the past, for example forest dieback due to bark beetle infestations in Canada or widespread forest fires in Russia clearly provide evidence for the sudden possibility of significant emissions from C stocks that endanger LULUCF contributions to reduction targets. Previously accounted removals, and related C stocks, may be lost within a short period of time.

LULUCF emissions/removals trends show a high annual variability which depends also on further external factors that are barely or not at all controllable by the land management (e.g. weather conditions).

Non-permanence of LULUCF removals

Projections and assessments display the limited nature of LULUCF removals due to saturation effects. Annual net-removals due to forest management measures cannot be sustained forever, and for some pools (e.g. soil) it is extremely difficult to assess when these saturation effects will be reached. Integrating of possible or expected LULUCF

emissions/removals into the design of long-term trends and targets causes a high degree of uncertainty in terms of actually achieving the targets. Possible climate change impacts on LULUCF emissions/removals which are not yet fully understood may further complicate the prediction of achievable future removals.

Inequity of current accounting systems under KP

There are system-inherent inequities in the KP approaches which are likely causes for its low acceptance.

Some examples are listed here:

- Single activities under the KP are rewarded differently due to the use of various accounting systems for these activities. A single ton of net CO_2 sink (i.e. real atmospheric removals) due to afforestation activities is given a higher accounting weight than a single ton of net CO_2 sink due to forest management measures, provided the FMRL projected removals). There are no fundamental natural law or management features which would justify such a different treatment of the activities: the atmosphere sees one ton CO_2 net sink in both cases. Afforestation measures are not more demanding or expensive than forest management measures.
- The KP concept allows rather problematic inequities between countries with respect to the potentials of accounting LULUCF. A simple example may illustrate this: Imagine countries A1 and A2. Both countries are completely equal except that country A1 historically sustained forests over half of its land area while country A2 has only a share of 10 % forests. The C stock of the forests of country A1 represents e.g. five decades of total annual emissions of the country (this magnitude is not an unusual real-world situation). Obviously, afforestation measures of country A2 to increase its carbon stocks to the levels of country A1 would fully offset the amount of several decades (e.g. from 1970 to the present) of its economic development and the associated total annual GHG emissions (using the KP approach of gross accounting of afforestation without cap). At the same time, country A1 may struggle to exceed its FMRL levels in order to allow any accounting of removals which even then would be subject to a cap. This may be very relevant in the long-term, especially as the PA has long-term targets.
- A further inequity is also evident. The FMRL has also the nature of a target which should be exceeded due to improved forest management measures, such a target does not exist for afforestation. Consequently, country A2, with a significantly higher potential to sequester carbon in its landscape in the future than A1, is free to choose whether it wishes to afforest or not. On the contrary, the FMRL will impact a much higher proportion of land in country A1, as 50% of its land is forested vs. 10% in country A2). If country A1 does not implement activities in these lands to exceed the FMRL it will be forced to account for emissions from forest management.
- Under the KP, net removals due to forest management can be only accounted for up to a cap, defined as 3.5 % of the base year emissions of the country. Under these conditions, countries B1 and B2 may have equal net removals from forest management, which are in both cases significantly exceeding the forest management cap, but are otherwise completely equal except that country B1 had higher per-capita GHG emissions than country B2 in the base year. Consequently, B1 had higher total GHG emissions in the base year, which allows it a higher cap on LULUCF removals, even though its overall environmental situation is worse.

MRV for LULUCF reporting and accounting

Substantial improvements in LULUCF reporting have been achieved in recent years, as well as for categories of activities which are not subject to accounting requirements. The following

are the likely reasons for this trend: 1) The requirement for relatively complete estimates for all LULUCF categories and pools under UNFCCC reporting requirements, as evidence for the KP need for a functioning national system for GHG inventory reporting, 2) the consequent review process by UNFCCC bodies, which encouraged Parties' progress, and 3) increased attention and progress in science, monitoring and administration due to these requirements.

Nevertheless, MRV for LULUCF remains challenging for the following reasons: 1) The complex nature of monitoring and estimating emissions and removals in LULUCF (e.g. the need for adequate activity data and emissions factors for soil carbon stock changes); 2) the high costs for surveys in LULUCF (e.g. for forest and soil inventories) and 3) limited financial, human and institutional resources in some countries. As a consequence, for much LULUCF input data, accurate and updated figures are only available some years after the reporting year, for multiple rather than single years, and frequently only on the basis of irregular cycles of several years. As a result, changes in reported LULUCF accounts are not necessarily the result of actual changes in emissions and removals, but rather of the above listed circumstances. A further observation could be made in the GHG inventory submissions: Significant revisions of annual LULUCF emissions and removals due to the introduction of improved methods, the results of new surveys or the introduction of estimates for a previously non-estimated pool are frequent (complete reporting is required, but Tier 1 methods allow the assumption of non-C-stock-changes in some pools).

The implementation of higher tier GHG estimation methods for LULUCF in order to achieve more complete GHG inventories does not necessarily lead to a reduction of the reported uncertainty of the LULUCF emissions and removals, because the previous non-estimation of the pool under Tier 1 methods is not considered in the uncertainty analysis for LULUCF.

In other words, there is a significant steady variation inherent to LULUCF in reported LULUCF emissions and removals for a single time period. Annual reporting of LULUCF emissions and removals does not necessarily lead to more accurate results for the respective years addressed. Thus, the value of yearly reporting and accounting for LULUCF and the close-to-reported-year submission of emissions/removals for LULUCF is questionable. Longer observation and time periods between the reported and accounted year and the year of submission may be more appropriate for LULUCF and lead to more robust results.

A further fact can be observed in the current KP procedures: The extra rules for the KP require substantial additional efforts in MRV, not least due to the fact that demands increased significantly between KP periods. It can also be observed that clear definitions, procedures and guidance according to the various KP Decisions for LULUCF reporting seem to be almost impossible. As a consequence, among both parties and reviewers many different understandings exist, even with respect to the same issue, and especially with respect to accounting. This may cause significant complications, and lead to unintended inequities between MS, and consequently, to the opposite of the original intention – stringent rules and guidance to reassure MS of equity and to avoid any abuse of LULUCF removal potentials.

These complications and limitations are probably one of the reasons for the low acceptance of the LULUCF KP regime among the parties, and call into question the usefulness of detailed bottom-up rules for the assessment of the LULUCF emissions/removals. It can be hypothesised that these experiences encouraged the PA to allow space for the establishment of different systems for reporting and accounting as compared to the KP.

Lack of full understanding of the correlation between LULUCF and effects in other sectors

Recently, independent evidence from some countries shows that there are significant effects of wood based products and fuels on the GHG balance (Taverna et al., 2007; Rüter et al.,

2011; Lundmark et al., 2014; Weiss et al., 2015). Namely, the production, use and disposal chain of wood based products and fuels is in most cases connected to lower GHG emissions than that of other materials. This substitution effect is several times higher than the total net removals associated with these wood products in both the forests and harvested wood product pools. These “avoided” emissions are not visible in GHG inventories. Even a system change of product use would not allow an adequate identification of the impact in the national GHG inventories, because several emissions categories (LULUCF, Energy, Industry, etc.) and countries are affected. The location of wood growth is frequently different to the countries of manufacture, use, and disposal of wood products and substitute products. As a consequence, a potential reduction in harvesting, which may lead to an increase in sequestrations in the forests, may even lead to a deterioration of the total GHG balance due to resulting higher emissions in other sectors. A thorough analysis of the relationships between management impacts in LULUCF and their effects on other sectors – and vice versa – is needed to optimize the system towards the most efficient GHG reduction. Countries differ, so results from one country on this issue cannot be generalised.

Annex 3 Projections in LULUCF

Annex 2 indicates why projections for LULUCF (e.g. for FMRL) are difficult and highly uncertain. Projections for the FMRL for the 2nd KP period were carried out by Parties. However, available information at the time of projection did not include the impact of the economic crisis and of current low oil prices, both of which have caused a decrease in the demand for wood and consequently the harvest. This leads to higher C sinks than projected. If the aim of the FMRL is to incentivise land management that fosters higher net removals and the fungibility of GHG removals beyond those of a business-as-usual management only, reality indicates that significant unintended effects (like the substitution of wood by fossil fuels) are also rewarded.

Forest Management in KP-1

During KP-1 the Article 3.4 activity FM was a voluntary activity that was included for accounting by 23 Parties. Because gross-net accounting for forest management can potentially generate in large amounts of credits for a party that are at least partly based on historic forest related activities in the country, the total net removals from FM that could be accounted were restricted. The accounting rules for Forest Management were agreed on in paragraphs 10 and 11 of Article 3.4 in the Annex to 16/CMP.1[30]. Paragraph 10 allows Parties that incur a net source of emissions from Art 3.3 activities (i.e. AR and D) in the first commitment period to compensate these with net removals from FM with a maximum of 45 Mt C. To the potentially remaining net removals from FM a cap was applied that was negotiated individually by each party. This cap is included in an appendix to 16/CMP.1.

As a result, eventually only 2 of the 23 parties were able to include (almost) 100% of their net removals in FM accounting[31]. For the other countries the net removals from FM significantly exceeded the cap (as a median for all Parties, 12% of total FM removals were included in the accounting). Consequently for most countries, the accounting for FM was equal to their cap.

As a result this approach to accounting does not provide an incentive to further increase mitigation actions in FM.

[30] http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf

[31] Calculations based on data from the UNFCCC data interface for compilation of accounting data: http://unfccc.int/di/FlexibleCADQueries/Event.do?event=go

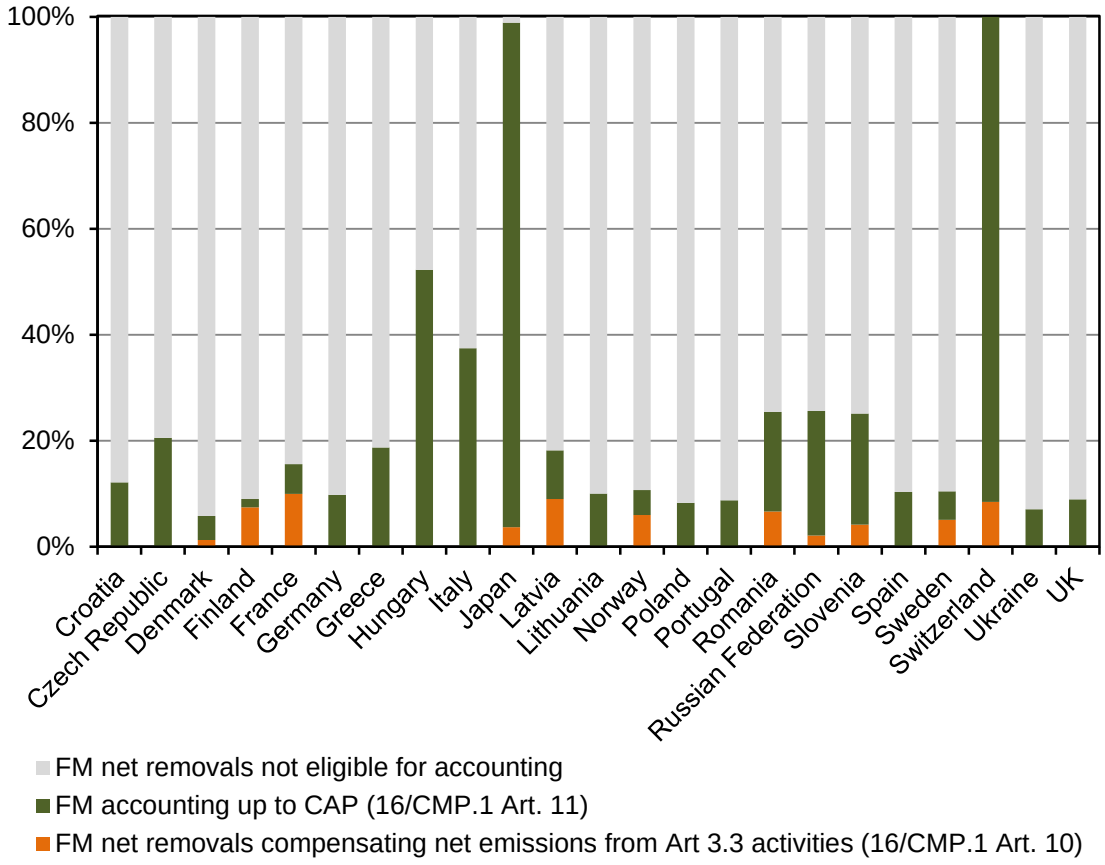

Figure A3.1 For countries that elected Forest Management in KP-1, the percentage of net removals from Forest Management that could be used in accounting, either to cancel out net emissions from Article 3.3 activities (see Article 10 in 16/CMP.1) or as "regular" FM accounting (Article 11 in 16/CMP.1) up to the cap set in the appendix in 16/CMP.1. Based on data on net emissions and removals and accounting data for FM from the UNFCCC data interface[32]. So, 100% indicates all net removals a country realises under FM, which may differ between the countries. If the orange and green bars together reach up to 20% this would imply that up to 20% of the realised removals in FM could be used in accounting.

Forest Management in KP-II

Due to the perceived shortcomings of the gross-net accounting, in the second commitment period of the KP for FM accounting a reference level approach was adopted. This Forest Management Reference Level should provide a quantified level against which actual emissions should be compared.

Based on the synthesis report of the technical assessments of the forest management reference level[33] four approaches can be distinguished in the FMRL projections by EU member states. These were:

[32] http://unfccc.int/di/FlexibleCADQueries/Event.do?event=go

[33] http://unfccc.int/resource/docs/2011/awg16/eng/inf02.pdf

1. Projections of “business-as-usual” based on policy and economic scenarios and models:
    a. Country specific approaches (10 MS)
    b. Common approach developed by the JRC (14 MS)
2. Average removals during the historical time series (1MS)
3. Linear extrapolation of historical emission data (2 MS)

However, a comparison of the historical sink reported by the EU28 Member States for Forest Land remaining Forest Land and the cumulative FMRL for the same countries shows a large gap between these two (Figure A3.2), potentially leading to relatively large amounts of credits (depending on the cap for the different MS). When comparing the historic trend for FL-FL as reported in 2015 with the same trend reported in 2013 (1990-2011), the sink as reported for 2011 in the NIR 2013 seems to have increased by about 15% in the NIR 2015. This is probably partly due to implementation of the 2006 IPCC guidelines, but possibly also availability of new inventory data could have an effect. Nevertheless this indicates an inconsistency between the inventory data and the FMRL for which a technical corrections on the FMRL is needed[34]. Such technical corrections, which will probably also increase the FMRL sink, has not yet taken into consideration in the FMRL data shown here.

In the meantime there is discussion on the reasons for the large gap. It appears that especially by using policy scenarios for FMRL projections, future harvesting has been overestimated for MS that applied this approach. The projections for the KP-2 reference level were mostly made in the course of 2009 and included policies and economic information up to April 2009. This was in a time that the full scope and duration of the economic crisis that started in 2008 was not yet known. It is likely therefore that the projections for wood demand and thus the harvest rates in the FMRL projections were strongly overestimated. This in turn resulted in an underestimation of the net removals in the FMRL.

Another factor, which will also play a role in other approaches in which the future demand for wood harvests is projected on the basis of forest management regulations (i.e. percentage of wood that potentially is allowed to be harvested), is the changing composition and attitude of private forest owners resulting in changing perceptions on forest use and management[35,36]. For these forest owners, decisions about whether to harvest or not are based not only on financial considerations. This would explain at least some of the differences between economic projections of harvests and realised harvests. It also poses another challenge for the projection of future harvests for FMRL purposes.

[34] See IPCC. (2014). *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*. IPCC, Switzerland.

[35] Nordlund, A. and K. Westin. (2011). Forest Values and Forest Management Attitudes among Private Forest Owners in Sweden. *Forests* 2:30.

[36] Ní Dhubháin, Á., R. Cobanova, H. Karppinen, D. Mizaraite, E. Ritter, B. Slee and S. Wall. (2007). The Values and Objectives of Private Forest Owners and Their Influence on Forestry Behaviour: The Implications for Entrepreneurship. *Small-scale Forestry* 6:347-357.

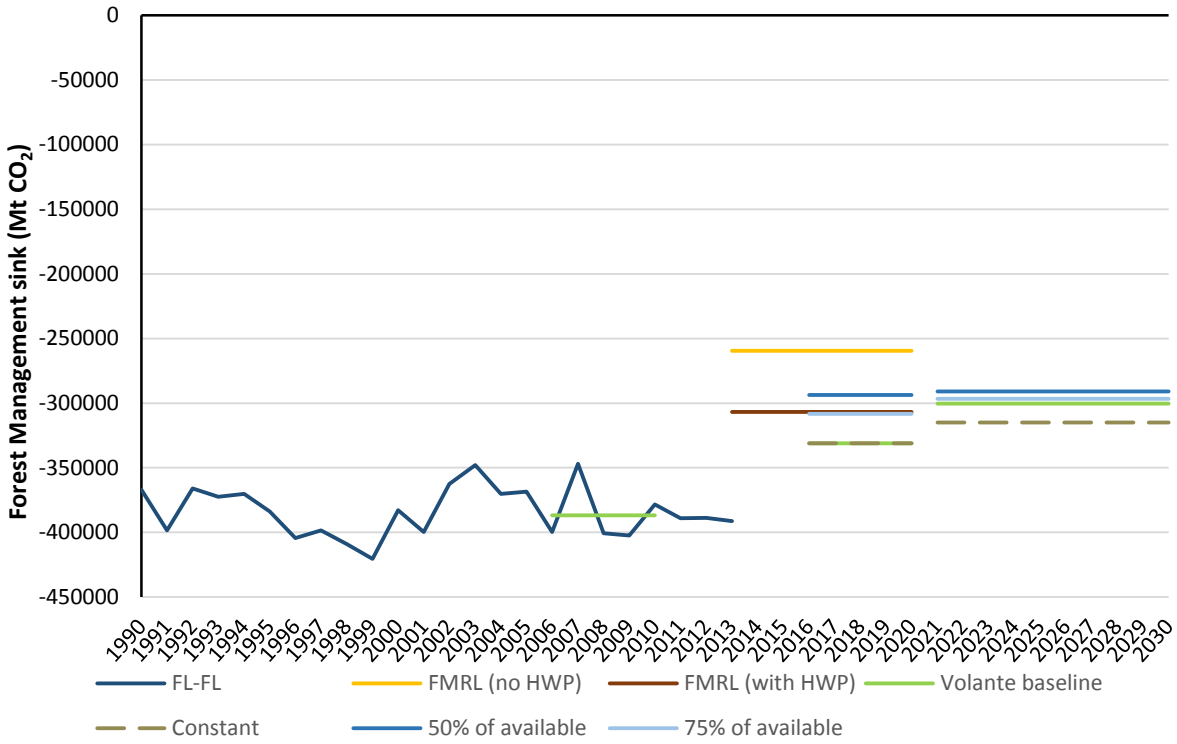

Figure A3.2 Estimated historical and projected forest management sink for the EU28. The historical sink (1990-2013) is based on data for Forest Land remaining Forest Land as reported to the UNFCCC in the NIR 2015[37]. Also the reported KP-2 Forest Management Reference Levels (FMRL; cumulative for the EU28) with and without Harvested Wood Products) are indicated. Additionally projections with the EFISCEN model for four scenarios with different wood demands were provided. For the Volante baseline wood demand from 2010 onwards was derived from a partial equilibrium model (EFI-GTM). For the constant projections, the wood demand from 2016 onwards was kept constant and for the two remaining scenarios the wood harvests were set to 50% or 75% of the wood that is potentially available for harvest (see main text for further explanation).Note that for the period 2016-2020 the volante baseline is not visible separately because it was very similar to the constant scenarios.

To get a feeling for the sensitivity of the FMRL to the assumptions on which future harvests are based, we compared three approaches for establishing an EU wide forest management reference level using the EFISCEN model.

EFISCEN is a large-scale forest scenario model that assesses the availability of wood and projects forest resource development on regional to European scale[38,39,40] (Eggers et al.

[37] Data from the Land Use Sector GHG tool (JRC, 2016)

[38] Eggers, J., M. Lindner, S. Zudin, S. Zaehle and J. Liski. (2008). Impact of changing wood demand, climate and land use on European forest resources and carbon stocks during the 21st century. Global Change Biology, 14: 2288-2303.

[39] Nabuurs, G. J., A. Pussinen, J. v. Brusselen and M. J. Schelhaas. (2007). Future harvesting pressure on European forests. European Journal of Forest Research, 126: 391-400.

2008; Nabuurs et al. 2007). It is an area-based matrix model simulating the development of forest resources in terms of increment, growing stock, area, tree species and age class distribution. The model uses forest inventory data like forest area, volume of growing stocks and annual increment as input. The model works with time steps of five years and is usually used for projections of forest development for periods of 50-60 years. A detailed model description is given by Schelhaas et al. (2007). The EFISCEN model was one of the two forest models that have been applied in the common approach developed by the JRC, which was the basis for the FMRL for 14 MS.

The model was run for four scenarios for 26 of the EU28 member states (excluding Cyprus and Malta):

1. Baseline scenario: Wood demand for each MS is derived at the national level from the EFI-GTM[41] model which is a partial equilibrium model for the forest sector. Macro-economic developments were based on the A2 marker scenario from the Volante project[42]. The resulting trend in demand is calibrated to the wood harvest levels in 2010 from FAO statistics.
2. Demand for wood is kept constant from 2016 onwards (2010-2016 based on the scenario under 1).
3. Harvest will follow the potential for harvesting in a given year. This is a proxy for the approaches for FMRL in which forest management are the drivers for harvest. Over time actual harvests are determined by the age structure of the forest in relation to countries' rules on harvesting. For this we will implement two scenarios.
    a. 50% of the growing stock that is considered harvestable (age and management dependent) in a given year will be harvested
    b. 75% of the growing stock that is considered harvestable in a given year will be harvested.

The scope of this project did not allow for very detailed scenario development and analysis. The scenarios were based on existing recent scenarios runs with the EFISCEN model. Therefore this analysis has the following limitations:

- The model has not been calibrated to fit the historical data. A quick check of the Volante baseline showed that on the EU level the model estimates and the historical data are very similar (See Figure A3.2, Volante baseline average for 2010-2015).
- The economic parameters for the baseline scenarios that partly determine wood demand do differ from the parameters used in the FMRL scenarios.
- Emissions and removals resulting from carbon stock changes in soil were not included.
- The analysis did not consider emissions and removals related to the Harvested Wood Products.

[40] Schelhaas, M. J., E. Cienciala, M. Lindner, G. J. Nabuurs and G. Zianchi. (2007). Selection and quantification of forestry measures targeted at the Kyoto Protocol and the Convention on Biodiversity. Alterra Wageningen UR, Wageningen. http://edepot.wur.nl/38535.

[41] Kallio, A. M. I., A. Moiseyev and B. Solberg. (2004). The global forest sector model EFI-GTM - The model structure. European Forest Research Institute, Joensuu, Finland

[42] http://www.volante-project.eu/images/stories/DELIVERABLES/VOLANTE_D7.1_Description_of_a_coupled_macroeconomic_multi-sector_analysis_at_global_scale_with_first_simulation_results.pdf

Nevertheless the results (Figure A3.2) indicate that at the EU level the differences in the approaches can have important consequences for the FMRL level, especially in the shorter term (up to 2020), but that over longer time periods (up to 2030) the approaches tend to converge. This is probably due to increasing limitations posed by the age class structure of the forest resources on actual harvest potentials. The results also show that scenarios built on policy and economic projections for future wood harvesting do not necessarily project a smaller sink than scenarios based on extrapolations of management practices.

Annex 4 Options for elements of a LULUCF accounting system for the EU under the PA

In this Annex potential options for accounting LULUCF are provided which try to meet the principles as addressed in the PA, Art. 4(13): “In accounting for anthropogenic emissions and removals corresponding to their nationally determined contributions, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, …”. The proposal below goes significantly beyond “promote”. However, none of these following ideas for accounting is mentioned or required by the PA – the PA allows freedom to the parties in establishing their accounting system (see Chapter 2). So, they may serve just as ideas for elements of an accounting system for LULUCF.

In addition, the following principles and steps were considered for the following LULUCF accounting ideas:

1. Avoiding continuing with problematic approaches as described in previous chapters.
2. The attempt to construct a system which allows an equal treatment of the MS and a win-win situation for the MS. Elements of the win/win situation may be the higher allowance of LULUCF net removals compared to the KP periods, more flexibility in their use, but also significant reductions in the demand for MRV for LULUCF accounting.
3. A simple accounting system for the EU: only the GHG inventories under the UNFCCC should form the basis for LULUCF accounting (provided they will be continued and reviewed in a similar manner as now). No further MRV requirements for LULUCF are needed for the MS. A central LULUCF accounting unit at EU level is proposed to implement the LULUCF accounting steps. This will also reduce the needs in the MS. A simple centralized gap filling process is foreseen to account for uncertainties and estimate gaps in reporting.
4. MS net totals of LULUCF emissions/removals according to the GHG inventory for UNFCCC represent the starting point for the procedures of LULUCF accounting. The approach is land-based only and fully compatible with the LULUCF categories according to UNFCCC reporting. A gross accounting approach is applied for all categories and pools[43]. All LULUCF categories and pools are included (if this is too ambitious, a stepwise approach of integration of all land-categories or pools may be conducted, with the intention of full inclusion at a later date).
5. LULUCF totals of MS which represent net emissions need to be fully accounted by the MS together with the emissions of the other sectors (except those from natural disturbances under some circumstances - see below). This is an incentive for land management that reduces the risk of such net emissions from LULUCF.
6. The LULUCF net removal totals of all MS are added at EU level to “EU LULUCF net removal totals”.
7. Two caps are applied to reduce the “EU net removal totals” to the “allowable removal units” (aRMUs). Their bookkeeping and administration should be administrated at EU level.
8. A cap is suggested due to the significant uncertainty of the LULUCF net removals (“uncertainty cap”, “UC”). UC is calculated as the absolute statistical uncertainty of the

[43] It is assumed that the reduction challenge according to the PA is incentive enough to make optimum use of all opportunities. Even without that challenge the European forests represented a C sink in the last decades. The approach of non-LULUCF-targets could be revised if LULUCF will not contribute as expected.

"EU LULUCF net removal totals" according to step 6 plus the likely emissions of pools not estimated in some MS. These are estimated on basis of a gap filling process at EU level. There is a twofold purpose of this UC: reducing the uncertainty that the long-term GHG target of the PA will be achieved and underpinning the environmental integrity of the EU LULUCF accounting system. The UC is not fixed but will be estimated for each accounting period. An improvement in methods and completeness from period to period will reduce the UC – a clear incentive to improve the MRV in LULUCF. The amount of LULUCF net removals represented by the UC will never become allowable against the GHG emissions in other sectors and remains also untouched in the LULUCF sector.

9. A further cap to the EU net removal totals is proposed as an insurance reserve ("insurance cap", "IC"). The purpose of IC is to counterbalance the emissions of unexpected natural disturbances which lead to LULUCF net emission totals in MS (other limits may be defined) or other unforeseeable disasters (to be defined) which lead to significant deviations (to be defined) in the foreseen total GHG emission reduction path of the MS. The net removals represented by the cap should be used only in these two cases. The assessment of the quantity of net removal units which can be used for the purpose to reduce the GHG emission units in the affected MS needs to be defined. The quantity used for such counterbalancing for cases of disturbances and disasters reduces the insurance reserve in an equal quantity. So, the percentage of the IC which is used to derive the insurance reserve needs to be defined, but should be significant, particularly in light of potential increases of disturbances due to climate change. The insurance reserve is estimated for each accounting period. Non-used insurance reserve in the accounting period remains useable in following accounting periods. This cap is also a measure of environmental integrity and safeguards a robust accounting system in a changing world.
10. The "allowable removal units" (aRMUs) are estimated as ("EU LULUCF net removal totals" minus UC) multiplied with (1- IC).
11. The MS specific aRMUs which are redistributed to the MS for allowance are estimated in the following way: The total aRMUs at EU level are multiplied by the same shares of the "MS LULUCF net removal totals" in the "EU LULUCF net removal totals". The resulting amount of potential aRMUs per MS may be further reduced by a MS specific equity cap ("EC") to compensate for disparities among MS.
12. The equity cap needs to be defined but should include two elements. The first element should reduce very high per-head aRMU availability in some MS due to the low population/high forest ratio in the country. It is estimated as X percent (to be defined) of the average annual per-head GHG emission at EU level (without LULUCF) at a defined historic period multiplied with average population of the MS in that period. This approach is similar to the one for the KP cap for forest management, but fairer (see chapter 5.3.5). The percentage used for this approach might be significantly increased compared to the 3.5 % in the cap according to KP, because UC and IC already reduced the total amount of net removals significantly.

    A second element of the EC is needed to compensate for the inequity according to the example in Annex 1 ("countries A1 and A2"). Ideas for a fair approach exist, but are a bit more complicated and not further elaborated here.
13. The application of EC at MS level leads to a "rest of aRMUs" ("raRMUs") which are not distributed to the MS. These raRMUs are by definition fungible and may be used as incentives and bonus. The raRMUs may be distributed to the MS according to defined rules, for extraordinary accomplishments: e.g. best achievements in per head emission reductions in the GHG emission sectors (thus forming an incentive for enhanced action in emission reduction), low per-head GHG emissions, high accuracy and completeness of the LULUCF GHG inventory (thus forming an incentive for improvement of MRV in

LULUCF) etc. This would introduce also some competition into the arena. A related "entertainment" component could be carried out (e.g. a public show of the raRMU awards distribution). This is also an incentive, and it may enhance the visibility of efforts and requirements in the MS in the perception of the public, which may in turn raise the public acceptance of the challenge of the PA. Figure A3.1 demonstrates the whole approach.

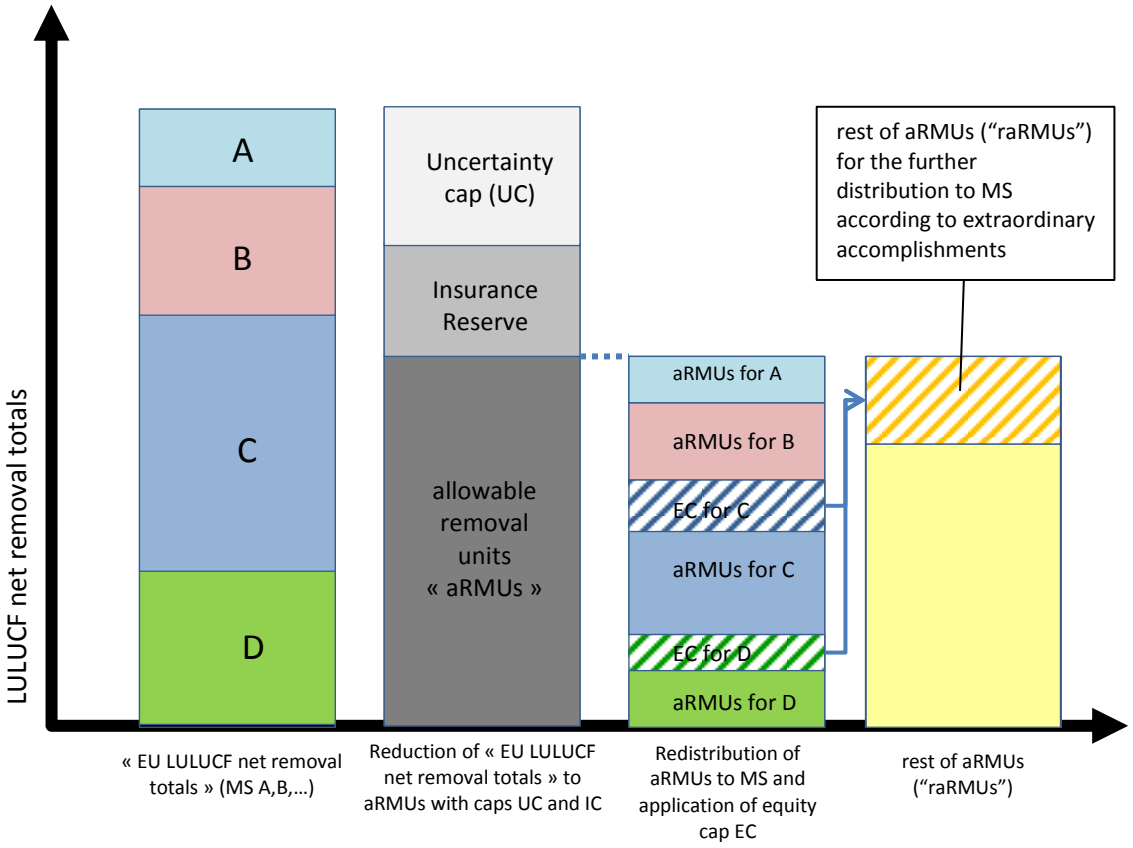

Figure A3.1 **Proposal for the accounting of LULUCF net removals in the EU (quantity has no meaning)**

14. A delayed accounting of LULUCF emissions/removals is proposed for reasons and advantages described in chapters 0 and 5.3.4. For instance, the final LULUCF figures for commitment period t1 could be requested at the end of commitment period t2 and the related aRMUs can be used for accounting at the earliest for the commitment period t2 (or any later period).
15. It is recommended to administer and keep LULUCF in an extra pillar. aRMUs of a MS are allowed to reduce the accounted GHG emissions of the MS from other sectors in an equal amount. This can be done at any period(s) the MS wishes.

Annex 5 Overview of characteristics of National Forest Inventories

Country	repres. area per plot (ha)	Nr. of plots	plot size	soil carbon monitoring	remote sensing used	dbh threshold	ground vegetation	permanent plots	dead wood
Austria		22236	radius of 9.77m	?	kNN used	5cm	?	yes	yes
Belgium (Walloon region)	50	11000	3 circles, 4.5-9-18m	?	complementary	70cm circumference	yes	yes	yes
Bulgaria									
Croatia									
Cyprus									
Czech Republic		14000	2 circles 3-12.6m	yes	?	7cm (small plot)	?	no?	yes
Denmark		7610	3.5-10-15m	?	?	0-10-40	?	yes (33%)	?
Estonia		1375 clusters	7-10m	no	no	8cm	?	yes (25%)	yes
Finland	129-2000	60000	5.64-9m	testing in NFI11	testing/implementing	4.5cm-9.5cm	?	yes (60%)	yes
France			6-9-15m	no	?	23.5-70.5-117.5cm circumference	?	Implementing	?
Germany		54000	angle count sampling		separate inventory	7cm	?	yes	yes
Greece								no	
Hungary								no	
Ireland	400	1829	3-7-23.62m	no	no	7-12-20cm	yes	yes	yes
Italy		6865	4-13m	?	no?	4.5cm	?	no?	yes
Latvia	300		5.64-12.62m	no?	no?	6.1-14.1		yes (partly)	yes
Lithuania	400	7637	5.64-12.62m	no?	increasing	6.1-14.1		yes (partly)	yes
Luxembourg		1800	4.5-9-18	yes?	no	7-20-40	no	yes	yes

Country	repres. area per plot (ha)	Nr. of plots	plot size	soil carbon monitoring	remote sensing used	dbh threshold	ground vegetation	permanent plots	dead wood
Malta									
Netherlands	100	3190	5-20m radius	no (only litter depth)	no	5cm	coverage only	yes (50%)	
Poland		28000	200, 400 or 500m2	no?	no?	7	?	yes	yes
Portugal		11038	500m2	no	photos for mapping	7.5 (but 5 for eucalyptus	yes	yes	yes
Romania		37500	7.98-12.62	no?	photos for mapping	5.6-28.5	?	?	?
Slovenia			7.98-13.82			10-30	?	yes	yes
Slovak Republic		1486	3-12.62	yes?	partly	7-12	?	yes	yes
Spain		95327	5-10-15-25	yes	mapping	7.5-12.5-22.5-42.5	yes	yes	yes
Sweden		60000	3.5-7-10	yes	mapping, kNN	4-10	yes	yes	yes
United Kingdom		~17500	100m2		mapping	?	?	no?	yes

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