Policy options for including LULUCF in the EU reduction commitment and policy instruments for increasing GHG mitigation efforts in the LULUCF and agriculture sectors

SYNTHESIS REPORT

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Disclaimer

This report has been submitted in fulfilment with the requirements of Service Contract 2009/S 231-330911 Policy Options for Including LULUCF in the Community Reduction Commitment and Policy Instruments for Increasing GHG Mitigation Efforts in the LULUCF and Agriculture Sectors. The opinions expressed in this report represent the views of the authors and do not bind the European Commission in any way.

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Executive Summary

The EU has committed unilaterally to reduce its overall greenhouse gas (GHG) emissions to 20 % below 1990 levels by 2020, and to 30 % below 1990 levels if conditions are right.[1] The current reduction commitment is mainly implemented through Directive 2009/29/EC[2] and Decision 406/2009/EC[3] which require sectors participating in the EU Emissions Trading Scheme (EU ETS) to jointly reduce emissions by 21 % and non-trading sectors (under the Effort Sharing Decision, ESD) by 10 % below 2005 levels. While sectors in the EU ETS are regulated at the EU level, it will be the responsibility of Member States to define and implement policies and measures to limit emissions of sectors under the ESD. There are other policy instruments, such as the Renewable Energy Directive[4] that could also contribute to reaching the target. Taken together, these various policy initiatives are known as the Climate and Energy Package[5].

Emissions and removals relating to Land Use, Land-Use Change and Forestry (LULUCF) are not part of the commitment but provisions in the ESD (Articles 8 and 9) require the Commission to assess and, as appropriate, propose how they may be included. A report on this assessment must be submitted within three months after the signature by the EU of an international agreement on Climate Change. However, in the event of no international agreement by the end of 2010, the Commission should come forward with an assessment and, as appropriate, a proposal for the inclusion of emissions and removals from LULUCF in the reduction commitment of the EU.

In the light of the EU's current and future ambitions all available policy options must be explored to ensure cost effectiveness and environmental integrity of the EU's GHG commitments. This project has identified policy options for including LULUCF in the EU's reduction commitment and has proposed policy instruments for increasing GHG mitigation efforts in the LULUCF sector.

In order to develop these options and proposals, it has been necessary to answer a set of questions:

- **Firstly,** what is the expected development of emissions and removals in LULUCF over the period up to 2020, what measures can be undertaken to mitigate climate change, and what is the potential magnitude of the contribution of LULUCF to the EU's overall GHG reduction effort?

- **Secondly,** and mainly, should emissions and removals related to LULUCF be included in the EU's commitment and, if so, how should this be done? The answer to this question must be guided (according to Decision 406/2009/EC) by principles including *environmental integrity*, *harmonised modalities*, *accurate monitoring*, *accurate accounting* and *permanence*.

- **Thirdly,** given that it was agreed in the Climate Change and Energy Package that all sectors must contribute to climate change mitigation in the EU, do Member States have sufficient tools to provide incentives for mitigation or could incentives usefully be provided at the EU level?

Key results and findings, arrived at in addressing these questions, have been assembled in this synthesis report.

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[1] I.e. that other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries contribute adequately according to their responsibilities and respective capabilities.

[2] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

[3] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

[4] 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.

[5] The Climate Change and Energy Package has four pieces of complementary legislation: (1) A revision and strengthening of the ETS; (2) The introduction of the ESD governing emissions from sectors not covered by the EU ETS; (3) Binding national targets for renewable energy which collectively will lift the average renewable share across the EU to 20% by 2020; (4) A legal framework to promote the development and safe use of carbon capture and storage. See http://ec.europa.eu/clima/policies/package/index_en.htm and http://ec.europa.eu/clima/documentation/package/index_en.htm.

The land use, land use change and forestry sector

Land use, land-use change and forestry (LULUCF) is an inventory sector defined by the Intergovernmental Panel on Climate Change (IPCC) that covers anthropogenic emissions and removals of GHGs resulting from changes in terrestrial carbon stocks. It covers the carbon pools of living biomass (above and below ground), dead organic matter (dead wood and litter) and organic soil carbon for specified land categories (forest land, cropland, grassland, wetland, urban land and other land).

The LULUCF sector has a number of inherent properties that complicate mitigation activities and reporting. A complex set of processes in terrestrial vegetation and soil cause both emissions and removals of GHGs, which can result in either net emissions or removals on balance over an area of land. Emissions reductions or increased removals achieved through mitigation activities in the LULUCF sector are also potentially reversible due to both human and natural causes – a phenomenon known as **impermanence**.

In addition, agriculture and forestry measures can indirectly contribute to GHG mitigation through growing and harvest of biomass to substitute for GHG intensive materials and fossil fuel. The harvesting and utilisation of biomass obviously has impacts on emissions and removals of GHGs in the LULUCF sector, but also influences emissions in other IPCC GHG inventory sectors, through what can be referred to as **cross-sectoral impacts**. Any increased production of biomass for bio-energy production will be associated with higher emissions in the LULUCF sector. However, this can generate savings in other United Nations Framework Convention on Climate Change (UNFCCC) sectors, e.g. energy and transport. Measures related to lowering agricultural production across the EU27 are likely to induce higher imports of these products from outside the EU (carbon leakage and indirect land use change). Consideration of cross-sectoral impacts is important, as mitigation efforts based on substitution of energy-rich materials and fuels may be associated with increased emissions (or reduced removals) in LULUCF due to changes in carbon stocks associated with intensified production. It is therefore important to consider the net effect across sectors including carbon leakage effects.

According to UNFCCC GHG inventory reports for the year 2009, the EU27 reported an overall net GHG removal (sink) for the LULUCF sector of 0.43 $GtCO_2\ yr^{-1}$, which is **comparable to about 9% of GHG emissions** due to other sectors at current rates. With the exception of the Netherlands and Germany, all of the EU27 countries reported a net removal of GHGs in the LULUCF sector. However, about 80% of the reported GHG removals in the LULUCF sector were concentrated in just seven EU Member States.

Projected removals due to forest management decline in magnitude during the period 2009 to 2020, reflecting changes in age class structure of forests and increased harvesting. Projected emissions due to cropland management also decline between 2009 and 2020; projected removals due to grassland management are relatively small in magnitude. Estimated emissions due to deforestation do not change substantively over the period from 1990 to 2020, whereas relatively small removals due to afforestation and reforestation since 1990 are projected to increase steadily up to 2020.

For 9 out of the 12 Member States with the largest net removals due to LULUCF in 1990, it is estimated that the magnitude of the removals will diminish or become a net emission in 2020. In general this results from a projected reduction in the removal due to **Forest Management**. Overall for the EU27, the net removal of 0.34 $GtCO_2$ in 1990 is projected to diminish to 0.22 $GtCO_2$ in 2020, a reduction of 37% if management of land continues on the basis of 'business as usual'.

Ambitious targets for the LULUCF sector to reduce emissions and increase removals will be rather difficult to accomplish, especially in the short term, i.e. 2020. Substantial emission reductions or increased removals from LULUCF would require significant land use changes from e.g. cropland to (permanent) grassland or forest and is likely to be almost impossible for EU27 on a short term, i.e. by 2020. Several projections from scenario studies on biofuel and bio-renewables suggest that the area of cropland in EU27 to meet demands for more biomass may increase alongside with growing demand for food and feed. Also, afforestation will have a small effect on the short term as growth and carbon sequestration will start slowly, and relatively large areas are needed.

Potential magnitude of the contribution of LULUCF to the EU's GHG reduction effort

Land management activities offer a potential for both reducing GHG emissions and also for sequestering carbon. This study has attempted to estimate the potential for mitigation through the LULUCF

sector. Possible mitigation measures in LULUCF include all actions that can reduce emissions or increase removals of GHGs, particularly CO_2 related to changes in carbon stock in soils and biomass.

The **total technical and biophysical mitigation potential** in Europe (all practices and all GHGs) by 2030 has been estimated at 750 $MtCO_2$ yr^{-1} (Smith *et al.*, 2007). For soil carbon management in the agriculture sector the technical mitigation potential was estimated at about 200 $MtCO_2$ yr^{-1} (Smith *et al.*, 2000). The realisation 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. Due to physical, (socio-)economic and cultural constraints, these previous estimates were 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).

The potential for **mitigation through soil carbon management** in the agriculture (cropland) sector was estimated by Lesschen *et al*. (2009) at approximately 67 $MtCO_2$ eq. per year for the EU27 up to 2030 and approximately 1.5% of the total EU27 emissions from other sectors at current rates).

The two main forestry activities with potential for mitigation are:

- **Afforestation** – the combined potential of historical (since 1990) and future afforestation measures to contribute to net reductions in emissions across the EU27 by the year 2020 is estimated to be about 120 $MtCO_2$ yr^{-1}, allowing for economic constraints on implementation of measures (about 2.5 % of emissions due to other sectors).
- **Forest Management** – the combined potential of forest management and deforestation prevention measures to contribute to net reductions in GHG emissions across the EU27 by the year 2020 is estimated to be between 65 and 105 $MtCO_2$ yr^{-1} (about 2 % of emissions due to other sectors), or somewhat less if economic constraints are taken into account. However, generally, forestry measures involving enhancement of forest carbon stocks tend to involve less intensive management for production, which can restrict the availability of biomass and timber for harvest. These impacts can offset some or all of the carbon benefits of forestry measures in the LULUCF sector, more so when long time horizons are considered. The quoted potentials for forest carbon conservation measures are estimated to reduce to between 45 and 60 $MtCO_2$ yr^{-1} if negative cross-sectoral GHG impacts cannot be avoided.

These agriculture and forestry potentials are not distributed evenly between Member States. For example, the potential for mitigation through agricultural soil carbon management is concentrated in only six Member States. Similarly, the forestry mitigation potentials through Afforestation and Forest management activities are mainly concentrated in 8 of the 27 Member States.

Diverse regional conditions, relating to e.g. climate, soil and agricultural production systems, throughout Europe play an important role in defining the limits of mitigation possibilities. Therefore, it is necessary to formulate policies that take into account specific regional conditions and feasibility of mitigation (and of any related monitoring and reporting) while taking advantage of the opportunities different land-based vegetation systems can offer. Policies must also recognise synergies between different sectors and environmental policies, taking account of their linkages.

Accounting and MRV

Under the Kyoto Protocol (KP), Parties including the EU and its Member States took on binding obligations to limit their GHG emissions. There are provisions in the KP for LULUCF activities and associated detailed rules for accounting net emissions or removals associated with these activities. However, Member States are actually obliged to account for only a limited and very specific set of activities, namely afforestation, reforestation and deforestation since 1990. For all other activities (including forests in existence before 1990), accounting is voluntary. This partial nature of accounting, and other problems associated with existing internationally agreed rules, would need to be addressed before LULUCF is included in the EU's GHG reduction commitments.

Existing accounting under the KP is not adequate to reflect the true impacts of LULUCF mitigation actions. However, this could be addressed through – in our view - 'many' **changes to accounting**

rules. It seems appropriate to continue with application of gross-net accounting for afforestation, reforestation and deforestation (ARD) activities and net-net accounting for cropland management (CM), grazing land management (GM) and revegetation (RV) activities. In the case of forest management (FM) a move to 'reference-level' accounting would appear to have advantages, whilst acknowledging that some technical challenges to implementation exist. The adoption of the production approach to accounting for **harvested wood products** (HWP) would differentiate between different uses of harvested biomass and incentivise those that hold a greater climate change mitigation benefit.

Any accounting rule changes do not necessarily involve more complex **monitoring, reporting and verification** (MRV) or changes to existing MRV methodologies already developed and adopted to meet existing commitments to the UNFCCC and the KP. However, it is clear that significant improvements are needed in many Member States, particularly as regards monitoring and reporting of carbon fluxes from agricultural and forest soils. The European Environment Agency considered the main problem at present to be the lack of harmonisation in existing soil monitoring programmes, and we conclude that this applies also to monitoring soil carbon levels. It is also important that National Forest Inventory reporting is made more consistent across EU Member States to ensure comparability and compatibility.

There are well established methods for monitoring forest carbon stocks, in the form of methodologies and protocols for National Forest Inventories (NFIs) and most Member States already have NFI programmes. Methodologies for MRV of soil carbon stocks are well advanced but soil carbon monitoring programmes are not 'routine'.

It is important to factor in the capacity and capability in Member States for any additional MRV that might be needed if LULUCF were to be included in the EU's reduction commitment. However, the existing Good Practice Guidance issued by the IPCC allows for an incremental approach to improving MRV. Also, a recent EU project included an analysis of GHG inventories submitted by EU Annex I countries in 2007, 2008 and 2009 which highlighted a progressive improvement of the completeness of, and the methodologies used to assess, GHG emissions and removals reported.

There is considerable and progressive improvement in the completeness of the reporting of GHG emissions and removals. Despite this, the main problem at present seems to be the lack of harmonisation in existing soil monitoring programmes (EEA, 2003). It is also important that NFI reporting is harmonised across EU Member States to ensure comparability and compatibility. When designing MRV systems, it will be necessary to ensure reasonable consistency between national-scale and project-scale reporting and accounting, although this does not mean that the methodologies applied at the different scales have to be exactly the same.

Approaches to climate policy for LULUCF

A review of climate policy in non-EU countries demonstrates that different countries are considering or implementing different approaches to LULUCF mitigation. Some are considering how LULUCF activities can contribute offsets within a market-based trading scheme, while others are developing national action programmes to directly support LULUCF mitigation measures. Some cases involve a mix of both approaches. Different countries are indeed considering or implementing sharply contrasting approaches to LULUCF mitigation policy and these include market-based trading schemes, while others are developing national action programmes to directly support LULUCF mitigation measures. Some cases involve a mix of both approaches. Clearly, therefore, **countries have not converged on a common and 'preferable' policy option**.

One consistent feature in **market-based cap and trade schemes** is that all take a 'soft' approach to inclusion of the LULUCF sector; the LULUCF sector itself is left 'uncapped' and its contribution is made through **provision of project-based credits** as a component of the cap and trade mechanism operating in other sectors. Generally the level of this contribution is limited in order to avoid too great an emphasis on purchase of LULUCF credits rather than direct action on emission reductions within the other sectors. By implication, countries developing such market based approaches have all concluded that the particular characteristics of the LULUCF sector render it unsuitable for full inclusion in trading schemes. This suggests a partial and possibly biased approach in which only areas or projects that produce net removals are accounted for, whilst others (net emissions) are not. A partial inclusion would also suggest high risk of leakage between different land areas. Furthermore, countries

taking a cap and trade approach based on project off-sets have consistently recognised that the potential contribution due to LULUCF credits could distort market-based trading and needs restricting.

Market based trading schemes also commonly include **safeguards against various risks** arising from inclusion of LULUCF credits, e.g. price distortions or fluctuations, or risks of impermanence of LULUCF credits or general uncertainty over the actual outcome of LULUCF activities. One such safeguard involves a requirement for participants to guarantee the effectiveness of LULUCF credits for long periods, e.g. 100 years. However, long term commitments of this nature are not well aligned with a trading-based approach (which generally involves annual or otherwise short-term accounting periods) and present a significant barrier to an effective contribution from LULUCF mitigation activities.

The approaches are based on national programmes and are delivered at national level. And therefore, domestic leakage and the requirement to ensure **additionality** should be addressed. Arguably, nationally coordinated approaches based on action plans can target specific activities and issues, judged of highest priority either due to large mitigation potential or a requirement to remediate or protect against negative effects. Such an approach could be regarded as consistent with the existing payments for environmental services already in operation in the EU under Common Agricultural Policy (CAP) and, to that extent, there is a precedent if the EU took a similar initiative for mitigation in the LULUCF sectors.

A feature of note in the approaches based on direct support through national action plans is a recognition that mitigation of GHG emissions in the LULUCF sector will be delivered in the long term, thus the emphasis is on achieving emissions reductions or removals over long time scales rather than on meeting short term targets. This probably reflects the inherent properties of the LULUCF sector, which may also be critical to shaping any policies developed in the EU.

Finally, the Icelandic and Norwegian policies are ‘light’ in terms of MRV at the level of individual holdings, instead of implicitly relying on UNFCCC reporting and KP accounting as sufficient for registering any impacts of the mitigation measures. This could be viewed as an effective way of linking to existing policies and an efficient use of existing MRV efforts.

The case examples raise the more fundamental question whether EU should adopt a market-based trading approach to GHG emissions reductions in the LULUCF sector, or an approach based on direct support through national action plans, or some combination of the two approaches? Additionally, if a combination of these approaches is taken, how is it possible to ensure they will work effectively together without overlaps or conflicts? These questions are pertinent when considering the possibilities for including the LULUCF sector within existing EU policies on GHG emissions reduction.

How is the EU’s GHG reduction commitment regulated and can LULUCF be accommodated?

This work has assessed whether the existing policy frameworks ESD or EU ETS that regulate the EU's GHG reduction commitment could accommodate the LULUCF sector.

Based on the analysis it was concluded that either the ESD or EU ETS would require significant development and amendment to enable inclusion of the LULUCF sector, to the extent that the possibility of creating a separate policy framework especially to deal with LULUCF needs to be considered. Consequently, the work developed three possible policy options for comparison with ‘Business As Usual’ (BAU):

- **BAU** Continue with on-going international agreements and efforts, but do nothing extra, meaning that LULUCF remains excluded from contributing to the EU's domestic GHG reduction commitment for 2020.
- **Option 1** Integrate LULUCF in the Effort Sharing Decision (ESD).
- **Option 2** Integrate LULUCF in the EU Emissions Trading Scheme (ETS).
- **Option 3** Handle LULUCF in a new, separate framework.

A number of 'building blocks' were developed which were considered essential for the integration of LULUCF in the EU reduction commitment under any policy option. These building blocks included

definitions, sectoral coverage, transferability, targets, link to the overall target (of the EU reduction commitment), *accounting rules, MRV, risk management, compliance, corrective actions* and *liability*.

Business as Usual

BAU is the measure against which the other options in this section can be judged and is defined here as an EU commitment which excludes LULUCF, as it currently does. It is important to consider the consequences of this exclusion if at the same time an international agreement is reached and includes at least some mandatory accounting. The EU would have to meet international obligations whether or not it includes LULUCF in its own "domestic" reduction commitment (unless no international agreement is reached). Since BAU involves not including LULUCF in the "domestic" EU commitments and legislation (although likely in its international commitments following Decision 1/CMP.6), all the building blocks defined could not be fully developed.

Since BAU involves not including LULUCF in the "domestic" EU commitments and legislation (although likely in its international commitments), all the building blocks defined above could not be fully developed. However, definitions are likely to follow the ones currently used under the KP and a general assumption was made for accounting and sectoral coverage under the BAU scenario that the successor to the current KP would include mandatory accounting for Afforestation, Reforestation and Deforestation (ARD), possible mandatory Forest Management (FM) with a cap, discount factor, or reference level, possible voluntary accounting for the activities of Cropland Management (CM), Grazing land Management (GM), Wetland drainage and rewetting (WM), and Revegetation (RV) with net-net accounting, domestically produced Harvested Wood Products (HWP) accounted for on a mandatory basis and a further commitment period, yet to be defined.

It is also likely that there would be voluntary provisions to reduce the risk of *non-compliance* following disturbance events. *MRV* would essentially follow the current requirements under the Kyoto Protocol, with some additions following changes in accounting in the second commitment period.

However, there are several negative implications of continuing with BAU. The details depend on whether or not an international agreement is reached on GHG emissions reductions involving LULUCF. In general, GHG accounting would likely be partial and not include all emissions and removals. Member States with opportunities to act on mitigation in the LULUCF sector would have no flexibility to do so to meet either EU or international commitments. The lack of a formal commitment to act on LULUCF in the EU might result in Member States meeting EU level commitments and targets to GHG reductions, while the EU might fail to meet its international commitments because of uncoordinated action in the LULUCF sector.

There could be problems for the **environmental integrity** of EU legislation, because there would not be a mechanism recognising the importance of management of land-based carbon stocks for climate change mitigation alongside other objectives such as food and energy security, landscape and habitat conservation and enhancement, or economic capacity building in rural areas. Notably, impacts in the LULUCF sector involving actions to increase utilisation of biomass for energy/materials would not be covered and accounted for as part of a balanced approach to mitigation across all sectors. There would be no ‘level playing field’ for action in the energy and construction sectors and action in the LULUCF sector.

Ultimately there is a risk that non-inclusion of LULUCF potentially undermines the achievement of the ultimate objective of the UNFCCC because an important sector (globally) is not accounted for. If the EU wants to set an example, inaction in the LULUCF sector is not consistent with this ambition. By not including LULUCF, the EU would be sending a signal internationally that LULUCF was not important and that action on LULUCF was neither needed nor appropriate.

Including LULUCF in the ESD or EU ETS (options 1 and 2)

When considering options 1 and 2, it was concluded that simple inclusion of the LULUCF sector in either the ESD or EU ETS was not possible. The analysis shows some significant difficulties associated with including the LULUCF sector in the ESD.

Inclusion in the ESD may require a redistribution of effort amongst Member States to allow for the potential for LULUCF mitigation actions. It would also require a change to one of the key features of the legislation because of the high inter-annual variations in emissions and removals of LULUCF and

therefore difficulties associated with annual compliance following linear trajectories in emissions levels in Member States and across the EU. LULUCF would also require special allowances for departures from expected emissions levels due to uncontrollable disturbance events. A number of other provisions of the ESD would need review and possible amendment, e.g. definitions, eligibility of project credits, rules for corrective action and extension of registries of emissions and removals.

Many of the problems that have been identified in the context of the ESD would also apply to the EU ETS and the analysis confirms that there would be serious problems with inclusion of the LULUCF sector in the EU ETS.

In addition, existing reviews carried out by the Commission (which were concerned with linking Joint Implementation and/or Clean Development Mechanism offset projects to the EU ETS) have concluded that **inclusion in the EU ETS** would involve increased **risks of impermanence of emissions reductions** and a loss of simplicity, transparency and predictability. There are 2.8 million discrete forest areas and 14 million agricultural holdings in the EU that make it impractical to allocate emission allowances. For many but not all LULUCF activities, very high costs would be associated with MRV, particularly since MRV would be required at installation levels (e.g. many areas and land holdings). Even if the ESD and EU ETS alone were sufficient to achieve the EU's 20% (or any other target up to 30%) in GHG emission reductions from 1990 levels in 2020, LULUCF could be included to add further potential for cost efficiency in achieving either of these targets as action is taken where cost effectiveness is greatest. In addition to the huge costs associated with monitoring and reporting at installation level, the standard of monitoring of emissions and removals in the LULUCF sector would not be of a quality consistent with the existing EU ETS sectors. Good practice guidance, which has been developed for national reporting purposes, would have to be developed at installation level. If included on a project basis, the sheer quantity of potential credits arising in the LULUCF sector could undermine the carbon market. Whether or not inclusion at project- or sector- level is considered, there would likely be significant impacts in terms of fluctuations in the carbon price given the high inter-annual variations of emissions and removals. In addition, detailed consideration of the Articles of the EU ETS reveals the need for special handling of LULUCF accounting because of a requirement to comply with linear reductions in the need for allowances for emissions levels. Other issues include difficulties in appropriately defining liability (responsibility over time for reversals) and that capacity and expertise for verification of EU ETS compliance would require significant development. A number of other provisions of the EU ETS would need review, *e.g*. definitions, flexibilities to address country-specific issues and carbon leakage, tracking of transactions in LULUCF emissions and the exclusion of small land units ("installations").

When considering the consequences of including LULUCF in either option 1 or 2, it was concluded that this would require more effort than involved for establishing a separate framework to accommodate LULUCF.

Including LULUCF in a separate framework (option 3)

A **separate framework** which includes all key activities in the LULUCF sector would ensure that economy-wide emissions and removals are reflected in accounting and thereby ensure the environmental integrity of the EU's GHG reduction commitment. The option of a separate framework for the LULUCF sector may also offer certain advantages in terms of addressing the specific characteristics of the sector, e.g. inter-annual variations in emissions and removals and impermanence. Furthermore, it would be able to take into account the timeframe for delivering emissions reductions (or increases in removals). Given that different activities have impacts both in the short- and long term, it is important to consider the sector both by 2020 and in the longer term. However, it will still be the case that the potential for the implementation of different mitigation measures will be very different between Member States. For a separate framework based on targets for levels of mitigation activity, timely delivery of emissions reductions would depend on the provision of the right incentives although it may be difficult to predict the magnitude of the contribution to emissions levels in a specific time period.

In summary, a detailed analysis appears to confirm that **a separate framework is the preferred option**. There are serious problems associated with continuation of BAU and the inclusion of the LULUCF sector in the EU ETS. There would be problems, although fewer, also with inclusion of the LULUCF sector in the ESD.

A separate framework based on targets for emissions levels or activities would appear to present certain opportunities that would be less easy to realise through inclusion within the ESD. A separate framework could be designed to match the specific needs of a land based sector and would be able to address the problems encountered with regards to annual compliance under the ESD. If the framework included all key mitigation activities in the LULUCF sector, there should be measures that can deliver emissions reduction in the short term (i.e. by 2020) and longer terms.

For the option of a separate framework for the LULUCF sector it would still be the case that the potential for the implementation of different activities would be very different between Member States. For a separate framework based on targets for levels of mitigation activity, timely delivery of emissions reductions would depend on **targeted incentives for mitigation measures** and it may also be difficult to predict the magnitude of the contribution to emissions levels in a specific time period. Consideration of **cross-sectoral impacts** is also important as mitigation efforts based on substitution of energy-rich materials and fuels may be associated with increased emissions (or reduced removals) in the LULUCF sector due to increased production. When considering the definition of targets, it is therefore important to look at the net effect across sectors, including carbon leakage effects. Finally, it should be noted that LULUCF consists of a heterogeneous set of sub-sectors, comprising mainly forestry and soils. When defining possible approaches to include LULUCF in the reduction commitment, the specificities of the sub-sectors would need to be taken into account, including their challenges as regards MRV.

A full assessment of the options, and in particular of the possible setting of targets, will also have to be based on an evaluation of the economic and environmental impacts that this would have. However, a full economic impact evaluation of this nature falls outside the scope of this report.

Policy instruments that could incentivise further mitigation efforts in the LULUCF sector

Finding the necessary tools to provide incentives may be relatively straightforward for implementing mitigation activities in agriculture, since these activities are largely based on existing legislation and policies under the CAP. This study suggests that policy instruments could usefully be strengthened and / or introduced. Under the first Pillar the **cross compliance mechanism** could be strengthened, by making Good Agricultural and Environmental Condition standards (GAECs) and Statutory Management Requirements (SMRs) more strict, or by adding a 'greening component'. Under the second Pillar more funds should be allocated to climate change measures in the rural development programmes both for agriculture and forestry. Member States should specify in their rural development plans how they will address climate mitigation and which incentives they will provide.

Policy instruments for **three climate mitigation activities were developed for agriculture**: improved cropland- , grassland- and wetland management. These terms are used since they are linked to the current and proposed Kyoto Protocol activities, and they are sufficiently generic to be useful for implementation in EU legislation. Selection criteria for the three activities were a large and realistic mitigation potential within agriculture and no high risks on indirect land use change effects. Furthermore the activities should make use of existing EU legislation and regulations. The terms for the three activities are rather broad and the detailing of the policy instruments will refer to more specific measures. At member state level these instruments can be further detailed to account for natural conditions and differences in farming structure.

The objective of the **improved cropland management** activity is to enhance existing carbon stocks and to reduce losses in arable soils through stimulating soil-carbon-friendly practices. This objective can be reached by making the current soil management practices more climate-oriented and by raising awareness on climate mitigation via soil carbon measures amongst farmers. **Improved grassland managemen**t aims at the protection of existing carbon stocks under permanent grassland and enhancement of carbon sequestration in non-permanent grasslands. Strengthening current cross compliance requirements for permanent pastures and raising awareness amongst farmers on climate mitigation and the importance of permanent pastures are important aspects. The objective of the improved wetland management is to protect existing carbon stocks in peatlands and prevent further losses of carbon through reduced drainage and disturbance. **Wetland management** deals with a change in hydrological management of land and its consequences. **Peatland restoration**, through blocking of drainage channels, is becoming increasingly widespread, with aims including restoration

of ecological quality, improved drinking water quality, and restoration of the function of peatlands as a carbon sink.

For **forestry**, policy instruments for four climate mitigation activities were developed: actions aimed at limiting deforestation, encouraged creation of new forest areas, conservation of existing forest carbon stocks and enhancement of existing forest carbon stocks. These four activities have been chosen because they cover a wide range of mitigation options. They have been defined generically with the aim of allowing wide scope in EU legislation and responsiveness to particular Member State circumstances.

The objective of limiting deforestation is to maintain forest carbon stocks and prevent the release of carbon dioxide to the atmosphere. This could be achieved by **harmonising and strengthening legislation and regulation** to protect forest areas from deforestation, which is already in place in some Member States. The approach is thus based strongly on regulation rather than incentives. The aim of creating new forest areas is to enhance land-based carbon stocks and, potentially, increase the available biomass and timber resource. An approach to achieving this is proposed based on payments for creation of new forests, which are already available to some extent as part of rural development mechanisms, although not explicitly to meet climate change mitigation objectives. The two activities involving management of existing forests aim to conserve and where appropriate enhance forest carbon stocks, which constitute a significant carbon reservoir in the EU.

1 About this LULUCF policy options synthesis report

1.1 Introduction

This document summarises the work that has been completed under the service contract **2009/S 231-330911**, *Policy options for including LULUCF in the Community reduction commitment and policy instruments for increasing GHG mitigation efforts in the LULUCF and agriculture sectors*.

This project has identified policy options for including Land Use, Land Use Change and Forestry (LULUCF) in the EU's reduction commitment and has proposed policy instruments for increasing greenhouse gas (GHG) mitigation efforts in the LULUCF sector.

In developing these options and instruments, it has been necessary to review the characteristics of the LULUCF sector and to summarise the mitigation potentials of relevant agriculture and forestry measures. The study has also needed to consider how the sector is currently included in international reporting obligations under the UNFCCC and the Kyoto Protocol and how this treatment might change in the light of current international climate negotiations. The inclusion and exclusion of any GHG emissions due to the sector in the current relevant EU legislation, and also in climate mitigation policy frameworks in non-EU countries required review. Existing capacity for monitoring, reporting and verification of net GHG emissions in the sector also required consideration.

1.2 Background to the project

The EU has committed unilaterally to reduce its overall greenhouse gas (GHG) emissions to 20 % below 1990 levels by 2020, and to 30 % below 1990 levels if conditions are right.[6] The current reduction commitment is mainly implemented through Directive 2009/29/EC[7] and Decision 406/2009/EC[8] which require sectors participating in the EU Emissions Trading Scheme (EU ETS) to jointly reduce emissions by 21 % and non-trading sectors (under the Effort Sharing Decision, ESD) by 10 % below 2005 levels. While sectors in the EU ETS are regulated at the EU level, it will be the responsibility of Member States to define and implement policies and measures to limit emissions of sectors under the ESD. There are other policy instruments, such as the Renewable Energy Directive[9] that could also contribute to reaching the target. Taken together, these various policy initiatives are known as the Climate and Energy Package[10].

Emissions and removals relating to Land Use, Land-Use Change and Forestry (LULUCF) are not part of the commitment but provisions in the ESD (Articles 8 and 9) require the Commission to assess and, as appropriate, propose how they may be included. A report on this assessment must be submitted within three months after the signature by the EU of an international agreement on Climate Change. However, in the event of no international agreement by the end of 2010, the Commission should come forward with an assessment and, as appropriate, a proposal for the inclusion of emissions and removals from LULUCF in the reduction commitment of the EU.

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[6] I.e. that other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries contribute adequately according to their responsibilities and respective capabilities.

[7] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

[8] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

[9] 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.

[10] The Climate Change and Energy Package has four pieces of complementary legislation: (1) A revision and strengthening of the ETS; (2) The introduction of the ESD governing emissions from sectors not covered by the EU ETS; (3) Binding national targets for renewable energy which collectively will lift the average renewable share across the EU to 20% by 2020; (4) A legal framework to promote the development and safe use of carbon capture and storage. See http://ec.europa.eu/clima/policies/package/index_en.htm and http://ec.europa.eu/clima/documentation/package/index_en.htm.

In the light of the EU's current and future reduction commitments, all available policy options must be explored to ensure cost effectiveness and environmental integrity. In the EU, LULUCF is estimated currently as a net sink of CO_2 which amounts to about 9 % of the combined emissions in other sectors. However, national GHG inventory reports and studies in the scientific literature strongly indicate that certain LULUCF activities are associated with significant sources of CO_2 emissions. As the nature of the LULUCF sector varies among Member States of the EU, certain activities may be either net sinks or net sources for some Member States.

Land use activities offer a potential for both reducing GHG emissions and sequestering carbon. They can indirectly contribute to GHG mitigation through growing and harvest of biomass to substitute for GHG-intensive materials and fossil fuels. Diverse regional conditions, relating to e.g. climate, soil and agricultural production systems throughout Europe, play an important role in mitigation possibilities. Therefore, it is necessary to formulate policies that take into account specific regional conditions and feasibility of mitigation, while taking advantage of the opportunities that different land management activities can offer. Policies must also take account of synergies between different sectoral and environmental policies as well as their interlinkages.

1.3 Questions that this project addresses

The work carried out has focused on three key questions:

- **Firstly,** what is the expected development of emissions and removals in LULUCF over the period up to 2020, what measures can be undertaken to mitigate climate change, and what is the potential magnitude of the contribution of LULUCF to the EU's overall GHG reduction effort?

- **Secondly,** and mainly, should emissions and removals related to LULUCF be included in the EU's commitment and, if so, how should this be done? The answer to this question must be guided (according to Decision 406/2009/EC) by principles including *environmental integrity*, *harmonised modalities*, *accurate monitoring*, *accurate accounting* and *permanence*.

- **Thirdly,** given that it was agreed in the Climate Change and Energy Package that all sectors must contribute to climate change mitigation in the EU, do Member States have sufficient tools to provide incentives for mitigation or could incentives usefully be provided at the EU level?

Key results and findings, arrived at in addressing these questions, have been assembled in this synthesis report.

1.4 Structure of this synthesis report

Three chapters in this synthesis report summarise the work of this project.

Chapter 2 considers fundamental characteristics of the LULUCF sector and summarises historic and projected net emissions as reported for the sector. The range and likely effectiveness of mitigation measures in the agriculture and forestry sectors are reviewed and estimates presented of the potential magnitude of the contribution of LULUCF to the EU's GHG reduction effort, based on technical rather than economic potentials.

Chapter 3 considers the reporting and accounting required for LULUCF under the current UNFCCC and Kyoto Protocol (KP) and also the possibilities for changes to accounting under the current UNFCCC climate negotiations. The chapter then considers the current approaches to monitoring, reporting and verification (MRV) of net GHG emissions in the LULUCF sector and makes suggestions about improvements in standards that would be needed for the inclusion of LULUCF in the EU's reduction commitment.

Chapter 4 presents the analysis of if and how LULUCF could be included in the EU's GHG reduction commitment, starting by looking at how the EU's reduction commitment is currently regulated. Examples of climate mitigation policy frameworks in non-EU countries are also reviewed to establish whether there are any lessons to learn for the development of EU policy. Three possible policy options for including LULUCF in the EU's reduction commitment are then developed for comparison with 'Business As Usual' (i.e. to exclude mitigation action in the LULUCF sector), before finally assessing the options against a set of criteria.

Chapter 5 then reports on the assessment of the options to include LULUCF in the EU's GHG reduction commitment against a set of criteria.

Chapter 6 discusses policy instruments that, once the possible role of LULUCF in the EU's GHG reduction commitment has been established, could incentivise further mitigation efforts. This includes consideration of several existing EU and international policies and legislations that may have some impact on the LULUCF sector.

2 Mitigation in the LULUCF sector

2.1 What is the LULUCF sector?

Land Use, Land-Use Change and Forestry (LULUCF) is an inventory sector defined by the IPCC that covers anthropogenic emissions and removals of GHGs resulting from changes in terrestrial carbon stocks. It covers the carbon pools of living biomass (above and below ground), dead organic matter (dead wood and litter) and organic soil carbon for specified land categories (forest land, cropland, grassland, wetland, urban land and other land).

It is important to stress that both emissions and removals of carbon may occur in the LULUCF sector. Estimating these emissions and removals requires an understanding of how natural processes affecting greenhouse gas dynamics *interact in response* to the interventions of humans. This is in sharp contrast to nearly all other sectors in GHG inventories, which are concerned with emissions *directly and entirely caused* by human activities.

The main GHG concerned is carbon dioxide (CO_2) from carbon stock changes. Other GHGs include nitrous oxide (N_2O) from, for example, nitrogen inputs (when fertilising forest land), cultivation of organic soils and soil organic matter mineralization (e.g. due to land use conversion and drainage of forest soils) and methane (CH_4). As further examples, CO_2 and N_2O are also emitted during forest fires and from anaerobic decomposition of organic material in wetlands. Non-CO_2 GHG emissions from agricultural land are covered by the inventory sector 'agriculture' and are therefore not part of the LULUCF sector.

2.2 Reporting and accounting obligations of Member States

Under the United Nations Framework Convention on Climate Change (UNFCCC) the EU and its Member States are already committed to reporting annually on emissions and removals of GHGs in the LULUCF sector for various categories of managed land, most importantly including forest land, cropland, grassland, wetland and settlements. The KP requires the EU and Member States to commit to binding emissions limitations and reduction targets and explicitly requires the EU and Member States to report on the contribution of particular forestry activities (Afforestation, Reforestation and Deforestation) to achievement of emissions targets. Other specified LULUCF activities may also contribute towards emissions targets, namely 'Forest Management' (FM), 'Cropland Management' (CM), 'Grazing land Management' (GM) and 'Revegetation'(RV). Individual Member States (and the EU collectively) can elect or not elect to account for and report on these activities. 'Wetland Management' (WM) is not (yet) part of these accounting and reporting categories.

2.3 Inherent properties of the LULUCF sector

The LULUCF sector has a number of inherent properties that can complicate mitigation activities and reporting.

2.3.1 A balance of emissions and removals, human and natural causes

A complex set of processes in terrestrial vegetation and soil cause both emissions and removals of GHGs, which can result in either net emissions or removals on balance over an area of land. These emissions and removals are directly associated with changes in vegetation and soil carbon stocks on land. Net emissions or removals may thus by estimated either directly or by quantifying net changes in vegetation and soil carbon stocks.

Managed land is strongly influenced, but not entirely controlled, by human intervention. Emissions and removals on land are driven primarily by natural processes, while terrestrial vegetation systems are susceptible to natural disturbances which can lead to substantial release of carbon to the atmos-

phere. In general, the development of the net GHG balance for an area of land develops over time according to complex short term and long term cycles, and responses to human intervention can take place over variable time scales. Emissions reductions or removals claimed as due to mitigation activities under the KP need to be 'additional'. In the LULUCF sector in particular, this means that *only* emissions and removals due to human activity should be reported, excluding any contribution due to natural processes. In practice the separation of natural and human effects on GHG emissions and removals can be highly problematic.

2.3.2 Saturation and impermanence

The capacity for terrestrial vegetation and soil to remove carbon from the atmosphere 'saturates' because ultimately a steady state will occur in the balance of emissions and removals for a given area of land. The magnitude of the carbon stock at this saturation point, and the time taken to reach it, depend on various factors including soil type, vegetation type, long-term management and climate. It is possible to distinguish the term saturation as applied in a 'biological' sense (effectively, the carbon stock that would be associated with a 'climax' ecosystem) and in a 'technical' sense (the maximum long-term average carbon stock, subject to both the biological capacity of the land and vegetation *and also* the way in which the land is being managed). As a consequence of saturation, the potential to mitigate greenhouse gas emissions through vegetation management is finite.

Emissions reductions or removals achieved through mitigation activities in the LULUCF sector are also potentially reversible due to both human and natural causes – a phenomenon known as impermanence. This quality of impermanence is not usually observed in other IPCC GHG inventory sectors, with the result that mitigation in the LULUCF sector is viewed as relatively high risk. Most critically, the risks of impermanence of net emissions reductions in the LULUCF sector require that any framework for supporting and implementing LULUCF GHG mitigation measures would need to be able to account for incidents where net emissions reductions are subsequently reversed and support remediation where appropriate.

2.3.3 Cross-sectoral impacts

Any harvesting and utilisation of biomass from crops or timber from trees for use as material, energy of chemical feedstock not only has impacts on emissions and removals of GHGs in the LULUCF sector but also influences emissions in other IPCC GHG inventory sectors than LULUCF. These may be referred to as cross-sectoral impacts.

There is some continuing debate over the relative merits of conserving and enhancing vegetation and soil carbon stocks on the one hand, or harvesting and using biomass for energy and materials and save on emissions from fossil sources on the other hand, including how these two functions should be accounted for.

Accounting rules in the LULUCF sector (and other sectors) thus would need to ensure a 'level playing field' between the two functions, in which neither activity is favoured unduly but in which GHG impacts of vegetation management and use in all sectors are represented faithfully. In terms of UNFCCC reporting, all sectors and categories are represented in terms of cross-sectoral impacts, but the links between them are not explicitly monitored.

In terms of KP accounting (as opposed to UNFCCC reporting), unless emissions due to utilisation of harvested biomass are accounted for in the LULUCF sector, they will not enter accounting at all. Under the KP, emissions due to use of harvested biomass for energy and materials are not accounted for in the Energy or Industrial processes sectors, nor in the Waste sector and may or may not be accounted for in the LULUCF sector, depending on what LULUCF activities are adopted for accounting and what methods are used as part of implementation.

Under the KP, Member States have the option to elect, or not to elect, specific activities. This could mean that the consequences of cross-sectoral impacts are not accounted for. For example, if activities to increase the use of renewable energy cause long term reduction in carbon sinks, the reductions in stocks may not be monitored if Forest Management is not elected. Therefore a "level playing field" between conservation and enhancement of carbon stocks and utilisation of biomass for energy

and materials cannot be ensured. Currently, harvested wood products are not accounted for under the KP and negotiations on this point are ongoing. Consideration of cross-sectoral impacts is important, as mitigation efforts based on substitution of energy-rich materials and fuels may be associated with increased emissions (or reduced removals) in LULUCF due to changes in carbon stocks associated with intensified production. It is therefore important to consider the net effect across sectors including carbon leakage effects.

A full assessment of the options, and in particular of the possible setting of targets, will also have to be based on an evaluation of the economic and environmental impacts that this would have. However, a full economic impact evaluation of this nature falls outside the scope of this report.

2.3.4 Ownership and management of land

Action to mitigate GHG emissions in the LULUCF sector across the EU27 is likely to be complicated by the number and diversity of land holdings and ownership arrangements. Agricultural land and forests in the EU are owned and managed by large numbers of individuals, companies and public sector organisations. In 2007, there were at least 13.7 million agricultural holdings in the EU27. The area of publicly owned forest in the EU in 2005 was 73.1 million hectares while the area of forest owned by the private sector was 103.9 million hectares. Some of the agricultural and forest areas are very small, while others are more substantial. The total number of discrete woodland areas in the EU27 has been estimated at 2.8 million. The successful introduction and implementation of measures to achieve mitigation of GHG emissions would clearly require the support and positive participation of a large number of landowners, and/or a focus on the larger land holdings, which tend to be publicly owned. The extensive monitoring of LULUCF GHG emissions and removals at the level of individual holdings to verify the effectiveness of mitigation activities (which is different from national reporting) also represents a challenge (but could be simplified). The monitoring and reporting at national levels, however, does not require the involvement of individual land owners and can be based on national surveys.

2.4 Current LULUCF emissions and removals in the EU

According to UNFCCC GHG inventory reports for the year 2009, the EU27 reported an overall net GHG removal for the LULUCF sector of 0.43 $GtCO_2$ yr^{-1}, which is comparable to about 9% of GHG emissions due to other sectors at current rates. With the exception of the Netherlands and Germany, all of the EU27 countries reported a net removal of GHGs in the LULUCF sector. However, about 80% of the reported GHG removals in the LULUCF sector were concentrated in just seven Member States. Although the magnitude of removals in many Member States is small compared to this 'main seven', it can be an important contribution to the overall GHG inventory for some Member States (Figure 2.1). For example, removals in the LULUCF sector for Estonia and Slovenia are small compared to other Member States, but are estimated to be about 40% of the total emissions in those countries due to other sectors at current rates, while in Latvia the removals due to LULUCF exceed emissions in other sectors making the country a net sink.

2.5 Expected trends in EU LULUCF emissions and removals

Historical and projected estimates of LULUCF net emissions or removals (assuming 'business as usual' land management) have been reported in the Joint Research Centre (JRC) LULUCF tool (version 16th May 2011, see Figure 2.2)[11]. Projected removals due to forest management decline in magnitude during the period 2009 to 2020, reflecting changes in age class structure of forests and increased harvesting. Projected emissions due to cropland management also decline between 2009 and 2020; projected removals due to grassland management are relatively small in magnitude. Estimated emissions due to deforestation do not change substantively over the period 1990 to 2020, whereas relatively small removals due to afforestation and reforestation since 1990 are projected to increase steadily up to 2020.

[11] The JRC LULUCF tool can be found at: http://afoludata.jrc.ec.europa.eu/index.php/models/JRC_LULUCF_TOOL

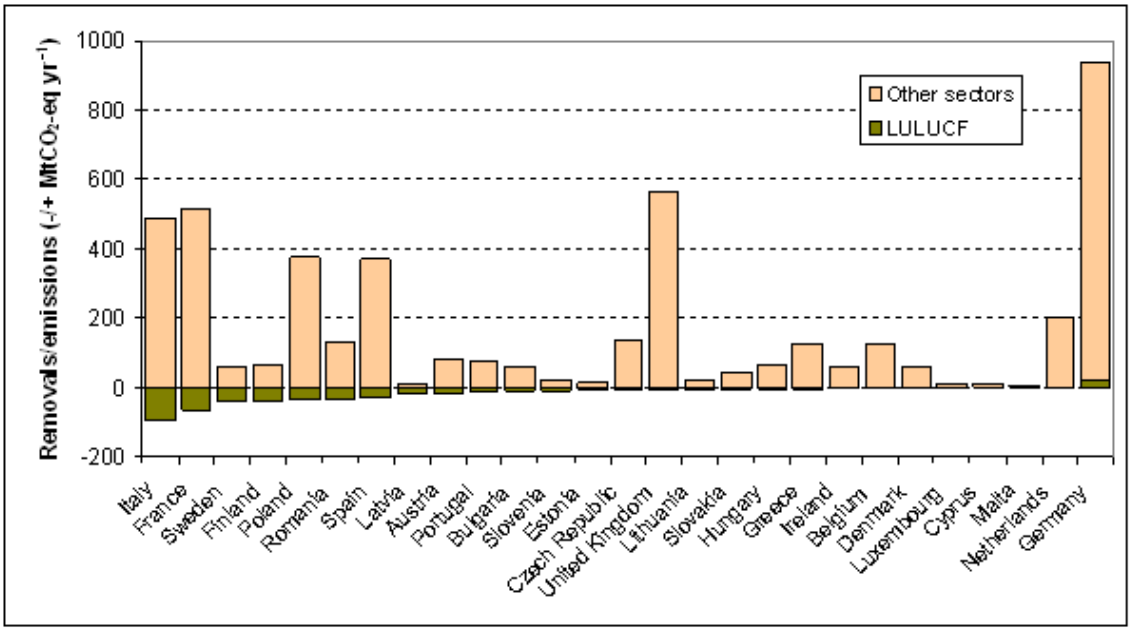

Figure 2.1 Reported GHG emissions of EU27 member states for the year 2009 emphasising contribution due to LULUCF sector. Countries are listed in descending order of the magnitude of the removal due to LULUCF[12]

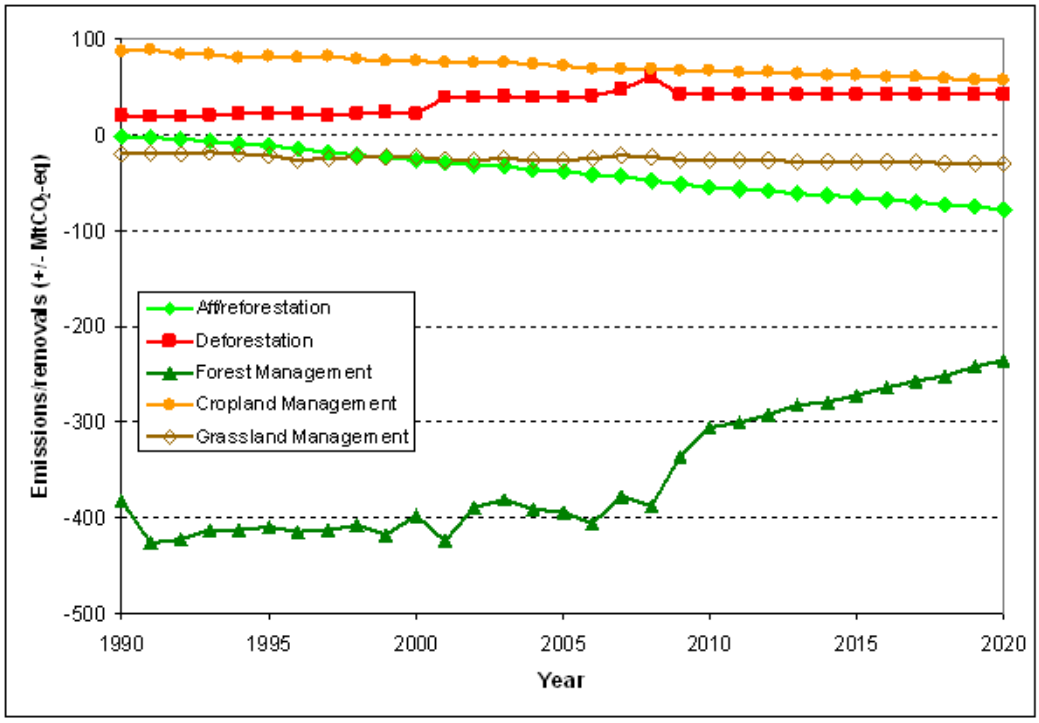

Figure 2.2 Historical data and projections for the different KP activities / land uses for the EU-27

[12] Data obtained from the EEA GHG data viewer, found at http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=475

2.6 LULUCF GHG mitigation measures

There is a range of possible GHG mitigation measures in agriculture and forestry relevant to LULUCF. The general characteristics of (and potential for) agriculture and forestry measures are quite distinct, thus possible measures in agriculture need to be considered and assessed separately to those for forestry.

The primary scope of the analysis was concerned with how to achieve GHG mitigation directly in the LULUCF sector, generally through conservation or enhancement of carbon stocks in terrestrial vegetation. Such measures when implemented in agricultural and forestry ecosystems can provide wider co-benefits, for example soil organic matter can be important for agricultural productivity, for soil water holding capacity, and for resilience against soil erosion. In general (but not always), conservation of carbon stocks can also involve conservation of habitats, landscape diversity and so on. It is also clear that the products of agriculture and forestry (i.e. crops, biomass and timber) can play an important role as a source of renewable energy and materials, which may have significant positive impacts in other GHG inventory sectors. However, the emphasis in this study was to develop an understanding of how agriculture and forestry measures can achieve positive impacts on GHG emissions and removals specifically in the LULUCF sector. At the same time, where appropriate, the wider implications of certain agriculture and forestry measures across all sectors were assessed, in the spirit of a holistic approach to assessment of GHG mitigation impacts.

2.6.1 Measures and mitigation potential in agriculture

The basis for the selected agricultural measures was the fourth IPCC assessment report, Chapter 8 (Mitigation of Climate Change – Agriculture; Smith *et al.*, 2007). This analysis only assessed the agricultural sector in terms of what is reported under the LULUCF sector, i.e. the contribution due to soil carbon.

A selection was made from the measures listed in Smith *et al.* (2007) for further analysis in terms of mitigation of emissions within the LULUCF sector, with the aim of focussing on those measures which are of most relevance for Europe and which can have a significant effect on LULUCF removals or emissions.

Within **cropland management**, the specific measures selected for further consideration were:

- Agronomic practices
- Tillage/residue management
- Agro-forestry
- Set-aside/land-use change.

Within **grazing land management**, the main focus on specific measures concerned management of grazing intensity, increased productivity and nutrient management, considered in combination. Measures concerned with **improved management of organic soils** and **restoration of degraded land** were also selected for further consideration.

Soil carbon sequestration is the result of specific activities and measures and 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 $MtCO_2$ yr^{-1} (Smith *et al*., 2007). For soil carbon management in the agriculture sector the technical mitigation potential was estimated at about 200 $MtCO_2$ 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. The previous estimates were 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). Based on Lesschen *et al.* (2008, 2009) a lower mitigation potential of 67 $MtCO_2$ yr^{-1} was estimated for carbon sequestration on arable soils and this potential is mainly concentrated in only 6 of 27 Member States.

Very few sources provide information about the cost-effectiveness of measures in the LULUCF sector and most estimates are based on global studies (Smith *et al.*, 2007; McKinsey, 2009).

For some of the measures identified the mitigation potential is uncertain (e.g. zero/reduced tillage), and the difference between the technical and realistic potential has been estimated as large (Smith, 2004; Smith *et al.*, 2008). For some measures, there is even a risk of higher emissions upon implementation in some regions across the EU27, as was concluded from the PICCMAT project (Lesschen *et al.*, 2008). Therefore regional approaches deserve priority and could be actively promoted, as such approaches will account for the local soil conditions and management practices and their impact on the effectiveness in agriculture and yield regionally explicit estimates on cost and cost-effectiveness.

The EU Climsoil project (Schils *et al.*, 2008) identified that the most effective option to manage soil carbon in favour of climate change mitigation is to preserve existing stocks in soils rather than attempt additional carbon sequestration. This holds true especially for the relatively large stocks in peat and specific mineral soils with a high content of organic matter, e.g. permanent grassland.

As discussed in the earlier section on cross-sectoral impacts, the increased production of biomass for bioenergy could be associated with higher emissions in the LULUCF sector. However, bioenergy utilisation can lead to emissions reductions in other UNFCCC sectors (energy and transport). All measures that involve a lowering of agricultural production across the EU27 are likely to induce higher imports of agricultural products from outside the EU. This can generate 'leakage' and be less effective in mitigating climate change on a global scale. This is due to the high likelihood that land elsewhere will be used to sustain overall global production levels and this - without doubt - will increase emissions elsewhere (indirect effects, including from LULUCF, sometimes referred to as indirect land use change).

An analysis was carried out against a set of criteria to evaluate the effectiveness of agricultural mitigation measures (Table 2.1). This analysis has suggested that it is possible to develop an effective package of agriculture measures based on conservation of carbon and sequestration of additional carbon but that risks of impermanence and competing claims on land need to be addressed. There is no specific measure that scores well against all criteria. The ability to measure change in carbon stocks and the risks of impermanence of sequestered carbon are identified as the most important challenges for all measures. Most of the measures can have significant co-benefits in terms of soil quality improvement, reduction of soil erosion and increase in biodiversity.

Box 2.1 Key to colour codes in Table 2.1

Colour	Interpretation
	High potential for effective implementation of the measure, when evaluated against the criterion.
	Moderate potential for effective implementation of the measure, when evaluated against the criterion.
	Low potential for effective implementation of the measure, when evaluated against the criterion.

2.6.2 Measures and mitigation potential in forestry

It is possible to identify a number of specific measures in the forestry sector to reduce net emissions or increase net removals of GHG emissions through net sequestration of carbon in forest vegetation and soils. These measures include **prevention of deforestation**, **afforestation.** For (KP) **forest management** measures aimed at achieving mitigation in the LULUCF sector, options include longer rotations, avoidance of clear felling, restricted production/conversion to wilderness. If aiming to achieve mitigation in other sectors through changes to forest management, options include bringing rotation durations closer to productive maximum, intensified production, increased harvest of offcuts and branchwood, and changes in species to enhance productive potential.

Table 2.1 Summary of the criteria analysis of agriculture measures. The colour-coding is defined in Box 2.1.

	Agronomy	Tillage/residue management	Agro-forestry	Set-aside / land-use change	Grazing land management	Restoration of organic soils	Restoration of degraded lands
Reliable outcome							
Potential per hectare							
Potential (across EU27)							
Cross-sectoral impacts							
Co-benefits							
Timing							
Measurable							
Permanent							
Leakage							
Cost							

Changes to management of existing forest areas (including forest conservation and prevention of deforestation) can have moderate to large impacts on GHG emissions on a per-hectare basis. The combined potential of such measures to contribute to net reductions in GHG emissions across the EU27 by the year 2020 was estimated to be between 65 and 105 $MtCO_2$ yr^{-1} (about 2 % of emissions due to other sectors), or somewhat less if economic constraints are taken into account. The contribution can be much more important for a small number of individual EU MS. For some measures, e.g. longer rotations, the development of carbon stocks can be quite complex and sometimes uncertain, while carbon sequestration will generally only be significant for some decades, after which biological or technical saturation will be reached. Cross-sectoral impacts on GHG emissions are an important feature of forestry measures and can be significant. Generally, forestry measures involving enhancement of forest carbon stocks tend to involve less intensive management for production, which can restrict the availability of biomass and timber for harvest. These impacts can offset some or all of the carbon benefits of forestry measures in the LULUCF sector, more so when long time horizons are considered. The potentials given above for forest carbon conservation measures (i.e. between 65 and 105 $MtCO_2$ yr^{-1}) are estimated to reduce to between 45 and 60$MtCO_2$ yr^{-1} if negative cross-sectoral GHG impacts cannot be avoided.

Apart from the management of existing forests, another potentially important measure involves the creation of new forest areas through afforestation. The combined potential of historical and future afforestation measures to contribute to net reductions in emissions across the EU27 by the year 2020 was estimated to be about 120 $MtCO_2$ yr^{-1}, allowing for economic constraints on implementation of measures (about 2.5 % of emissions due to other sectors). This potential will depend on the land required to sustain food production and meet goals or targets for bioenergy production. As with management of existing forests, the contribution can be much more important for a small number of individual EU Member States.

The additional forest areas created through afforestation should imply the expansion of the biomass and timber resource available for harvesting. Cross-sectoral impacts on GHG emissions may arise from utilisation of these extra resources. Calculations made for the EU27 MS suggested that such cross-sectoral impacts were negligible for the year 2005 (forests created since 1990 would be too

young). However by 2020, carbon sequestration in wood harvested from forests created since 1990 could amount to about 4 $MtCO_2$ yr^{-1}, with a further mitigation potential of about 8 $MtCO_2$ yr^{-1} through substitution of biomass for fossil fuels and timber for other materials. These are small contributions but emissions reductions are permanent and continue to rise as more of the additional forest resource becomes available for production.

An analysis has been completed to evaluate the impacts and effectiveness of forestry measures against a set of criteria (Table 2.2). The analysis of the forestry measures suggests that it may be difficult to develop an effective and reliable package of measures. In general the risks of impermanence of measures relating to conservation of forest carbon limit their potential, particularly in association with high costs. Measures associated with enhanced forest production appear to offer potential due to both the GHG reductions from such options being permanent in the Energy and Industrial processes sectors and also relatively low cost. However, the positive impacts in other sectors may often be offset by negative impacts in the LULUCF sector, requiring a 'level playing field' to be adopted when evaluating net benefits over all sectors. The option with the most potential for implementation seems to be afforestation, though the risk of impermanence may be a limitation.

Table 2.1 Summary of the criteria analysis of forestry measures. The colour-coding is defined in Box 2.1

	Prevent deforestation	Afforestation	Longer rotations	Avoid clear felling	Restricted production / conversion to wilderness	Rotations closer to productive maximum	More production	Increase harvest of offcuts and branchwood	Changing species
Reliable outcome									
Potential per hectare									
Potential (across EU27)									
Cross-sectoral impacts									
Co-benefits									
Timing									
Measurable									
Permanent									
Leakage									
Cost									

2.7 General conclusions on LULUCF measures

Mitigation efforts in the LULUCF sector, and the assessment of their effectiveness, would need to take account of the fact that the development of net emissions and removals over time occur as a result of both anthropogenic and natural processes, often with complex time courses. Similarly, mitigation measures need to be developed so as to reduce net emissions or increase net removals at the margin to projected levels for scenarios in which no additional mitigation action is taken.

Ambitious objectives for the LULUCF sector to reduce emissions and/or increase removals will be difficult to accomplish, especially in the short term, e.g. by 2020. Substantial emission reductions could be achieved by:

- Reducing land-use changes (such as conversion of forest or grassland to vegetation with smaller carbon stocks)
- Better management of peatlands and organic soils
- Increasing removals through land-use change (for example converting cropland to grassland or forest).

Nevertheless such mitigation actions are unlikely to contribute significantly in the short term, as growth and carbon sequestration will start slowly, and relatively large areas of land would be needed. Despite these limitations both the conservation and enhancement of carbon stocks represent potentially important measures for the mitigation of GHG emissions, particularly as part of a wider, long-term programme of measures.

3 Accounting and MRV in the LULUCF sector

3.1 Current LULUCF accounting under the KP

There are provisions in the KP for LULUCF mitigation activities and associated detailed accounting rules for emissions or removals associated with these activities. As already noted, under the KP, Member States are actually obliged to account for only a limited and very specific set of LULUCF activities, namely afforestation, reforestation and deforestation since 1990. For all other land activities (including forests in existence before 1990), Member States account for FM, CM, GM and RV activities on a voluntary basis, which clearly does not guarantee comprehensive coverage of the LULUCF sector. Only three Member States(have elected to account for any of CM, GM and RV, while more than two thirds of Member States have elected to account for FM. The pattern for the election of activities is very similar when considering all countries participating in the KP.

Apart from the selective accounting for mitigation activities by KP Parties, the current accounting rules of the KP present a number of issues. In particular there have been protracted debates about how to account for FM activities, whether and how to accounting for carbon stock changes in Harvested Wood Products (HWP) and how to deal with risks associated with significant natural disturbances to land-based vegetation and soil.

The debate over FM activities and accounting is due in part to the complexity of emissions and removals in the LULUCF sector, which can be particularly pronounced for forests. A key point of contention concerns the application of gross-net accounting (with a 'cap') for FM activities and net-net accounting for CM, GM and RV activities.

Under current accounting rules, when woody biomass is harvested from forests, the timber is assumed to be oxidised to the atmosphere instantaneously as CO_2. Some parties consider that correct GHG accounting should recognise that carbon can in fact be retained for some time in HWP. There have been long discussions amongst KP Parties about whether and how to account for HWP.

As they currently stand, the KP LULUCF accounting rules do not explicitly address the question of what to do if GHG emissions occur as a result of a major natural disturbance outside the control of participating countries, such as major grass fires, forest fires, storms and pest/disease outbreaks. Such disturbances could cause very large GHG emissions within a very short time and militate against the genuine efforts of countries to achieve targets for emissions reductions.

3.2 Options for improvement of KP accounting

Current commitments under the KP expire at the end of 2012 and Parties are in discussion over arrangements for a successor to the KP and/or a second commitment period. Recent negotiations have considered some possibilities for making accounting more consistent amongst countries. Given the complexities in the international negotiations, it is probably unrealistic to strive for complete standardisation in the election of activities, however, some consistency may be possible. Progress may also be possible through an incremental approach towards achieving greater consistency e.g. focussing on approaches to election of FM activities first, then moving on to other activities in succession. However, the EU could still lead by example by accounting for all the key activities (FM, CM and GM) in a consistent manner.

The option of making FM accounting mandatory is being considered, as well as options for the elaboration of gross-net accounting for FM activities, involving continued application of caps, or application of discount factors or reference levels, or adoption of 'land-based' accounting. The option of 'reference level' accounting, which has attracted some interest, involves comparing FM emissions or removals in a commitment period against a projected baseline value in order to determine the impacts of any additional FM activities (either positive or negative). Reference-level accounting aims to 'incentivise FM measures at the margin' (i.e. additional relative to 'Business as Usual') and, as such, is an approach that could be viewed as consistent with the intent of the KP and the ultimate objective of the

UNFCCC to reduce anthropogenic GHG emissions. Clearly implementation of reference-level accounting would require care and would need to include appropriate safeguards, notably strong independent technical review of calculations before 'signing off' the FM accounting for a commitment period.

Discussions amongst KP Parties have outlined three main possible approaches to accounting for carbon stocks and stock changes in HWP, assuming these were to be included. Most recently, the focus has been on possible adoption and elaboration of the so-called 'production approach'. Under the arrangements being developed, as a default, accounting would be on the basis of estimates of when emissions from HWP occur, and attributed to the Party owning the forests that produced the HWP. Adoption of the production (or any other) approach would require estimates to be based on verifiable and transparent data on the fate of HWP, or to be supported by credible default values. The production approach makes it easier for HWP emissions to be modelled (e.g. there is no need to represent complex exchanges of HWP carbon between Parties). The production accounting approach has the main advantages that it is relatively simple and easy to understand, and there is a clear rationale for adopting the approach. In particular, keeping HWP carbon associated with the forests that produced the HWP helps to avoid creating disincentives for harvesting of forests (where harvesting is an appropriate activity). It is possible to identify advantages and disadvantages with any of the main HWP accounting approaches; perhaps a key advantage of production approach is the general agreement or consensus amongst Parties to consider its adoption.

Parties have recognised the risks associated with significant natural disturbances. Essentially, the efforts of countries to manage land-based vegetation systems to conserve carbon stocks, reduce GHG emissions and enhance removals could be compromised by such events which are beyond their control, and could lead to failure to comply with KP targets within one or more commitment period. An option is under consideration for a mechanism to address the risks from such 'disturbance' events.

In summary, Parties are considering various options for improvement of KP LULUCF accounting, in particular seeking to address the selection of activities for accounting, the question of how FM should be accounted for, possible approaches to accounting for HWP and how to deal with major natural disturbance events. Discussions have identified different 'packages' of possible improvements involving 'few changes', 'moderate changes' or 'many changes' to existing KP accounting rules alongside the option of no change. On the one hand, making few changes might involve keeping most of the existing accounting rules unchanged, but including accounting for HWP and allowing Parties to voluntarily apply an agreed 'disturbance mechanism'. On the other hand, making many changes might additionally involve making accounting for some or all of FM, CM, GM and RV mandatory and changing the approach to FM accounting.

The accounting approaches and rules adopted under the KP are not perfect. However, the KP represents the extant 'best deal' that could be negotiated amongst many diverse Parties; this in itself is important. Ongoing negotiations and elaborations could seek to conserve those aspects of the KP and its accounting rules that work, while aiming for changes to aspects that do not work well.

3.3 Monitoring reporting and verification (MRV)

The state of play and potential for MS to implement improved approaches for the monitoring, reporting and verification (MRV) of the GHG impacts of activities in the LULUCF sector was reviewed. The focus was 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.

3.3.1 MRV methods and current implementation by Member States

As part of the implementation of any measures, and monitoring of associated actions, it is necessary to keep close track on the land areas where measures and associated actions are taking effect. As a minimum requirement, each Member States needs to be able to identify areas of managed land where monitoring is needed to meet reporting and accounting obligations. All surveys which involve sampling need to be carefully developed to ensure that sufficient samples are taken in order to give

results at the required level of precision. In order to ensure the reliability, transparency and verifiability of estimates of carbon stocks and stock changes, it is essential to define clear methodologies for carrying out field surveys, the collection of assessments in sampling units and the calculation of results. These methodologies need to be clearly specified in published protocols.

Member States of the EU27 are already committed to MRV of LULUCF carbon stocks as part of commitments under the UNFCCC and to the KP. Most Member States already have a programme of National Forest Inventories (NFIs) and also limited soil monitoring networks. It is worth noting that there is no legal requirement for MS to carry out either an NFI or national soil survey. However, there is implicit need for the data that would be collected in these surveys in order to satisfy UNFCCC reporting and KP accounting requirements.

There are established methods for MRV in the LULUCF sector, for example the IPCC GHG good practice guidance for the LULUCF sector. There are well established methods for monitoring forest carbon stocks, in the form of methodologies and protocols for NFIs and most Member States already have NFI programmes. Methodologies for MRV of soil carbon stocks are well advanced but soil carbon monitoring programmes are not 'routine'.

Two essential data needs are identified in the IPCC guidance on LULUCF MRV:

1. Area or area change data for the land use categories
2. Information on associated carbon stocks and relevant GHG emissions factors.

In order to enable countries to make the most efficient use of available data and resources for data collection to achieve acceptable levels of certainty, the IPCC guidance provides three overall methodological 'tiers' varying in complexity to be chosen on the basis of national circumstances. On the one hand, Tier 1 (basic) involves the application of coarse activity data, default emission factors and standard values, with consequent large uncertainties in GHG estimates. On the other hand, Tier 3 (sophisticated) may involve use of models, survey and inventory data and measured parameters, which should provide higher resolution and less uncertainty.

The guidance also recognises that a key issue concerns the level of detail with which areas (and area changes) are monitored and recorded for the six land use categories, and that higher tier methods ideally require a finer level of detail in area stratification and monitoring. Three approaches to area monitoring are defined in the guidance. Approach 1 involves the lowest spatial resolution and no tracking of changes between land categories, whilst Approach 3 tracks land use change on a spatially explicit basis.

IPCC guidance sets out minimum requirements of MRV in relation to LULUCF land categories (UNFCCC) and activities (KP) and the extent to which Member States meet these requirements varies. An analysis of the IPCC Tiers and Approaches adopted by EU27 Member States in estimating GHG inventories for reporting under the UNFCCC revealed significant variations and gaps in the reporting of some carbon stocks and stock changes. Some differences between Member States will reflect the differing importance of particular land categories in different countries, but some differences and gaps in reporting appear to be due to limitations in capacity.

The MASCAREF project (Cienciala *et al*., 2010) included an analysis of GHG inventories submitted by EU Annex I countries in 2007, 2008 and 2009, which highlighted a progressive improvement of the completeness of, and the methodologies used to assess, GHG emissions and removals reported. Nevertheless, the analysis suggests that further work is still needed to improve the MRV of the LULUCF sector, and there are marked differences in the quality of reporting between Member States.

3.3.2 Possible improvements to MRV

The MASCAREF report of Cienciala *et al*. (2010) included the following recommendations, amongst others, relevant to MRV:

- Efforts should be made to improve completeness of reporting in land use categories other than Forest land, in particular for the land converted to other categories.

- The reporting of the soil carbon pool should be enhanced, in particular of organic soils which are a significant reservoir of carbon and therefore a potential source of GHGs (e.g. peatlands).
- Another area of possible improvement is the reporting of emissions from disturbances in forest land.
- More transparency on the methods, emission factors and recalculations is needed especially from the new Member States. A compilation of these data in a synthetic form would help to evaluate the changes, identify further gaps and suggest improvements (e.g. summary tables).

It is also important that NFI reporting is harmonised across EU Member States to ensure comparability and compatibility. One example of the different parameters currently used by different Member States is the definition of “Forest”.

4 How might LULUCF be accommodated in the EU's GHG reduction commitment?

4.1 The EU's existing commitment

In 2008, the EU committed unilaterally to reduce its overall greenhouse gas (GHG) emissions to 20 % below 1990 levels by 2020, and to 30 % below 1990 levels if conditions are right, in the so-called Climate and Energy Package. The 20 % reduction commitment is mainly implemented through a requirement for sectors participating in the EU Emissions Trading Scheme (EU ETS) to jointly reduce emissions by 21 % below 2005 levels and for non-trading sectors (under the Effort Sharing Decision; ESD) to reduce emissions by 10 %.

While sectors in the EU ETS are regulated at the EU level, it will be the responsibility of Member States to define and implement policies and measures to limit emissions of sectors under the ESD. There are other policy instruments, such as the Renewable Energy Directive, that will also contribute to reaching the target. Emissions and removals relating to are not part of the commitment.

The main existing pieces of EU legislation, the ESD and EU ETS, were analysed with the aims of describing their modes of operation and sectoral coverage, in particular highlighting issues associated with a decision to simply include the LULUCF sector in either the ESD or EU ETS, and whether these impacts constitute major barriers.

4.1.1 Analysis of the Effort Sharing Decision

The ESD establishes annual binding GHG emission targets for Member States for 2013–2020. Each Member State will contribute to this effort according to its GDP per capita, with national emissions reduction targets ranging from –20 % for the Member States with greatest GDP, to +20 % for Member states with smallest GDP, to be achieved in 2020 when compared with 2005 levels. The ESD covers generally small-scale emitters in a wide range of sectors such as transport (cars, trucks), buildings (in particular heating), services, small industrial installations, agriculture and farm businesses and waste. These sectors currently represent some 60 % of total GHG emissions in the EU. As a general rule, it will be left to Member States to define and implement policies and measures in such sectors, although a number of EU-wide measures in areas such as energy efficiency standards, CO_2 emissions from cars and waste and the CAP will also have an effect on emissions and emissions reductions in these sectors. The ESD covers emissions of all 6 gases included in the KP.

The ESD defines a linear trajectory to limit the GHG emissions of the Member States between 2013 and 2020. Member States with a negative target shall ensure that emissions in 2013 do not exceed average annual emissions for the period 2008-2010. Those with a positive target shall ensure that emissions in 2013 do not exceed a level defined by a linear trajectory, starting in 2009, based on their average annual emissions for the period 2008-2010 and ending in 2020 at the target for that Member State. A key flexibility is that the ESD allows for **a transfer of allowances between years and** Member States. It is intended that a strong monitoring and compliance system should be in place at the EU level for monitoring MS action and to help them make any necessary corrective measures if they fail to meet their targets. The **complex timecourse of emissions and removals in the LULUCF sector** would make compliance with a progressive linear reduction in levels of emissions difficult.

Under the ESD, GHG reduction efforts by Member States are based on the principle of solidarity between Member States and the need for sustainable economic growth across the Community and, as already noted, taking into account the relative per capita GDP of Member States. In general, the potential for mitigation activities in the LULUCF sector is not so obviously related to economic activity, but rather to the extent of the land area and the associated vegetation of individual Member States. In particular the potential for mitigation activities in the LULUCF sector would appear to be very unevenly distributed amongst Member States, with the bulk of the potential residing in a handful of Member States, depending on the type of activity. If the existing limits on GHG emissions assigned to different Member States were *not* recalculated, then it seems very likely that inclusion of the LULUCF sector in

the ESD would make it significantly easier for some Member States to achieve their existing GHG emissions limit, whilst possibly making it more difficult for some others. Also, for some Member States, it would place the achievement of the existing GHG emissions limit at **greater risk** (because of the possibility of uncontrollable disturbance events in the LULUCF sector). Although there are provisions within the ESD to address such risks, these are not designed to deal with the significant emissions that might occur due to disturbance events in the LULUCF sector.

4.1.2 Analysis of the EU Emission Trading Scheme

The EU ETS is one of the key policies introduced by the EU to help meet its GHG emissions targets under the KP. It is a Europe-wide "cap and trade" scheme that started in 2005. An overall cap is set on the total emissions allowed from all the installations covered by the Scheme. The EU ETS covers 30 countries, i.e. the EU27 plus Iceland, Liechtenstein and Norway.

At the end of each year, installations are required to surrender allowances to account for their actual emissions. A proportion of these allowances were allocated for free by Member States in accordance with National Allocation Plans (NAPs). Installations can emit more than their allocation by buying allowances from the market. Similarly, an installation that emits less than its allocation can sell its surplus allowances. The environmental outcome is not affected because the cap is fixed. A limited quantity of credits from Joint Implementation (JI) or Clean Development Mechanism (CDM) projects can be used by operators to fulfil their obligations under the EU ETS.

The EU ETS covers electricity generation and the main energy-intensive industries – power stations, refineries and offshore, iron and steel, cement and lime, paper, food and drink, glass, ceramics. Small scale installations, e.g. burners/boilers rated below 20 MW are generally excluded. As of 2013, the scope of the EU ETS will be extended to also include other sectors and GHGs.

The reliance of the EU ETS on monitoring emissions from discrete installations could be unworkable for the LULUCF sector due to the **general uncertainty over locations, ownership and magnitudes of GHG sinks and sources in the LULUCF sector**. By nature the LULUCF sector is dispersed, extensive, involving both sinks and sources with relatively high uncertainties. There are 2.8 million discrete areas of forest and 14 million agricultural holdings in the EU, and they are generally small.

Similar to the ESD, the EU ETS specifies that, from 2013, the overall allowances for emissions within the scheme should decline in a linear manner, a feature which constitutes an obstacle for inclusion of LULUCF (see previous discussion of the ESD).

MRV requirements under the EU ETS would be unsuitable for the LULUCF sector as the characteristics of the sources are different. Estimating GHG emissions from fuel combustion can be done accurately and the recording systems for fuel or energy consumption are uniform and well developed. In the LULUCF sector, emissions and removals are usually calculated with **models with uncertainties** that are large compared to fossil fuel consumption. This incompatibility and uncertainty would need to be addressed if LULUCF was to be included in the EU ETS.

4.1.3 Issues with including LULUCF in the ESD or EU ETS

The analysis of the main existing pieces of EU legislation made clear that simple inclusion of the LULUCF sector into either the ESD or EU ETS is not possible.

Inclusion in the ESD may require a redistribution of effort amongst MS to allow for the potential for LULUCF mitigation actions. There may also need to be special handling of LULUCF accounting because of the need to comply with linear trajectories in emissions levels in MS and across the EU. LULUCF may also require special allowances for departures from expected emissions levels due to uncontrollable disturbance events. A number of other provisions of the ESD would need review and possible amendment, *e.g.* definitions, eligibility of project credits, rules for corrective action and extension of registries of emissions and removals.

Earlier reviews carried out by the Commission have concluded that inclusion in the EU ETS would necessitate the addressing of impermanence of emissions reductions and a loss of simplicity, trans-

parency and predictability. Monitoring of emissions and removals in the LULUCF sector would not be of a quality consistent with the currently regulated installations. The sheer quantity of potential credits arising in the LULUCF sector (if introduced as an offset mechanism) could undermine the carbon market. In addition, consideration of the Articles of the EU ETS reveals that it would be an extremely challenging task to include LULUCF accounting because of a need to comply with linear reductions and strict monitoring and reporting obligations. Capacity and expertise for verification of EU ETS compliance would require significant development.

It follows that the modes of operation and detailed provisions of the ESD or EU ETS would need to be significantly amended and developed before the LULUCF could be included in one of them, if indeed at all.

4.2 Lessons from non-EU LULUCF policies

Examples of **climate mitigation policy frameworks in non-EU countries** were reviewed, to establish whether these policies include the LULUCF sector in some way and, if so, how they are designed and whether there are any lessons to learn for the development of any EU policy. In addition to a number of specific detailed points relevant to the particular schemes being considered a number of general conclusions are drawn.

4.2.1 Schemes reviewed

Five case examples in four countries and one significant region within a fifth country were reviewed:

- The Carbon Pollution Reduction Scheme (CPRS) of Australia
- The Emissions Trading Scheme of New Zealand
- Measures in Iceland and Norway (considered together)
- Two acts proposed in USA
- The Air Resources Board Cap-and-Trade Program in US State of California.

A general description was given for each case example, key components were identified and an assessment was made of the consequences if similar approaches were adopted as part of EU policy. The analysis of key components was structured to consider a number of elements relevant to the development of LULUCF mitigation policies. The policy components considered were those of: 'Definitions', 'Sectoral coverage', 'Transferability', 'Link to overall target', 'Targets', 'Accounting rules', 'MRV'., 'Risk management', 'Compliance and corrective action', 'Liability' and 'Integration' (see Table 4-1, Chapter 4). In addition to a number of specific detailed points relevant to the particular schemes being considered a number of general conclusions were drawn.

The EU may be able to draw upon selected features and components of the various non-EU policies and proposals, for example in determining a set of relevant definitions, or approaches to risk management or compliance. However, it must be noted that the different policies define these terms and processes in varying levels of detail.

The policies and proposals considered in the case examples illustrate a diversity of approaches to sectoral coverage. The Icelandic and Norwegian policies define a bespoke set of measures across the LULUCF sector, designed to address specific mitigation opportunities. At the same time, accounting addresses the requirement to fully monitor both emissions and removals of a wide set of LULUCF activities rather than specific mitigation activities. Whilst the New Zealand policy also recognises the need for different measures and incentives for recently created forests (post-1989) and older forest areas, it adopts specific measures for afforestation in some areas, and distinguishes indigenous forests types (although with no decision yet on specific mitigation measures) from other forest. In terms of accounting, the approach is narrow (i.e. focussed on specific mitigation activities) and may not ensure full coverage of the LULUCF sector. Although the details may not always be relevant to circumstances in the EU, this may suggest the need for comprehensive or near-comprehensive coverage of the LULUCF sector, but with varying approaches to mitigation measures and activities, tailored to address specific objectives and potentials for forest land, cropland, grassland and so on.

One consistent feature can be identified in all the case examples involving market-based cap and trade schemes, in that all take a 'soft' approach to inclusion of the LULUCF sector; the LULUCF sector itself is left 'uncapped' and its contribution is made through provision of project-based credits as a component of the cap and trade mechanism operating in other sectors. Generally the level of this contribution is limited in order to avoid too great an emphasis on purchase of LULUCF credits rather than direct action on emissions reductions within the other sectors.

The case examples involving market based trading schemes commonly include safeguards against various risks arising from inclusion of LULUCF credits, e.g. price distortions or fluctuations, or risks of impermanence of LULUCF credits or general uncertainty over the actual outcome of LULUCF activities. One such safeguard involves a requirement for participants to guarantee the effectiveness of LULUCF credits for long periods e.g. 100 years. However, long term commitments of this nature are not well aligned with a trading-based approach (which generally involves annual or otherwise short-term accounting periods) and present a significant barrier to an effective contribution from LULUCF mitigation activities.

Mitigation policies based on direct support for a specific set of measures are delivered at national level, therefore, domestic leakage and the requirement to ensure additionality should be addressed. Arguably, nationally coordinated approaches based on action plans can target specific activities and issues, judged of highest priority either due to large mitigation potential or a requirement to remediate or protect against negative effects. Such an approach could be regarded as consistent with the existing payments for environmental services already in operation in the EU under Common Agricultural Policy and, to that extent; there is a precedent if the EU took a similar initiative for mitigation in the LULUCF sectors.

Targets are set for levels of activity (or even just for levels of funding available for such activities), rather than setting targets for levels of emissions or removals. This could be viewed as pragmatic given the uncertainties and incomplete human control over GHG emissions and removals in the LULUCF sector. This approach can usefully complement MRV at the national level and which meets the UNFCCC and KP requirements.

A feature of note in the approaches based on direct support through national action plans is a recognition that mitigation of GHG emissions in the LULUCF sector will be delivered in the long term, thus the emphasis is on achieving emissions reductions or removals over long time scales rather than on meeting short term targets. This probably reflects the inherent properties of the LULUCF sector which may also be critical to shaping any policies developed in the EU.

Finally, the Icelandic and Norwegian policies are very 'light' in terms of MRV at the level of individual holdings, instead implicitly relying on UNFCCC reporting and KP accounting as sufficient for registering any impacts of the mitigation measures. This could be viewed as an effective way of linking to existing policies and an efficient use of existing MRV efforts.

4.3 Options for including LULUCF in a policy framework

4.3.1 Creating policy options

Either the ESD or EU ETS would require significant development and amendment to enable inclusion of the LULUCF sector, to the extent that the possibility of creating a separate policy framework especially to deal with LULUCF needed to be considered. Consequently, there are three possible policy options for comparison with 'Business As Usual' (BAU):

- BAU – Continue with ongoing international agreements and efforts, but do nothing extra, meaning that LULUCF is excluded from contributing to the EU's domestic reduction commitment.
- Option 1 – Integrate LULUCF in the Effort Sharing Decision (ESD).
- Option 2 – Integrate LULUCF in the EU Emissions Trading Scheme (ETS).
- Option 3 – Handle LULUCF in a new, separate framework.

'Building blocks' were developed for the three policy options for inclusion of LULUCF in an EU commitment on GHG emissions reduction as defined above. The elaboration of the building blocks into full and robust legislation would require significant effort. In this project each building block was considered in outline and the main issues identified for development of policy options.

4.3.2 Analysis of Business As Usual

BAU is the measure against which the other options can be judged and is defined here as an EU commitment which excludes LULUCF, as it currently does. It is important to consider the consequences of this exclusion if at the same time an international agreement is reached and includes at least some mandatory accounting (a likely possibility in the context of Decision 1/CMP.6 by the Conference of the Parties serving as the meeting of the parties to the Kyoto Protocol). The EU would have to meet international obligations whether or not it includes LULUCF in its own "domestic" reduction commitment (unless no international agreement is reached). Since BAU involves not including LULUCF in the "domestic" EU commitments and legislation, all the building blocks defined could not be fully developed.

On the positive side, under BAU; there would be no need to implement potentially complicated instruments and measures dealing with LULUCF, requiring significant changes and additions to associated legislation. There would be no need to review and revise targets for emissions reductions due to the contribution of LULUCF. Conflation of the overall uncertainty of emissions reductions due to mitigation actions and greater risks of impermanence of emissions reductions/ removals could also be avoided. MRV would essentially follow the current requirements under the KP, with some additions following changes in accounting in the second commitment period.

However, there are several clear negative implications of continuing with BAU:

- Non-inclusion of LULUCF potentially undermines the achievement of the ultimate objective of the UNFCCC because an important sector (about 10% of the EU's total GHG budget) is not accounted for.
- By not including LULUCF, the EU would be sending a signal internationally that LULUCF was not important and that action on LULUCF was neither needed nor appropriate.
- There could be problems for the environmental integrity of EU legislation, because there would not be a mechanism recognising the importance of management of land-based carbon stocks for climate change mitigation alongside other objectives such as food and energy security, landscape and habitat conservation and enhancement, or economic capacity building in rural areas.
- The potential for a cost-effective achievement of targets is limited as mitigation efforts will not include all sectors of the economy.
- There are major cross-sectoral issues associated with management of vegetation either to maintain and enhance vegetation carbon stocks or to provide a source of timber and biomass for use in the energy and industrial processes sectors. If the LULUCF sector is excluded from commitments to GHG emissions reductions, this would not provide the 'level playing field' needed in accounting for emissions and removals across all sectors. Inclusion of LULUCF would enhance the legitimacy of policies that support the use of timber and biomass in the energy and industrial processes sectors on an equal basis with conservation and enhancement of carbon stocks in the LULUCF sector.
- Not all the emissions related to agriculture are accounted for because methane and nitrous dioxide form part of the agriculture sector (which already counts towards the target) in reporting.
- There would be a discrepancy between EU and international commitments which would be difficult to justify if the EU signs up to an international agreement that includes the sector.

4.3.3 'Building block' analysis for Policy Options 1 to 3

An analysis was carried out of the 3 policy options identified for including LULUCF in the EU's reduction commitment (i.e. integration into the ESD, integration into the EU ETS, or a new, separate framework). As with the earlier analysis of non-EU LULUCF policies, the building blocks considered were: 'Definitions', 'Sectoral coverage', 'Transferability', 'Targets', 'Link to the overall target (of the EU

reduction commitment)', 'Accounting rules', 'MRV', 'Risk management', 'Compliance', 'Corrective actions' and 'Liability' (see Table 4.1).

Policy building blocks under all options

These definitions would be essential building blocks in any of the policy options.

Definitions

A great deal of work has been done in the course of international negotiations which should be taken into account. Compatibility (but not necessarily a one-to-one correspondence) with a possible international agreement is also important. It is therefore suggested that the definitions, emanating from Decisions 16/CMP.1 and 2/CMP.6, and the most recent text used in the negotiations (FCCC/KP/AWG/2010/CRP.3, or any later update) should be used for the following terms, if LULUCF were to be included in the EU's GHG reduction commitment: Forest, Afforestation, Deforestation, Revegetation, Forest management, Cropland management, Grazing land management and Wetland drainage and rewetting.

Table 4.1 Essential building blocks of a policy framework covering the LULUCF sector

Building block	Description
Definitions	What entities, processes and quantities would require clear definitions, e.g. activity, emissions?
Sectoral coverage	Would the framework cover the entire LULUCF sector or parts of it? If only parts, which activities?
Transferability	Assuming the framework would generate "units" in terms of (net) emissions reductions, would these be transferable between Member States? What about transfer between systems/schemes (EU ETS, ESD)?
Targets	Would targets be set? How, e.g. binding or non-binding targets? Different Member States have different circumstances in terms of land and vegetation cover, climatic conditions, vegetation characteristics and land use. Therefore Member States would vary in terms of their opportunities for positive action, and also their liabilities. How would the framework deal with this?
Link to the overall target	How is/ would the contribution of emissions and removals to the EU's overall target be regulated by the framework?
Accounting rules	What rules (if any) would be applied as part of the calculation of units in terms of (net) emissions reductions?
MRV	What MRV would be needed to support the framework? Is there sufficient technical know-how to implement MRV to a sufficient standard? Would countries have (or be able to build) the capacity to carry out the required MRV?
Risk management	There are risks that (net) emissions reductions could be reversed, either because of natural disturbance or because positive actions are undone (inadvertently or intentionally). How would the framework handle these risks?
Compliance	How would compliance be defined, e.g. on an annual basis or over the whole commitment period (average or moving average)?
Corrective actions	How would the framework deal with non-compliance (e.g. failure to meet a target for net emissions reductions)?
Integration	How could the framework support, respect, build on and/or work with the provisions made in existing relevant EU legislation?

Sectoral coverage

It would be necessary to define the sectoral coverage of the option. The activities accounted for could include afforestation, reforestation and/or deforestation as covered under the current KP and also the activities of forest management, cropland management, grazing land management, wetland drainage and rewetting and revegetation as already partially covered under the current KP.

It is clear that "many changes" would be required to existing internationally agreed accounting rules e.g. in addition to afforestation, reforestation and deforestation, mandatory accounting would be required for at least the most important KP activities (forest, cropland and grazing land management), to achieve a broad coverage of LULUCF activities. In principle, a partial inclusion of LULUCF would exhibit the same problems as a non-inclusion and would therefore be difficult to defend.

Accounting rules

The inclusion of LULUCF makes it necessary to define the accounting rules for the three options, which could comprise:

- Effectively gross-net accounting for afforestation, reforestation and/or deforestation activities that were started on or after 1 January 1990 and before the end of the last year of the commitment period.
- Net-net accounting for revegetation, cropland management, grazing land management and wetland drainage and rewetting activities.
- 'Reference level' accounting for forest management activities.
- 'Production approach' accounting for harvested wood products arising from afforestation, reforestation, deforestation and forest management.

Risk management

In order to limit compliance risk, it is necessary to deal with the risks of increased emissions as a result of disturbance events affecting the LULUCF sector outside of the control of Member States. A proposal to deal with disturbances is currently under discussion in the international climate change negotiations, which could form the basis of an appropriate accounting mechanism.

Integration

Any new policy development to deal with LULUCF will need to integrate, complement and reinforce existing EU climate, agriculture and forestry policies. Therefore an attempt was made to identify the main existing relevant EU policies. These were considered to be the Habitats and Birds Directive, Natura 2000, MCPFE Resolutions H2, V1 and V4, the 2006 Communication of the Biodiversity Action Plan, the EU Forest Strategy, Forest Action Plan and Green Paper on Forest Protection and Information, the Soil Thematic Strategy, the CAP (Cross-compliance and Rural development), Renewable Energy Policy in general, the EU ETS, the EU ESD, the European Economic Recovery Plan, EU Waste Policy and the EU Regulation on Protection Against Forest Fires.

The key aspects of policy integration for a new policy dealing with GHG mitigation in the LULUCF sector would appear to consist of:

- Including criteria for wider environmental objectives in the implementation of GHG mitigation agriculture and forestry policy instruments and measures.
- As far as possible, making use of existing mechanisms in the agriculture and forest sectors for monitoring, reporting and verification of the effectiveness of LULUCF GHG mitigation activities.

- Ensuring sufficient and consistent sectoral coverage and, at the same time, avoiding the possibility of double-counting of LULUCF emissions and removals within the scope of actions taken under other policies.
- Devising accounting rules for GHG mitigation that ensure a 'level playing' field with activities in other sectors.

Statements made about implications for integration under the EU ETS and ESD would seem to apply, regardless of whether LULUCF was included within one of these policies or treated in another way.

4.3.4 Policy building blocks by option

Further policy building blocks were considered separately with respect to each of the three policy options, as summarised in Table 4.2.

Table 4.2 Summary of consideration of specific building blocks needed for policy options

Building block	Option 1 (ESD)	Option 2 (EU ETS)	Option 3 (separate framework)
Transferability	There are existing transferability mechanisms, but the allowances for transfers are limited in order to achieve effective operation of the ESD. The magnitudes of these allowances are likely to be too small to permit the flexibilities needed in the LULUCF sector, and would limit flexibilities intended for other purposes. Introducing larger allowances may undermine one of the key principles of the ESD. Details may depend on how targets are set.	The EU ETS allows the transfer of credits between installations, but on the basis of tradable units. A major issue is the potential impermanence of the net emissions reductions in the LULUCF sector, should they be transferred between participants. No modalities have been developed to mitigate the impacts of impermanence, high uncertainties (including the likely necessity of recalculations), jeopardising the environmental effectiveness of the EU ETS.	Transferability mechanisms are only necessary in the case of a quantitative target. These could be modelled on the current mechanisms of transferability in the ESD, with suitable adaptation. Details may depend on whether/how targets are set. Transferability between this new framework and the ESD has to be evaluated in order not to compromise effectiveness. Given the trade-off in mitigation effects between LULUCF and other sectors, transferability between LULUCF and the ESD may be required if there are specific LULUCF targets.
Link to overall target	LULUCF would form part of this. Resulting credits and debits would be added to or subtracted from the achievements in other sectors. The contribution of LULUCF to the EU reduction commitment would be the sum of individual MS.	EU ETS installations are required to jointly reduce emissions by 21% by 2020 compared to 2005. The principle of operation would not change if LULUCF were added. Because of the high uncertainty, inter-annual variability and risks of credits/debits potentially affecting the scheme (and quantity in the case of project off-sets), the functioning of the carbon market might be undermined.	LULUCF may or may not be required to meet a specific target. The overall target for the LULUCF sector could be expressed as: a ceiling value, a fixed reduction in net emissions, or a progressive reduction in net emissions (see table below), depending on how ambitious the EU wishes to be in achieving mitigation in the sector, and views taken on the feasibility of effective action. A target should take account of mitigation effects holistically, i.e. considering emissions reductions through materials and energy substitution as well as carbon sequestration in vegetation and soil.
Targets	Existing limits for MS would need to be recalculated and reallocated. Some negative limits may become positive and vice versa. The application of the linear reduction factor would be very difficult in the LULUCF sector because emissions and removals are not entirely under human control and develop in a complex way over time.	The EU ETS does not include sector-specific targets (emissions permits), but has an overall cap on emissions, country-specific allocations of emissions permits, and installation-specific emission targets. There would need to be some mechanism for assigning emissions limits/permits to areas of land, whether defined directly as installations, or through some analogous classification. This could prove to be very difficult.	Either LULUCF could be included in the EU's commitment so that relevant emissions and removals contribute but without counting towards a sector-specific target, or the sector can be included with quantitative targets for levels of emissions/removals in all MS. In the second case, an approach analogous to that described under the ESD could be adopted. A target for the LULUCF sector could be set for a longer timescale than 2020. As noted above, targets should take account of mitigation effects holistically, i.e. considering emissions reductions through materials and energy substitution as well as carbon sequestration in vegetation and soil. This is needed to ensure that there are no barriers to effective mitigation across sectors.

Table 4.2 Summary of consideration of specific building blocks needed for policy options (continued)

MRV	The ESD relies on UNFCCC reporting. LULUCF would require application of accounting rules (not just reporting).	A quality of monitoring and reporting at the land holding level would be needed that is comparable to the monitoring and reporting of emissions from the installations currently covered by the scheme. The currently available guidance for monitoring LULUCF has been designed for national inventory systems and is not intended for monitoring at the farm/land holding level. Specific LULUCF verifiers would be needed. There is likely to be a disproportionate cost associated with MRV, particularly for small land holdings.	MRV could rely as much as possible on existing reporting requirements in the EU GHG Monitoring Mechanism,, supplemented by bespoke systems to manage and assess the performance of specific policy instruments and measures and to indicate whether targets (if set) are being achieved.
Compliance, corrective action and liability	Inclusion would require two problems to be solved. First, annual reporting (required for ESD) of LULUCF emissions and removals would be difficult and expensive. Second, the requirements for annual compliance would be very difficult to adhere to because of large interannual fluctuations of emissions and removals between years. Mechanisms to handle corrective action may also require amendment.	At the EU level, it is likely that work would be needed to accommodate the LULUCF sector in the EU ETS registries for transactions to be correctly recorded. There could be great numbers of individuals potentially owning allowances that would need to be introduced within the EU ETS if LULUCF was included, creating logistical issues. The risk of non-compliance with targets and associated liabilities is likely to be increased.	Compliance and corrective actions would only apply in the case of binding targets of some sort (e.g. levels of emissions or extent of activities). To avoid the difficulties associated with annual compliance, the requirement for compliance could for example instead be based on the average of emissions and removals over the whole compliance period.

5 Assessment of LULUCF policy options

5.1 Introduction

This component of the work made the final assessment of the options identified for policies to support climate mitigation in the LULUCF sector.

5.2 Approach to assessment of options

The assessment was carried out by first developing a set of criteria against which different policy options could be evaluated. The criteria were selected to test BAU and the policy options in terms of their suitability to meet three key requirements:

1. **Environmental effectiveness** – does the specified aspect of the policy option actually work and in particular will it support achievement of commitments to emissions reductions?
2. **Efficiency of implementation** – how well does the specified aspect of the policy option work, in particular does it make it easy to take action on mitigation?
3. **Consistency** withintheEU27, within Member States and across mitigation activities in the LULUCF sector.

5.3 Assessment of policy options

A summary of the final assessment of the three policy options alongside an assessment of Business as Usual (BAU) is presented in Table 5.1. The colour codes used to classify assessments are defined in Box 5.1.

Box 5.1 Key to colour codes in Table 5.1

Colour	Interpretation
	No major problems likely for integrating LULUCF into the option, when judged against the requirements of the criteria.
	Some problems likely integrating LULUCF into the option when judged against the requirements of the criteria. Likely to involve significant but tractable modifications to existing policies or careful articulation in new policies.
	Serious problems that may prevent LULUCF integrating into the option when judged against the requirements of the criteria. Modifications to existing policies or articulation of new policies extremely problematic or impossible.

Table 5.1 Summary of assessment against criteria of BAU and the three policy options.

Criterion	Business As Usual (BAU)	Option 1 Inclusion in the ESD	Option 2 Inclusion in the EU ETS	Option 3 Separate framework with targets
Effectiveness				
Leakage: how is leakage minimized? i.e. are measures taken to ensure emissions reduction in one place don't lead to emissions in another location.				
Additionality: how is additionality of emissions reductions addressed? i.e. are techniques used to assess whether or not emission reduction activities would have happened under BAU.				
Permanence: how is the potential impermanence of LULUCF emission reductions dealt with?				
Coverage: are all LULUCF sectors covered?				
MRV: what mechanisms for measuring (quantification), reporting and verifying actions are in place?				
Uncertainties: how is the uncertainty associated with emissions reductions addressed?				
Relevance: how relevant is the contribution to the EU reduction commitment?				
Efficiency				
Timely delivery of emission reductions: can the mechanism deliver actions in the timeframe required?				
Implementation: can the policy/legislation be easily implemented across all MS? (i.e. capacity building)				
Incentives: what incentives, if any are provided for action? i.e. is it regulatory, economic, or voluntary				
Targets: are they any sectoral targets foreseen? If so what type? i.e. qualitative or quantitative, by MS or across the EU.				
Administrative issues: what are associated administrative costs to MS, EU, other? (qualitative/relative assessments only may be possible)				
Cost effectiveness: How cost effective is the policy legislation?				
Consistency				
Equity among MS: are actions comparability across MS? (i.e. Does 1 tCO_2e from forest management activities in one MS equate to 1 tCO_2e reduced in another)				
Specific conditions in MS: does the policy/legislation allow flexibility to take into MS situations (e.g. soil carbon varies greatly across MS)				
Legislation in EU27: is the policy/legislation aligned and consistent with other LULUCF policy/legislation?				
Does the policy/legislation take account of *co-benefits* from LULUCF, are measures taken to preserve biological diversity?				
How are *cross-sectoral impacts* (HWP, bioenergy, construction) considered?				

The **assessment of BAU** suggests that there are serious problems:

- **Permanence** – There is a great risk because unless there is an international agreement there will not be a mechanism to ensure that reversals of removals are remediated in the LULUCF and other sectors.
- **Sectoral coverage** – the facility to elect/not elect certain LULUCF sectors/activities means that coverage may not be complete for all Member States. It is not clear that this limitation will be addressed through the elaboration of the accounting rules of the KP, or KP successor.
- **Relevance** – by definition, BAU implies no explicit contribution to the EU's GHG reduction commitment.
- **Timely delivery of emissions reductions** – although existing frameworks have operated for some years, there has been slow progress on the development of associated instruments and measures as part of implementation. Delivery of significant additional emissions reductions in the LULUCF sector has not been timely in the current KP reporting period. The continuing negotiations over the details of defining activities and agreeing accounting rules is delaying action in the LULUCF sector.
- **Incentives** – the KP sets targets for emissions reductions in Member States. However there are no specific targets to be achieved in the LULUCF sector. Beyond the overall target, and particularly because of the problems associated with current accounting rules, therefore, there are no explicit incentives in existing frameworks. Generally, Member States do not have strong mechanisms to support mitigation in the LULUCF sector.
- **Targets** – the KP sets quantitative targets for emissions reductions in Member States, but across all sectors, not specific to LULUCF.
- **Equity among** Member States – the application of UNFCCC Good Practice Guidance ensures comparability of emissions across sectors. However the application of tier levels and approaches in MRV varies across Member States. This and the facility to elect or not elect certain LULUCF sectors/activities (e.g. forest, cropland, grassland management) means that reported impacts of actions cannot be guaranteed to be consistent across Member States.
- **Cross-sectoral impacts** – in terms of UNFCCC reporting, all sectors and categories are represented, but the links between them are not explicitly monitored. Under the KP, Member States have the option to elect, or not to elect, specific activities. This could mean that the consequences of cross-sectoral impacts are not accounted for. For example, if activities to increase the use of renewable energy cause long term reduction in carbon sticks, the reductions in stocks may not be monitored if Forest Management is not elected. Therefore a "level playing field" between conservation and enhancement of carbon stocks and utilisation of biomass for energy and materials cannot be ensured. Currently, harvested wood products are not accounted for under the KP and negotiations on this point are ongoing.

There would also be serious problems with **inclusion of the LULUCF sector in the EU ETS**, specifically:

- **Permanence** – as long as all emissions and removals are accounted for, permanence should in principle not be an issue because reversals will have to be remediated by additional action in the LULUCF or other sectors. However, since the liability rests with individual installations/holdings, there is a great risk of "unclaimed" GHG fluxes if companies face insolvency or bankruptcy. Liability for carbon stocks in soils, which may depend on maintaining certain agricultural and forestry practices may have negative economic impacts on land users, in particular farmers. Again, given the partial coverage of current KP and possible future accounting, the EU ETS would need to adopt accounting rules more ambitious than the KP for the LULUCF sector to ensure permanence. There are article of the EU ETS dealing with compliance and corrective action. The text of the EU ETS would need to be explicitly amended to include a disturbance mechanism.
- **Coverage** – additional activities could be added to the EU ETS. Ideally the inclusion of LULUCF in the EU ETS would require all Member States to account for all key activities, but not necessarily to implement mitigation based on all activities. Due to the high number of land holdings, it would be impractical to include every single piece of land. In the EU ETS small installations are excluded from the trading scheme, and this approach may offer a route to exclude small land holdings or areas with small associated net emissions in the LULUCF sector. However, this would also reduce the coverage.

- **MRV** – EU ETS MRV requirements for estimating emissions of GHGs are tailored towards installations (rather than MRV across large land areas, such as is the case in IPCC Good Practice Guidance for LULUCF) and involve the monitoring and reporting of annual emissions with high accuracy and low uncertainty for each installation. The high inter-annual variability in net LULUCF emissions would be unsuitable for the current EU ETS requirements. The potential to accommodate LULUCF will depend on whether the change in emissions/ removals needs to be monitored from year to year, or over a period of several years. Periodic accounting would be in stark contrast to the key features of the EU ETS and would be difficult to implement. The high inter-annual uncertainties in net LULUCF emissions would be unsuitable for the current EU ETS requirements. The potential to accommodate LULUCF will depend on whether the change in emissions/ removals needs to be monitored from year to year, or over a period of several years. Periodic reporting would be in stark contrast to the key features of the EU ETS and would be difficult to implement.
- **Uncertainties** – current uncertainties in LULUCF are greater than would be acceptable for the EU ETS.
- **Timely delivery** – if it were possible to include the LULUCF sector in the EU ETS, this would be highly likely to bind participants to taking action. However, participants would probably prioritise those activities that delivered short term GHG reductions, which not be the optimal strategy for mitigation in the sector. Also, given the requirement for annual compliance following a linear trajectory over the years 2013-20, it is highly unlikely that LULUCF measures, which require time to take effect, would be able to make a timely contribution on an annual basis. The high inter-annual variability of LULUCF emissions and removals also presents an obstacle.
- **Implementation** – in the EU ETS this would be problematic. For example, the definition of an installation would have to be extended to land areas, and there are a very large number of land holdings involved. Registries would need to be able to track of transactions potentially involving a huge number of land holdings and a diversity of associated mitigation activities. Changing the emissions cap would require negotiation at EU level.
- **Targets** – setting sector targets would be irrelevant in a cap-and-trade system. The EU ETS operates below the level of the sector by applying caps to individual installations. The large land area and the complexity of the LULUCF sector in terms of carbon stocks and ownership would make it very difficult but not impossible to assign emission caps to units of land. The liability introduced by including LULUCF into the EU Reduction Commitment could be mitigated by use of reference level, cap, or discount factor for accounting purposes.
- **Administrative issues** – there are likely to be significant costs as all MS would need to implement inclusion of LULUCF in the EU ETS (unless there was a significant facility for exemption in cases where *national* LULUCF net emissions were small), new legislation would be needed, and methods would need to be adapted or modified to estimate emissions or removals from all or parts of the LULUCF sector for the EU ETS.
- **Cost effectiveness** – several LULUCF activities are cost effective, but others are not. Very high costs would be associated with MRV, particularly since MRV would be required at installation levels (e.g. many areas and land holdings). Even if the ESD and EU ETS alone were sufficient to achieve the EU's 20% (or any other target up to 30%) in 2020, LULUCF could be included to add further potential for cost efficiency in achieving either of these targets (action is taken where cost effectiveness is greatest).
- **Equity** – the reporting and accounting rules used by the LULUCF participants in the EU ETS would need to be at least consistent with the UNFCCC and KP. All MS would need to implement inclusion of LULUCF in the EU ETS regardless of the potential magnitude of the contribution due to LULUCF in the Member States, unless there was a facility for exemptions covering cases where *national* LULUCF net emissions are small. Distributing allowances based on site-specific characteristics would be extremely difficult.
- **Legislation in the EU27** – The inclusion of LULUCF in the EU ETS would need the sectoral coverage to be consistent with the activity-based approach referred to by the UNFCCC and KP. There is a need to ensure emissions accounted for the EU ETS are not accounted for under the ESD and visa versa. If the EU ETS is used to incentivise LULUCF activities, it will be necessary to withdraw direct support for these activities under the CAP. This would be problematic as it would then not be possible to pay for wider related environmental services.

The assessment also shows that there are some significant difficulties associated with **including the LULUCF sector in the ESD**, specifically:

- **MRV** – In terms of *reporting*, ESD MRV requirements may be suitable for the LULUCF sector, as they are based on the reporting of annual GHG inventories under the Monitoring Mechanism 280/2004/EC. The LULUCF sector is covered under this mechanism and uses the IPCC MRV guidance (see BAU). However, the high inter-annual variability in net LULUCF emissions would be unsuitable for the current ESD requirements of annual *compliance*. The potential to accommodate LULUCF will depend on whether the change in emissions/ removals needs to be accounted for annually, or over a period of several years. The latter is in stark contrast to the key features of the ESD and would be difficult to implement. In terms of annual compliance, it would also be difficult to resolve how an average value would feed into the ESD annual compliance requirements. Most likely an ex-post adjustment mechanism at the end of a commitment period would be needed (but this would then repeal all the annual decisions on compliance).
- **Timely delivery** – Integration of LULUCF into the ESD would make it more likely for mitigation activities to take place. However, the general principle under the ESD is that Member States are free to choose those activities which are appropriate to achieve to achieve the GHG emissions targets. Therefore mitigation activity and delivery of emissions reduction in the LULUCF sector is not guaranteed. Also, given the requirement for annual compliance following a linear trajectory over the years 2013-20, it is highly unlikely that LULUCF measures, which require time to take effect, would be able to make a timely contribution on an annual basis.
- **Implementation** – The high inter-annual variability of emissions and removals in LULUCF, the long lead time for mitigation measures and the frequent and significant recalculations of reported data would make it impossible to include LULUCF in the current architecture of the ESD. Targets would require renegotiation at EU level.

The development of a policy covering LULUCF based on the option **of a separate framework** would need to take account of issues identified for most of the criteria in the assessment. However, a separate framework (based on targets for emissions levels or activities) would appear to present certain opportunities that would be less easy to realise through inclusion within the ESD:

- **Long compliance cycles** – A separate framework could be designed to match the specific needs of a land based sector and would be able to address the problems encountered with regards to annual compliance under the ESD.
- **Timely delivery** - If the framework included all key mitigation activities in the LULUCF sector, there should be measures that can deliver emissions reduction in the short term (i.e. by 2020) and longer terms. However, the potential for the implementation of different activities will be very different between MS.
- **Incentives** – the development of a separate framework gives the opportunity to ensure that specific incentives for mitigation activity in the LULUCF sector are put in place. Targets can be set for emissions reductions and should provide MS with the incentives to take actions in the LULUCF sector. The framework would need to be supported by associated instruments to incentivise mitigation measures (e.g. as modifications to the CAP).
- **Targets** - may or may not be set. If set, this may happen on the basis of mitigation potential, a fixed percentage or any other approach discussed in Table 6.3, Section 6.4. However, as long as emissions and removals count towards the overall target the ambition would be equitable with that of other sectors and a sector-specific target may not be needed.

For the option of a separate framework for the LULUCF sector it would still be the case that the potential for the implementation of different activities would be very different between Member States. For a separate framework based on targets for levels of mitigation activity, timely delivery of emissions reductions would depend on targeted incentives for mitigation measures and it may also be difficult to predict the magnitude of the contribution to emissions levels in a specific time period. Consideration of cross-sectoral impacts is also important as mitigation efforts based on substitution of energy-rich materials and fuels may be associated with increased emissions (or reduced removals) in the LULUCF sector due to increased production. When considering the definition of targets, it is therefore important to look at the net effect across sectors, including carbon leakage effects. Finally, it should be noted

that LULUCF consists of a heterogeneous set of sub-sectors, comprising mainly forestry and soils. When defining possible approaches to include LULUCF in the reduction commitment, the specificities of the sub-sectors would need to be taken into account, including their challenges as regards MRV.

A full assessment of the options, and in particular of the possible setting of targets, will also have to be based on an evaluation of the economic and environmental impacts that this would have. However, a full economic impact evaluation of this nature falls outside the scope of this report.

6 LULUCF sector policy instruments

There are several EU and international policies and laws that have or can have some impact on the LULUCF sector. However, none of these are specifically aimed at mitigation in the LULUCF sectors.

6.1 Existing legislation

Six EU policy themes cover LULUCF activities as illustrated in Figure 6.1. These specific policies and their effect on LULUCF mitigation are described in turn in this Chapter.

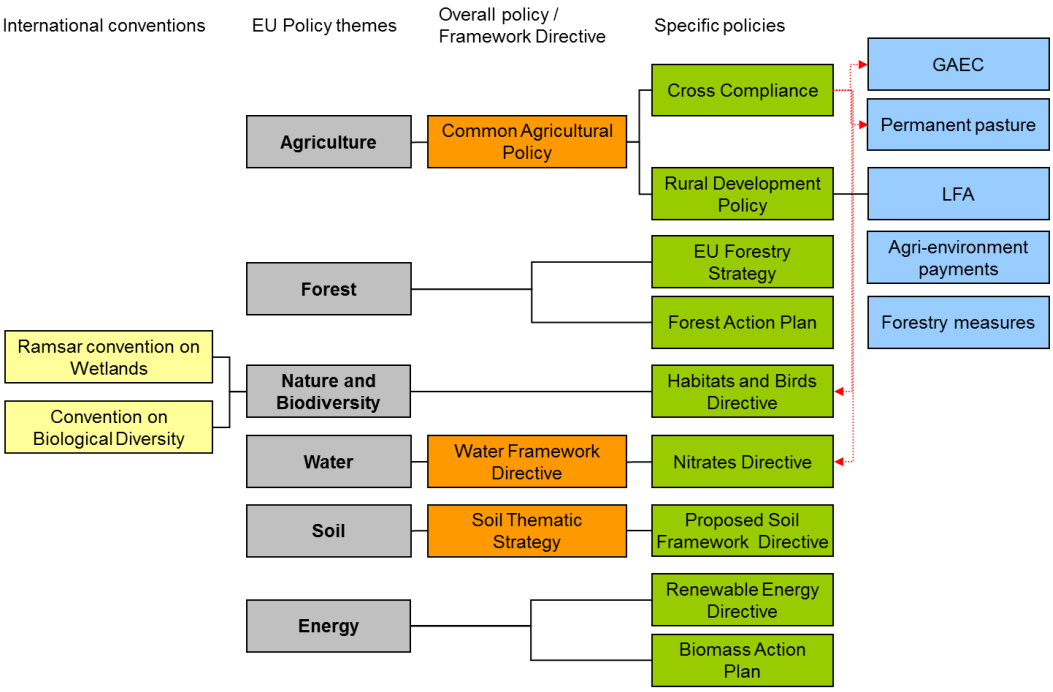

Figure 6.1 Overview of EU and international legislation and policies that are related to LULUCF

Most of the measures with an impact do not have climate mitigation as their primary objective. Some are focussed on conservation and enhancement of biodiversity, i.e. the Ramsar Convention on wetlands, the Convention on Biological Diversity and the Habitats and Birds Directive, which indirectly results in conservation of important carbon stocks in forests, wetlands, and other ecosystems.

Many policies include and identify specific measures that are aimed at specific non-LULUCF targets yet are directed towards effective management of soil carbon. However, most policy frameworks also include specific measures that have an associated risk of not managing the soil carbon stock and sink in a sustainable way. Management for reduced nitrogen (N) and reduced losses of soil carbon is a useful approach to prevent trade-off of emissions between the greenhouse gases CO_2, methane (CH_4) and nitrous oxide (N_2O).

The **Common Agricultural Policy** has many aspects that have an impact on emissions and removals of the LULUCF sector and offers several mechanisms through which future climate mitigation policies and measures can be linked. **The Cross Compliance** requirement for direct support under the CAP is an instrument that can contribute to maintain or enhance soil organic carbon. Soil protection and soil carbon protection aspects are included in GAECs (**Good Agricultural and Environmental Condition criteria**), but improvements are possible. Obligations for farmers to undertake certain climate relevant measures ("**greening measures**") could be introduced under the First Pillar of the CAP, provided that the additional expenses for farmers would be compensated. Also the Rural Development policy already offers opportunities to stimulate climate mitigation, for instance via its **agri-**

environmental payments. These opportunities could be further developed. In particular, it could be useful to improve the strategic programming at MS level in order to link rural development measures better to climate change objectives resulting from EU climate change legislation, the Renewable Energy Sources (RES) Directive and the Europe 2020 strategy.

In November 2010 the Commission published a communication on "the Common Agricultural Policy (CAP) towards 2020 – Meeting the food, natural resources and territorial challenges of the future"[13]. The paper outlines three options for further reform:

1. Adjusting most pressing shortcomings in the CAP through gradual changes
2. Making the CAP greener, fairer, more efficient, and more effective
3. Moving away from income support and market measures and focusing on environmental and climate change objectives.

The Communication stresses the need to overcome the challenge of climate change and the sustainable use of natural resources whilst at the same time being more productive. In order to achieve this, it is necessary to maintain the agricultural sector's ability, throughout Europe, to demonstrate that it is innovative, as well as its ability to invest and to respond to market developments.

The Commission's Communication suggests several key elements. Firstly, the architecture of direct payments must be reviewed. They must include a 'green' component of ecological competitiveness and must be distributed more fairly and in a more transparent way. Secondly, efforts must be increased with regard to innovation and the fight against climate change in the context of rural development programmes. Lastly, it is necessary to work on the transparency of the food chain and to examine the possibility of giving Member States new tools for combating the excessive volatility of the prices of agricultural raw materials.

Following discussion of these ideas, the Commission presented a formal legislative proposal in the second half of 2011. The Commission’s proposal gives specific attention to climate change. This may include the introduction of obligatory "greening measures" to be implemented by all farmers, some of which have a potential to contribute to climate change mitigation.

The **Forest Action Plan** is focussed on maintaining economic output, environmental and wider social benefits from forestry by encouraging appropriate research, circulation of knowledge and coordination within the EU. It was formulated and implemented with a view to facilitating support for Kyoto and UNFCCC initiatives. Ongoing implementation of the Forest Action Plan could further address LULUCF mitigation objectives. For instance, as part of the development of afforestation guidelines, there could be specific provisions dealing with promotion of carbon sequestration, but precluding afforestation on land with existing high carbon stocks.

6.2 Development of LULUCF policy instruments

Three climate mitigation activities were developed for agriculture: improved cropland management, improved grassland management and improved management of organic soil (under agriculture). These terms are used since they are partly linked to the KP activities, they comprise a set of measures and they are sufficiently generic to be useful for implementation in EU legislation. Selection criteria for choosing mitigation activities in these three activities should be a large and realistic mitigation potential within agriculture and no associated high risks of indirect land use change effects. Furthermore the activities should make use of existing and upcoming EU legislation and regulations. Although the terms for the three activities are rather broad, in the detailing of the activities it will refer to more specific measures and policy instruments. At member state level these activities can be further detailed to account for natural conditions and differences in farming structure.

The objective of mitigation activities in improved cropland management is to enhance existing carbon stocks and to reduce losses in arable soils through stimulating soil carbon friendly practices. This objective can be reached by making the current soil management practices more climate-oriented and

[13] http://ec.europa.eu/agriculture/cap-post-2013/communication/com2010-672_en.pdf

by raising awareness on climate mitigation via soil carbon measures amongst farmers. Improved grassland management aims at the protection of existing carbon stocks and enhancement of carbon sequestration under permanent grassland and in non-permanent grasslands. Strengthening current cross compliance requirements (or introducing a "greening component" under Pillar I of the CAP) for the maintenance of permanent pastures and raising awareness amongst farmers on climate mitigation and the importance of permanent pastures are important aspects. The objective of improved management of organic soils is to protect existing carbon stocks in peatlands and prevent further losses of carbon through reduced drainage and disturbance. Improved management of organic soils deals with a change in hydrological management of land and its consequences. Peatland restoration, through blocking of drainage channels, is becoming increasingly widespread, with aims including restoration of ecological quality, improvement of drinking water quality, and restoration of the function of peatlands as a carbon sink.

For LULUCF-based mitigation in forestry, three climate mitigation activities were developed: protection against deforestation, creation of new forest areas and conservation or enhancement of existing forest carbon stocks and enhancement of existing forest carbon stocks. These four activities have been chosen because they cover a wide range of mitigation options. They have been defined generically with the aim of allowing wide scope in EU legislation and responsiveness to particular Member State circumstances.

These mitigation actions need to be considered in combination with the impacts in other sectors due to substitution of wood for energy-intensive materials and fuels, considering fully the trade-offs between LULUCF carbon stocks and substitution, as well as carbon leakage.

The objective of protecting forested areas from deforestation is to mitigate the impacts of deforestation, so as to maintain forest carbon stocks and prevent the release of carbon dioxide to the atmosphere. This could be achieved by Member States cooperating to strengthen their national legislation and regulation to protect forest areas from deforestation, which is already in place in some Member States. The approach is thus based strongly on regulation rather than incentives. The aim of creating new forest areas is to enhance land-based carbon stocks and, potentially, increase the available biomass and timber resource. An approach to achieving this is proposed, based on payments for creation of new forests, which are already available to some extent as part of rural development mechanisms, although not explicitly to meet climate change mitigation objectives. The two activities involving management of existing forests aim to conserve and where appropriate enhance forest carbon stocks, which constitute a significant carbon reservoir in the EU. Measures aimed at managing existing forests to mitigate climate change need to be defined and implemented very carefully. It is difficult to construct a simple scheme to make payments for generic forest management activities. An example approach is illustrated in detail in Annex 3, however, it should be emphasised that this just one possible system, and some of the details (e.g. reference to modelled estimates of long term average carbon stocks in forests) may not be acceptable to all stakeholders. Communication measures in support of all the forestry measures will be important, but particularly for those involving management of existing forests.

All mitigation activities in both agriculture and forestry have to be further developed in detail and adapted to local circumstances in Member States. At EU level the current policies and regulations under the CAP can be oriented further towards climate change mitigation, which is part of current discussions regarding options for the post-2013 CAP. Under the first Pillar the cross compliance mechanism could be strengthened, by making GAECs and SMRs more strict, or by adding a ‘greening component’. The economic implications of such measures also need to be evaluated. Under the second Pillar more funds should be allocated to Climate Change measures in the rural development programmes. Member States should specify in their rural development plans how they will address climate mitigation in agriculture and which incentives they will provide. For forestry, the second Pillar is most relevant and more funds could be allocated to Climate Change measures in the rural development programmes. Member States should specify in their rural development plans how they will address climate mitigation in forestry and which incentives they will provide.

6.3 Assessment of the proposed mitigation activities

An assessment was made of the proposed agriculture and forestry mitigation activities. There are mitigation measures in relation to agriculture, which have a significant technical mitigation potential. Hotspots are linked to land conversion and the cultivation of organic soils. These affect relatively small percentages of the agricultural surface.

The main concerns for improved cropland management are issues that relate to additionality and permanence, since soil carbon sequestration is reversible. Other key barriers for implementation are costs (high costs in particular for taking land out of production, e.g. for re-wetting of organic soils), potential loss of agricultural production (leakage) – in particular in relation to crop production, offsets by non-CO_2 emissions, uncertainties in the application of some measures (e.g. reduced tillage) and limited applicability of some measures (e.g. limited to some climatic and soil conditions). These barriers make the assessment of the feasible mitigation potential more difficult. For grassland management the main concern is regarding permanence, because sequestered carbon can easily be lost upon change or temporary or permanent discontinuation in management for both crop- and grassland management. The abolition of set-aside showed that sequestered carbon can be easily released again when there is a change in policy and market demands. It may be difficult to develop appropriate legislation that does control and secure the carbon stocks built up over long time scales (decades to centuries) and that any changes both sequestration or removal and losses via emissions can and will be adequately monitored and reported. It is also difficult to assign liability for carbon in the soil of such time spans. As any of the almost permanent changes in land use from e.g. tilled cropland to permanent grassland and forest will involve a land-use change from transfer of crop production to other land, this requires careful implementation. MRV is a main limiting factor if individual measures need to be monitored, less so for national monitoring and reporting. Currently, soil inventories are incomplete and there is a lack of activity data and of adapted emission factors. Research is needed to improve the latter. Better activity data would be needed to improve the first.

Nevertheless, measures can be defined that contribute to mitigation. It is important to focus on the prevention of losses of sequestered carbon over time. An unknown component is, however, the effect of global warming, which may or may not contribute to losses of soil carbon over the coming decades.

Issues that would have to be addressed further include:

- Ensuring adequate management and MRV for all activities (i.e. adequate implementation of MRV to meet commitments to UNFCCC and KP), as few Member States are ready to report on cropland and grassland management so far.
- Clarifying where the bulk of the burden for administration should lie (i.e. with governments or their agents, or with the food industry, or with farmers and land owners).
- Verifying the cost-effectiveness of the agriculture activities and environmental benefits.
- Clarifying the attribution and ownership of any credits or liabilities arising from carbon sequestration or emissions reductions from cropland and grassland management.
- Providing supporting data, models and tools for use as part of the administration and management of cropland, grassland and wetland management.

The analysis of forestry activities suggests that there are very few absolute “showstoppers”. The most serious issues concern adequate protection against deforestation, where individual Member States will need to commit quite inflexibly to strong regulation, while, for encouragement of afforestation, the positive impacts are only fully expressed in the longer term, with only a relatively small contribution to climate change mitigation possible by 2020. For all forestry activities, generally there are many issues requiring clarification or resolution before effective implementation of the above outlined options can proceed. Issues of particular relevance are the need to:

- Ensure that mitigation policies are conducted in a holistic way, addressing both carbon stocks in LULUCF and substitution in other sectors, while considering other economic and environmental aspects

- Ensure adequate management and MRV for all activities (i.e. adequate implementation of MRV to meet commitments to UNFCCC and KP), and most notably the probable requirement for a dedicated approach for the 'forest management' activities.
- Establish the extent to which internal accounting for forestry activities needs to be harmonised with accounting rules adopted under the KP or any successor, and what to do if this is needed or not needed.
- Clarify where the bulk of the administrative burden should lie (i.e. with governments or their agents, or with land managers).
- Verify the cost-effectiveness of forestry activities.
- Ensure that activities are supported "in the right circumstances", i.e. so that co-benefits and cross-sectoral impacts are positive. (Part of this approach involves evaluating activities against wider criteria as part of their administration.)
- Provide supporting data, models and tools for use as part of the administration and management of forestry measures, particularly for 'forest management'.

Implementation, incentives, administrative issues, specific conditions of MS and legislation are all criteria that do not have to be problems for implementing the mitigation activities in agriculture, since these activities are largely based on existing legislation and policies under the CAP. Cross compliance and rural development policy, with its EARFD fund and the Common Monitoring and Evaluation Framework, form a good basis for the implementation of agricultural mitigation activities, possibly accompanied with future "greening measures". Implementation of the forestry mitigation activities may be more problematic, since there is not a strong overall policy at EU level (although there is some support via rural development), while MRV methodologies and capacities differ strongly among Member States.

Unlike MRV for the purposes of national reporting in the LULUCF sector, MRV for LULUCF measures requires a link to land areas where actions are taking place, and a methodology for estimating the impacts of those actions on the LULUCF GHG balance.

7 Conclusions on LULUCF policy options

The EU has committed unilaterally to reduce its overall greenhouse gas (GHG) emissions to 20% below 1990 levels by 2020, and to 30% below 1990 levels 'if conditions are right'. The current reduction commitment is mainly implemented through Directive 2009/29/EC and Decision 406/2009/EC, i.e. the EU Emissions Trading Scheme (EU ETS) and the Effort Sharing Decision (ESD). These policies provide frameworks for GHG mitigation activities in all economic sectors within the EU, with the exception of the LULUCF sector.

The EU's existing GHG reduction commitments for 2020 do not cover LULUCF for a number of reasons, for example, because the handling of LULUCF remains the subject of ongoing international negotiations, but in particular because careful analysis of the sector's potential role was needed prior to its inclusion in the commitment, including a closer look at the following issues:

- Emissions and removals follow complex time courses, under human influence but not complete control
- Saturation of carbon sequestration eventually takes place
- There are issues with additionality of emissions reductions and removals based on land management (for example, past actions are still having impacts now)
- Benefits can be impermanent (they can be reversed)
- Monitoring needs to be extensive (large land areas and complex vegetation systems), and estimates of emissions and removals are uncertain
- Management of vegetation involves significant cross-sectoral linkages (bioenergy, construction materials)
- The total land area involved is extensive, incorporating many owners, agents and managers.

However, excluding LULUCF means that the sectoral coverage of mitigation policies and actions is partial, which is also inherently problematic. Moreover, the potential of LULUCF mitigation activities is significant when compared to the EU's ambitions for GHG reductions. In terms of emissions and removals reported by MS for the year 2009 the LULUCF sector for the EU27 accounts for a net removal of 430 $MtCO_2yr^{-1}$, equivalent to about 9% of GHG emissions in other sectors. The technical potential for additional mitigation through soil carbon management in the agriculture (cropland) sector has been estimated at approximately 67 $MtCO_2$. yr^{-1} for the EU27 up to 2030. For all forestry activities in combination (but primarily due involving afforestation, forest management), the technical potential for mitigation (but allowing for certain physical and logistical constraints) has been estimated provisionally at between 185 and 225 $MtCO_2$-eq. yr^{-1} for the EU27 up to 2020, including a significant contribution due to new afforestation activities in the EU27 and those undertaken since 1990 (120 $MtCO_2$ yr^{-1}). These potentials are relatively significant (i.e. of the order of 4 % of emissions in other sectors at current rates) although the specific agriculture and forestry potentials are not distributed evenly between MS. In addition, forestry measures involving enhancement of forest carbon stocks tend to involve less intensive management for production, which can restrict the availability of biomass and timber for harvest. These impacts can offset some or all of the carbon benefits of forestry measures in the LULUCF sector, more so when long time horizons are considered. The quoted overall potentials for forestry activities are estimated to reduce to between 165 and 180 $MtCO_2$ yr^{-1} if negative cross-sectoral GHG impacts cannot be avoided.

Possible mitigation measures in LULUCF include all actions that can reduce emissions or increase removals of GHGs, particularly CO_2 related to changes in carbon stock in soils and forest biomass. For soils, this could include (amongst other measures)conversion from annually cultivated land to permanent cropping and or changes to cropland management that increase soil organic matter. For forests, mitigation measures can include prevention of deforestation, afforestation and various modifications to forest management. Forest management measures include changes to rotation lengths, significantly reduced harvesting and prevention of forest fires.

Three possible policy options have been identified for including LULUCF in the EU's reduction commitment:

- Option 1 – LULUCF included as part of the Effort Sharing Decision (ESD)
- Option 2 – LULUCF included as part of the EU Emissions Trading Scheme (ETS)
- Option 3 – LULUCF handled in a new, separate framework.

These policy options have been evaluated and compared with the alternative of 'business as usual' (BAU), i.e. continuing with on-going international agreements and efforts but doing nothing extra, meaning that LULUCF is excluded from contributing to the EU reduction commitment. The evaluation involved consideration of how the policy options might be developed in terms of key policy 'building blocks' (such as what definitions would need to be adopted, what the sectoral coverage would need to be, and how accounting, MRV, risk and compliance would need to be handled).A second stage in the evaluation involved a detailed assessment of continuing with BAU, or adopting policy options 1 to 3, against a set of criteria relevant to achieving effective and efficient GHG mitigation in the LULUCF sector.

There are a number of implications for the EU of continuing with BAU. Not including LULUCF in a commitment to reduce GHG emissions would avoid the need to implement potentially complicated instruments and measures dealing with LULUCF, and changes and additions to associated legislation. There would also be no need to review and revise targets for emissions reductions (due to the contribution of LULUCF). The greater risks to the EU commitment of impermanence of emissions reductions/removals would also be avoided.

On the other hand, there are several negative implications. Non-inclusion of LULUCF potentially undermines the achievement of the ultimate objective of the UNFCCC because an important sector (about 9 % of the EU's emissions in other economic sectors) is not accounted for. Also, if the EU wants to be an exemplar, and for example to encourage positive action by non-Annex I countries in e.g. REDD+ activities, inaction in the LULUCF sector is not consistent with this ambition. There could be problems for the environmental integrity of EU legislation, because there would not be a mechanism recognising the importance of management of land-based carbon stocks for climate change mitigation alongside other objectives. Also, the potential for a cost-effective achievement of targets is limited as mitigation efforts would not include all sectors of the economy. There are major cross-sectoral issues associated with management of vegetation either to maintain and enhance vegetation carbon stocks or to provide a source of timber and biomass for use in the Energy and Industrial processes sectors. If the LULUCF sector is excluded from commitments to GHG emissions reductions, this would not provide the 'level playing field' needed in accounting for emissions and removals across all sectors. Not all emissions related to agriculture would be accounted for because methane and nitrous dioxide form part of the agriculture sector (which already counts towards the target) in reporting. Finally, there would be a discrepancy between EU and international commitments if the EU signs up to an international agreement that includes the sector, but does not include it domestically. This could be difficult to justify

When considering policy options 1 and 2, it was concluded that simple inclusion of the LULUCF sector in either the ESD or EU ETS was not possible, and would appear to require more effort than involved for a separate framework.

Inclusion of LULUCF in the ESD (policy option 1) may require a redistribution of effort amongst MS to allow for the potential for LULUCF mitigation actions. It would also require a change to one of the key features of the legislation because of the high interannual variations in emissions and removals of LULUCF and therefore difficulties associated with annual compliance following linear trajectories in emissions levels in MS and across the EU. LULUCF would also require special allowances for departures from expected emissions levels due to uncontrollable disturbance events. A number of other provisions of the ESD would need review and possible amendment, e.g. definitions, eligibility of project credits, rules for corrective action and extension of registries of emissions and removals.

Inclusion of LULUCF in the EU ETS (policy option 2) would involve increased risks of impermanence of emissions reductions and a loss of simplicity, transparency and predictability. Because of the spatial extent, number and complexity of agricultural and forest holdings in the EU27, it would be impossible to allocate emissions allowances. In addition to the huge costs associated with monitoring and reporting at installation level, the standard of monitoring of emissions and removals in the LULUCF sector would not be of a quality consistent with the existing EU ETS sectors. Good practice guidance, which has been developed for national reporting purposes, would have to be developed at installation level. If included on a project basis, the sheer quantity of potential credits arising in the LULUCF sector could undermine the carbon market. Whether or not inclusion at project- or sector- level is considered, there would likely be significant impacts in terms of fluctuations in the carbon price given the high inter-annual variations of emissions and removals. In addition, detailed consideration of the Articles of the EU ETS reveals the need for special handling of LULUCF accounting because of a requirement to comply with linear reductions in the need for allowances for emissions levels. Other issues include difficulties in appropriately defining liability (responsibility over time for reversals) and that capacity and expertise for verification of EU ETS compliance would require significant development. A number of other provisions of the EU ETS would need review, *e.g*. definitions, flexibilities to address country-specific issues and carbon leakage, tracking of transactions in LULUCF emissions and the exclusion of small land units ("installations").

A detailed criteria-based assessment of continuing with BAU confirms that there are serious problems associated with continuation of BAU, and with policy option 2 (inclusion of LULUCF in the EU ETS). The assessment also confirmed that there were fewer, but still significant, obstacles associated with policy option 1 (inclusion of LULUCF in the ESD).

There do not appear to be serious barriers to the option of creating a separate framework for LULUCF. Indeed, a separate framework (possibly based on targets for emissions levels or activities) would appear to present certain opportunities that would be less easy to realise through inclusion within the ESD:

- **Long compliance cycles** – A separate framework could be designed to match the specific needs of a land based sector and would be able to address the problems encountered with regards to annual compliance under the ESD.
- **Timely delivery** - If the framework included all key mitigation activities in the LULUCF sector, there should be options that can deliver emissions reduction in the short term (i.e. by 2020) and longer terms. However, the potential for the implementation of different activities will be very different between Member States.
- **Incentives** – the development of a separate framework gives the opportunity to ensure that specific incentives for mitigation activity in the LULUCF sector are put in place. Targets can be set for emissions reductions and should provide MS with the incentives to take actions in the LULUCF sector. The framework would need to be supported by associated instruments to incentivise mitigation measures (e.g. as modifications to the CAP).
- **Targets** - may or may not be set. If set, this may happen on the basis of mitigation potential, a fixed percentage or any other approach. However, as long as emissions and removals count towards the overall target the ambition would be equitable with that of other sectors and a sector-specific target may not be needed.

Nevertheless the development of a policy covering LULUCF based on the option of a separate framework would need to take account of issues identified for most of the criteria in the assessment tables.

The option of a separate framework for the LULUCF sector with targets for emissions levels may also offer certain advantages in terms of timely delivery of emissions reductions. If the framework included all key activities in the LULUCF sector, there should be options that can deliver emissions reduction in the short term (i.e. by 2020) and longer terms. However, it would still be the case that the potential for the implementation of different activities will be very different between Member States. For a separate framework based on targets for levels of mitigation activity, timely delivery of emissions reductions would depend on tight definition of the mitigation activities and it may also be difficult to predict the magnitude of the contribution to emissions levels in a specific time period.

Finding the necessary tools to provide incentives may be relatively straightforward for implementing mitigation activities in agriculture, since these activities are largely based on existing legislation and policies under the CAP. This study suggests that policy instruments could usefully be strengthened and / or introduced. Under the first Pillar the cross compliance mechanism could be strengthened, by making GAECs and SMRs more strict, or by adding a 'greening component'. Under the second Pillar more funds should be allocated to Climate Change measures in the rural development programmes both for agriculture and forestry. Member States should specify in their rural development plans how they will address climate mitigation and which incentives they will provide.

Policy instruments were developed for three climate mitigation activities for agriculture: improved cropland-, grassland- and wetland management. Selection criteria for the three activities were a large and realistic mitigation potential within agriculture and no high risks on land use change effects. Furthermore the activities should be able to make use of existing EU legislation and regulations. At member state level these activities can be further detailed to account for natural conditions and differences in farming structure.

Policy instruments were also developed for three climate mitigation activities in forestry: protection against deforestation, creation of new forest areas, and conservation and enhancement of existing forest carbon stocks. These three activities have been chosen because they cover a wide range of mitigation options. They have been defined generically with the aim of allowing wide scope in EU legislation and responsiveness to particular Member State circumstances.

8 References

Cienciala, E., Seufert, G., Blujdea, V., Grassi, G. and Exnerová, Z. (2010) *Harmonized Methods for Assessing Carbon Sequestration in European Forests*. EUR – Scientific and Technical Research series – ISSN 1018-5593. Joint Research Centre, Luxembourg, 323 pp. (doi:10.2788/79401)

EEA (2003) *Europe's Environment. The Third Assessment*. European Environment Agency, Copenhagen

Frelih-Larsen, A., Leipprand, A., Naumann, S. and Beucher, O. (2008) *Climate change mitigation through agricultural techniques. Policy recommendations*. PICCMAT Deliverable D11. http://ec.europa.eu/environment/soil/pdf/final_report.pdf

IPCC (2000a) *Land use, land-use change, and forestry. Special Report of the Intergovernmental Panel on Climate Change*. Watson, R.T., *et al.* (eds.). Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA, 377 pp.

IPCC (2000b) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.* Penman, J., Kruger, D., Galbally, I. Hiraishi, T., Nyenzi, B., Emmanuel, S., Buendia, L., Hoppaus, R., Martinsen, T., Meijer, J., Miwa, K. and Tanabe, K. (eds.). IPCC/OECD/IEA/IGES: Hayama, Japan.

IPCC (2001) *Climate Change: 2001: Synthesis Report. A contribution of Working Groups I, II, III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press: Cambridge, United Kingdom.

IPCC (2006) *2006 National Greenhouse Gas Inventory Guidelines*. Institute of Global Environmental Strategies (IGES): Kanagawa, Japan.

IPCC (2007) *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC: Geneva, Switzerland, 104 pp.

Lesschen, J.P., Eickhout, B., Rienks, W.A., Prins, A.G. and Staritsky, I.G. (2009) *Greenhouse gas emissions for the EU in four future scenarios*. Netherlands Research Programme on Scientific Assessment and Policy Analysis for Climate Change (WAB). Netherlands Environmental Assessment Agency: Bilthoven, Netherlands. WAB report 500102 026, pp. 34

Lesschen, J.P., Schils, R., Kuikman, P., Smith, P. and Oudendag, D. (2008) *PICCMAT: implementation of measures to mitigate CO_2 and N_2O from agricultural systems across EU27*. Wageningen. PICCMAT Deliverable D7.

McKinsey (2009) *Pathways to a low carbon economy: Version 2 of the global greenhouse gas abatement cost curve*. McKinsey, McKinsey and Company, 20pp. (see https://solutions.mckinsey.com/ClimateDesk/default.aspx)

Morison, J.I.L., Matthews, R., Miller, G., Perks, M., Randle, T., Vanguelova, E., White, M., and Yamulki, S. (2011) *Understanding the carbon and greenhouse gas balance of UK forests*. Report for Forestry Commission, in press, April 2011, Forest Research, 256pp.

Schils, R., Kuikman, P., Liski, J., Oijen, M., Smith, P., Webb, J., Alm, J., Somogyi, Z., van den Akker, J., Billett, M., Emmett, B., Evans, C., Lindner, M., Palosuo, T., Bellamy, P., Jandl, R. and Hiederer, R. (2008) *Review of existing information on the interrelations between soil and climate change*. Final Report for EU DG-ENV service contract 070307/2007/486157/SER/B1. http://ec.europa.eu/environment/soil/pdf/climsoil_report_dec_2008.pdf

Smith, P. (2004) Carbon sequestration in croplands: the potential in Europe and the global context. *European Journal of Agronomy*, **20**, 229-236.

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H.H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, R.J., Sirotenko, O., Howden, M., McAllister, T., Pan, G., Romanenkov, V., Schneider, U., Towprayoon, S., Wattenbach, M. and Smith, J.U. (2008) Greenhouse gas mitigation in agriculture. *Philosophical Transactions of the Royal Society, B*, **363**, 789-813.

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H.H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, R.J., Sirotenko, O., Howden, M., McAllister, T., Pan, G., Romanenkov, V., Rose, S., Schneider, U. and Towprayoon, S. (2007a) Agriculture. Chapter 8 in Metz, B., Davidson, O.R., Bosch, P.R., Dave, R. and Meyer, L.A. (eds). *Climate change 2007: Mitigation. Contribution of Working group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA, 497-540.

Smith, P., Powlson, D.S., Smith, J.U., Falloon, P. and Coleman, K. (2000) Meeting Europe's climate change commitments: quantitative estimates of the potential for carbon mitigation by agriculture. *Global Change Biology*, **6**, 525-539.

9 Glossary and definitions

This glossary defines and explains terms and abbreviations in the context of this report. Where possible, existing definitions have been referred to. In particular, definitions adopted by the UNFCCC and IPCC, or under the Kyoto Protocol, have been used. References to specific documents are indicated by codes in brackets following the term being defined, as given in the table below.

Code	Document (see reference list for more details)
IPCC LULUCF Special Report	IPCC (2000a) Special Report on Land Use, Land-Use Change and Forestry
IPCC GPG 2000	IPCC (2000b) IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
IPCC TAR	IPCC (2001) Third Assessment Report - Climate Change 2001.
IPCC 2006 Guidelines	IPCC (2006) Guidelines for National Greenhouse Gas Inventories
IPCC AR4	IPCC (2007) Fourth Assessment Report: Climate Change 2007.
UNFCCC Decision 16/CMP.1	FCCC/KP/CMP/2005/8/Add.3. 30 March 2006. Decision 16/CMP.1. Land use, land-use change and forestry

Accuracy *(IPCC GPG 2000)*

Accuracy is a relative measure of the exactness of an emission or removal estimate. 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.

Adaptation *(IPCC TAR)*

Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Activities *(IPCC 2006 Guidelines)*

Practices or ensembles of practices that take place on a delineated area (e.g. of land) over a given period of time. In this report the word activity is often used in the specific senses referred to by the UNFCCC or the Kyoto Protocol.

Additionality

Additionality refers to the positive net benefits in terms of climate change mitigation directly attributable to a mitigation activity or project. The concept is generally used to mean net greenhouse gas emissions reductions or greenhouse gas sequestration that occurs over and above that which would have arisen anyway in the absence of a given mitigation activity or project. At international level, the idea that climate change mitigation must be 'additional' is stated in Articles of the Kyoto Protocol (e.g. Article 3.4).

Afforestation *(UNFCCC Decision 16/CMP.1)*

The direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

Annex I countries

Countries that have ratified the United Nations Framework Convention on Climate Change (UNFCCC), generally consisting of industrialised countries and economies in transition. These countries have 'committed' to reducing emissions of greenhouse gases.

Annex B countries

Annex I countries of the UNFCCC that have committed themselves to a quantified reduction in greenhouse gases emissions (usually compared with emissions in 1990) as inscribed in Annex B of the Kyoto Protocol.

Baseline

In order to estimate the benefits of a climate change mitigation activity in terms of "additional" greenhouse gas emissions reductions or greenhouse gas sequestration (see Additionality), it is necessary to compare the levels of emissions and removals estimated for the mitigation activity with those estimated assuming the mitigation activity is not carried out. The reference estimate used in such a comparison is referred to as a baseline.

Biomass

The mass of material comprising one or more living organisms, usually expressed as a dry weight. In this report biomass usually refers to plants and trees growing on an area of land.

Cap

A cap is a specified limit, generally placed on the level of greenhouse gas emissions allowed for an individual, company, installation or country. For example the Kyoto Protocol specifies emissions caps in a scheduled timeframe on the anthropogenic GHG emissions released by Annex B countries. Caps on emissions are also often (but not always) used as part of emissions trading schemes. In some circumstances, caps may also be placed on the levels of net emissions reductions (generally carbon sequestration) claimed by a company or by a country.

CAP

The Common Agricultural Policy of the EU.

Carbon offset

A carbon offset is a specified reduction in greenhouse gas emissions, or sequestered greenhouse gases achieved by a mitigation activity, claimed as compensation for greenhouse gas emissions that occur due to some other activity. For example, in principle, the greenhouse gas emissions from a power station could be "offset" by planting new areas of forest that sequester an equivalent quantity of carbon. It should be stressed that offsets could be achieved through either emissions reductions or sequestration. Carbon offsets are sometimes included as part of emissions trading schemes.

Co-benefits

The additional benefits of policies or activities beyond those of the primary objectives of the policies or activities. Policies and activities designed to address greenhouse gas mitigation can have other, often at least equally important, positive impacts (e.g., related to objectives of development, sustainability, environmental protection and equity).

Cropland management *(UNFCCC Decision 16/CMP.1)*

The system of practices on land on which agricultural crops are grown and on land that is set aside or temporarily not being used for crop production.

Decisions (EU)

Decisions may be issued either by the Council or by the Commission and are binding upon those to whom they are addressed, normally a Member State or a commercial enterprise. No national implementing legislation is required.

Deforestation *(UNFCCC Decision 16/CMP.1)*

The direct human-induced conversion of forested land to non-forested land.

Directives (EU)

Directives are binding on the Member States with respect to the result to be achieved (e.g. a target level of greenhouse gas emissions) and with respect to the deadline, but with the choice of method left to the Member States. Directives have to be implemented in national legislation in accordance with each Member State's own procedures. Enforcement is normally the responsibility of the national authorities.

Discount factor

A percentage reduction applied to a specified quantity (e.g. a given level of greenhouse gas emissions). The application of discount factors to levels of emissions and removals of greenhouse gases has been the subject of some discussion amongst Parties to the Kyoto Protocol.

Effort Sharing Decision (ESD)

The ESD establishes annual binding GHG emissions targets for EU Member States for 2013–2020. Each Member State will contribute to this effort according to its GDP per capita, with national emissions reduction targets ranging from –20 % for the Member States with greatest GDP, to +20 % for Member states with smallest GDP, to be achieved in 2020 when compared with 2005 levels. The ESD covers generally small-scale emitters in a wide range of sectors such as transport (cars, trucks), buildings (in particular heating), services, small industrial installations, agriculture and farm businesses and waste.

(see: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0136:0148:EN:PDF).

Emission(s) trading

A market-based approach to achieving environmental objectives. In greenhouse gas emissions trading, generally limits (or caps) are set on the levels of emissions (e.g. from large combustion sources such as power stations) for a number of parties if one party is able keep emissions at a level below the specified cap, it can trade the difference with a party to assist them with meeting their specified cap.

Emissions Trading Scheme (EU ETS)

The EU ETS is one of the key policies introduced by the EU to help meet its GHG emissions targets under the KP. It is a Europe-wide GHG emissions "cap and trade" scheme that started in 2005. An overall cap is set on the total emissions allowed from all the installations covered by the Scheme. The EU ETS covers 30 countries, i.e. the EU27 plus Iceland, Liechtenstein and Norway.

(see: http://ec.europa.eu/clima/documentation/ets/index_en.htm).

Environmental integrity

A term sometimes referred to in discussions of environmental policies. The idea is that different environmental policies should not conflict with one another and wherever possible should support one another.

EU15

The 15 Member States of the European Union consisting of: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the United Kingdom. Collectively the EU15 as a body is a signatory to the Kyoto Protocol.

EU27

The 27 Member States of the European Union consisting of: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

Factoring out

When making an assessment of GHG mitigation activities, factoring out is the act of distinguishing any GHG emissions or removals which would occur due to natural plant growth, soil respiration and site disturbance processes and separating these from GHG emissions and removals arising directly as a result of (and therefore attributable to) the mitigation activities. Factoring out can be difficult to achieve in practice.

Flux *(IPCC 2006 Guidelines)*

The rate of flow of any liquid or gas across a given area; the amount of this crossing a given area in a given time e.g., "flux of CO_2 absorbed by forests".

Forest *(UNFCCC Decision 16/CMP.1)*

In general terms a forest is a substantial area of land consisting of a number of component stands. (see Stand.) The word is often used as a legal definition or as a category of land use. It can relate to the primary vegetation, to the entire ecosystem, or to the land on which the trees are growing. Under the UNFCCC a forest is defined as a minimum area of land of 0.05–1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10–30 per cent with trees with the potential to reach a minimum height of 2–5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young ***natural*** stands and all plantations which have yet to reach a crown density of 10–30 per cent or tree height of 2–5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Forest management *(UNFCCC Decision 16/CMP.1)*

A system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

gC, gCO_2

1 gC = 1 gram carbon or carbon equivalent.

1 gCO_2 = 1 gram carbon dioxide or carbon dioxide equivalent.

Grazing land management *(UNFCCC Decision 16/CMP.1)*

The system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

Gross-net accounting

An approach to accounting for greenhouse gas emissions and removals.

GtC, $GtCO_2$

1 GtC = 1 gigatonne (1 thousand million metric tonnes) carbon or carbon equivalent.

1 $GtCO_2$ = 1 gigatonne (1 thousand million metric tonnes) carbon dioxide or carbon dioxide equivalent.

Impermanence

In the context of climate change mitigation, impermanence refers to the phenomenon whereby carbon sequestered in vegetation and soil could potentially be released back to the atmosphere in certain circumstances (e.g. as a result of storm damage, pests and diseases, fires, subsequent change of vegetation or soil management etc.)

kgC, $kgCO_2$

1 kgC = 1 kilogram (1000 grams) carbon or carbon equivalent. 1 $kgCO_2$ = 1 kilogram (1000 grams) carbon dioxide or carbon dioxide equivalent.

ktC, $ktCO_2$

1 ktC = 1 kilotonne (1000 metric tonnes) carbon or carbon equivalent 1 $ktCO_2$ = 1 kilotonne (1000 metric tonnes) carbon dioxide or carbon dioxide equivalent.

Land use and Land-use change, LULUCF *(IPCC AR4)*

Land use refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction, and conservation). Land-use change refers to a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land use change may have an impact on the sources and sinks of greenhouse gasses.

Leakage *(IPCC LULUCF Special Report)*

Leakage refers to the indirect impact that a targeted LULUCF activity in a certain place at a certain time has on carbon storage at another place or time. The term "leakage" has generally been used in the context of project-based accounting to refer to impacts outside the project boundary.

Measures *(IPCC AR4)*

Measures are technologies, processes, and practices that reduce greenhouse gas emissions or effects below anticipated future levels. Examples of measures are renewable energy technologies, waste minimisation processes, and public transport commuting practices.

Mitigation *(IPCC TAR)*

An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases. This intervention could include technological change, substitution or demand reduction.

Mitigation potential *(IPCC AR4)*

In the context of climate change mitigation, the mitigation potential is the amount of mitigation that could be – but is not yet – realised over time. Market potential is the mitigation potential based on private costs and private discount rates, which might be expected to occur under forecast market conditions, including policies and measures currently in place, noting that barriers limit actual uptake. Economic potential is the mitigation potential that takes into account social costs and benefits and social discount rates, assuming that market efficiency is improved by policies and measures and barriers are removed. The economic potential is therefore generally greater than the market potential. Technical

potential is the amount by which it is possible to reduce greenhouse gas emissions or improve energy efficiency by implementing a technology or practice that has already been demonstrated. No explicit reference to costs is made but adopting 'practical constraints' may take implicit economic considerations into account.

Montreal Protocol

The Montreal Protocol is an international treaty to protect the ozone layer by phasing out production (and emission to the atmosphere) of certain substances, notably gases known as chlorofluorocarbons and hydrochlorofluorocarbons. The treaty entered into force in 1989.

MtC, $MtCO_2$

1 MtC = 1 megatonne (1 million metric tonnes) carbon or carbon equivalent

1 $MtCO_2$ = 1 megatonne (1 million metric tonnes) carbon dioxide or carbon dioxide equivalent.

Net-net accounting

An approach to accounting for greenhouse gas emissions and removals.

NPP *(see Morison et al., 2011)*

Net Primary Productivity (of plants and trees). This is defined as gross primary production (the uptake of CO_2 from the atmosphere by plants during photosynthesis) minus autotrophic respiration (the loss of CO_2 by plants, above and below ground, due to respiration).

Offset

See *Carbon offset*.

Policies *(IPCC AR4)*

Policies are taken and/or mandated by a government – often in conjunction with business and industry within its own country, or with other countries – to accelerate mitigation and adaptation measures. Examples of policies are carbon or other energy taxes, fuel efficiency standards for automobiles, etc. Common and co-ordinated or harmonised policies refer to those adopted jointly by parties.

Policy framework

In the context of climate change mitigation a policy framework is a concept that includes a set of rules and modalities that regulate how emissions and removals may count (+/-) towards the EU GHG reduction target, taking into account a number of criteria and principles including environmental integrity, accurate accounting, accurate monitoring, harmonised modalities and permanence. Existing examples of policy frameworks are the EU ETS and the ESD, which regulate several sectors.

Policy instruments

Policy instruments are the different types of interventions that can be made and can be broadly classified as market based e.g. emissions trading, or command and control, e.g. regulations. A distinction can be made between 'regulatory instruments', 'economic instruments' or 'communicative instruments'.

REDD+

A set of mitigation activities based on reducing deforestation and forest degradation, whilst protecting and enhancing wider environmental and social benefits of the forest areas. Such activities, which are of greatest relevance in non-Annex I countries, are currently the subject of ongoing international discussions.

Reforestation *(UNFCCC Decision 16/CMP.1)*

The direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land.

Revegetation *(UNFCCC Decision 16/CMP.1)*

A direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation and reforestation contained in UNFCCC Decision 16/CMP.1.

Regulations (EU)

Regulations are binding and directly applicable in all Member States without any implementing national legislation. Management of the day to day aspects of the Common Agricultural Policy, for example, is by means of regulations.

Saturation

In the context of carbon sequestration, saturation refers to the phenomenon that the vegetation on an area of land can only sequester a finite amount (i.e. stock) of carbon, i.e. up to an upper limit. In the absence of any vegetation management, this upper limit depends on biological and environmental factors (e.g. vegetation type, site conditions, climate and occurrences of natural disturbance events). This can be referred to as “biological” saturation. When vegetation is subject to management, this will also influence the upper limit on carbon stocks. This can be referred to as “technical” saturation.

Sink *(IPCC AR4)*

Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol from the atmosphere.

Source *(IPCC AR4)*

Source mostly refers to any process, activity or mechanism that releases a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol into the atmosphere. Source can also refer to e.g. an energy source.

Sequestration *(IPCC TAR)*

The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological sequestration includes direct removal of CO_2 from the atmosphere through land-use change, afforestation, reforestation, carbon storage in landfills and practices that enhance soil carbon in agriculture.

Stand, forest

A group of trees of similar properties which may include those of species (or species mix), tree age (or age distribution), numbers of tree stems per unit area and management history. A stand is a subset of a forest.

Time series consistency *(IPCC 2006 Guidelines)*

In an emissions inventory, all emissions estimates in a time series should be estimated consistently, which means that as far as possible, the time series should be calculated using the same method and data sources in all years.

Uncertainty *(IPCC TAR)*

An expression of the degree to which a value is unknown.

UNFCCC

The United Nations Framework Convention on Climate Change.

(see: http://unfccc.int/2860.php)

Verification *(IPCC GPG 2000)*

Verification refers to the collection of activities and procedures that can be followed during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of that inventory. Typically, methods external to the inventory are used to check the truth of the inventory, including comparisons with estimates made by other bodies or with emission and uptake measurements determined from atmospheric concentrations or concentration gradients of these gases.