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Impacts on the EU 2030 climate target of including LULUCF in the climate and energy policy framework

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Acronym list

AFOLU:	Agriculture Forestry and Land Use
AR:	Afforestation and Reforestation
CH4:	Methane
CO_2:	Carbon Dioxide
CO_2e:	Carbon Dioxide Equivalent
CM:	Cropland Management
CP:	Commitment Period
D:	Deforestation
EEA:	European Environment Agency
ESD:	Effort Sharing Decision
EU:	European Union
EU ETS:	EU Emissions Trading System
FM:	Forest Management
FMRL:	Forest Management Reference Level
GDP:	Gross Domestic Product
GM:	Grazing land management
IPCC:	Intergovernmental Panel on Climate Change
JRC:	Joint Research Centre
LULUCF:	Land Use, Land Use Change and Forestry
Mt:	Megatons
N_20:	Nitrous Oxide

Executive Summary

The European Union (EU) has a target to reduce emissions by at least 40 per cent by 2030. This is an economy-wide target and therefore includes the Land Use, Land Use Change and Forestry (LULUCF) sector. The EU is currently consulting stakeholders on how to integrate LULUCF into the EU's 2030 Climate and Energy Framework.[1]

The LULUCF sector has several particularities and differs from energy, industrial processes, waste and agriculture (non-CO_2) emissions in a number of ways.[2] Adequate rules are therefore essential to reflect the changes in LULUCF and to assess progress towards targets. The most specific particularity is that the sector includes activities that cause emissions but also can lead to carbon being taken up and stored (e.g. through biomass accumulation), referred to in this report as a 'removals', though the removal is not permanent. Currently LULUCF is a net sink in the EU, i.e. it removes more carbon than it releases, though this sink is projected to decline by 2030. Another particularity is that not all emissions and removals are directly human-induced. This is especially true for removals from forest management. One more general particularity is data uncertainty. Average uncertainty ranges reported by Member States that are associated with estimates of the level of emissions and removals are relatively high (32 per cent) compared to emissions from fossil fuel combustion (1 per cent) for EU-15 countries.

In the impact assessment prepared for the 2030 Climate and Energy Framework, three principal options for future policy design were identified by the European Commission.[3] These three options form the basis of the options the EU is consulting on:

Option 1: LULUCF pillar: Maintain non-CO_2 Agriculture sector emissions in the Effort Sharing Decision (ESD), and further develop a LULUCF sector policy approach separately

Option 2: Land Sector Pillar: Merge the LULUCF and non-CO_2 Agriculture sector emissions into one new independent pillar of the EU's climate policy[4]

Option 3: Include LULUCF in the ESD

The implications of the different options for the 2030 Climate and Energy Framework depend to a large degree on the accounting rules for different land use activities. This report assesses the implications of the three options on the level of ambition required to meet the EU's target of reducing emissions by at least 40 per cent by 2030.

The focus of this study is on the period 2021-2030. Emissions in this future period are estimated by using projections which make assumptions about the development of emission drivers and describe a future trajectory of how emissions might develop. For the projection, this report uses European Commission figures, published in the Trends to 2050 Report (EC, 2014). It describes the EU Reference scenario projection 2013.

[1] http://ec.europa.eu/clima/consultations/articles/0026_en.htm

[2] Iversen P., Lee D., and Rocha M., 2014: Understanding Land Use in the UNFCCC. Available at: http://www.climateandlandusealliance.org/uploads/PDFs/Understanding_Land_Use_in_the_UNFCCC.pdf

[3] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0015&from=EN

[4] Note that there is a discrepancy between Option 2 in the EU's Impact Assessment, which refers to merging LULUCF into the Effort Sharing Decision, whereas for the purposes of the LULUCF consultation, Option 2 refers to a 'Land Use sector pillar'

To simulate the implications of the three options, this report uses historical data (1990-2012) for LULUCF emissions based on data reported by Member States to the United Nations Framework Convention on Climate Change (UNFCCC) including the LULUCF activities Afforestation and Reforestation (AR), Deforestation (D), Forest Management (FM), Cropland Management (CM), and Grazing land Management (GM). In addition reported historical non-CO_2 emissions from Agriculture are used. We calculate accounted emissions and removals under different combinations of accounting rules:

- Accounting case A) - scaled Forest Management Reference Level (FMRL) of Commitment Period (CP) 2
- Accounting case B) - constructed high FMRL
- Accounting case C) - constructed low FMRL
- Accounting case D) - historical reference period for forest management (1991-2000)
- Accounting case E) - alternative afforestation and reforestation accounting

All cases assume the same historic and future emissions and removals, but make different assumptions on accounting. Due to different assumptions, the cases result in different volumes of credits and debits, increasing (in case of debits) or reducing (in case of credits) efforts of emission reduction in other sectors. Credits or debits from LULUCF are compared to the effort of emissions reduction needed in the Agriculture sector, the ESD for the period 2021-2030 and to the overall emission reduction target of 40 per cent in 2030.

In the past, the EU reported that uptake and storing of carbon through LULUCF activities was higher than emissions from this sector. The LULUCF sector thus acted as a relatively stable net sink of emissions at around -300 to -350 Megatons (Mt) CO_2. The data suggests that the EU had a stronger sink than projected over the period 1990 to 2012. The projection presented by the European Commission to the UNFCCC reverses this trend and foresees the net sink declining rather constantly at an unprecedented rate of 12 Mt CO_2 per decade, reaching 279 Mt CO_2 in 2030. According to the models used for the projection this is due to increased harvest rates expected for the future caused in part by increased demand for bioenergy as well as age-class shifts in EU forests.

Since the FMRL has not yet been set for the period 2021-2030, this report has built a model that estimates the impact that different choices for the FMRL would have on LULUCF credits and debits. Country examples of relatively low (i.e. underestimating the future sink) and high (i.e. overestimating the sink) FMRLs are discussed. If the EU were to choose a FMRL based on (too) low estimates for carbon uptake and storage, FM could potentially generate credits that would be gained ‘artificially’ as a result of an underestimation of the projected net sink. A relatively high FMRL could potentially lead to debits from FM. Besides accounting for FM, the rules for afforestation accounting could have an impact on the overall ambition needed to reach the EU’s 40 per cent emission reduction target, depending on how LULUCF is included. Under CP2 accounting rules all afforestation that has occurred since 1990 can be accounted for using gross-net accounting. This means that emissions and removals reported in the commitment period are not compared against a reference, but fully accounted for (see Box 1-1). This study models the impact if only the most recent afforestation would receive afforestation credits, where after 20 years, the afforested area would then enter FM and be accounted for against the FMRL. This would be in keeping with Intergovernmental Panel on Climate Change (IPCC) rules.

Results

This study concludes that depending on accounting rules used, including LULUCF would change the effort needed to reach the 40 per cent target by between 7.5 and 16 per cent of total emissions. This means a 2030 target of between 37 per cent and 33.6 per cent (instead of an at least 40 per cent target). If FM was calculated net-net according to a ten year base period (1990-1999), LULUCF would produce debits and the target 2030 target would increase, to 40.6 per cent. Similarly, if afforestation rules were changed to be more in line with IPCC rules, the 2030 target would be 37 per cent.

If compared to the total effort under the ESD, the highest sink impact would result in a reduction in effort of between 30 per cent and 65 per cent of the ESD. This means an ESD target of between 10.6 per cent and 20.8 per cent, instead of 30 per cent. If FM was calculated net-net according to a ten year base period (1990-1999), LULUCF would produce debits and the ESD target for 2030 would be 31.8 per cent. Similarly, if afforestation rules were changed to be more in line with IPCC rules, the 2030 target would be 21.7 per cent.

If the agriculture and LULUCF sector were to form a Land Use Pillar (as described in Option 2), and if this pillar were to take on a 30 per cent emission reduction target, in line with the ESD target, this would impact the effort needed to reach this target by between 94 per cent to 198 per cent of agriculture reduction efforts.

These are figures for the EU as a whole and effects are different for different MS. While accounting rules are equal for all MS, methods for estimating the FMRL can differ according to data availability. This study has provided details of three countries: Finland, France and Ireland.

For the most plausible setting of accounting rules (a translation of CP2 rules to 2021-2030) LULUCF credits would mean the ESD in fact has a target of 15.7 per cent and the overall emission reduction target would be 35.3 per cent.

1. Introduction to the policy framework

1.1. Background

The current EU climate policy framework consists of two main elements: the EU Emissions Trading System (EU ETS), covering 45 per cent of the EU's total emissions and the Effort Sharing Decision (ESD), covering more than 50 per cent of the EU's total emissions. CO_2 emissions and removals from land use, land use change and forestry were not accounted against the EU target.

The EU climate policy framework addresses agriculture, forestry and other land use at present in two separate pillars. While non-CO_2 emissions from agriculture are covered under the ESD, CO_2 emissions and removals from LULUCF are covered under the Kyoto Protocol. This will be the framework for the EU target of 20 per cent greenhouse gas reduction until 2020. European Council conclusions[5] of October 2014 include provisions for the LULUCF sector to be included in the EU's target to reduce by at least 40 per cent by 2030. The EU is currently consulting stakeholders on how to integrate LULUCF. Three principal options for future policy design were identified:

- Option 1 — LULUCF pillar: Maintain non-CO_2 Agriculture emissions in a potential future ESD, and further develop a LULUCF sector policy approach separately;
- Option 2 — Land use sector pillar: Merging the LULUCF and agriculture sector non-CO_2 emissions into one new and independent pillar of the EU's climate policy;
- Option 3 — Effort Sharing: Include the LULUCF sector in a potential future ESD.

Implications of the different options for the effort needed by sectors to reach the ESD target (reducing emissions by 30 per cent by 2030) and the agriculture sector (were Option 2 to be realised), but also the impact on the overall level of ambition of the 40 per cent reduction target depends to a large degree on the accounting rules for different activities. Rules will be applied at the Member State level. While accounting rules are equal for all Member States, methods for estimating the FMRL can differ according to data availability. The following describes existing accounting rules as applied under the Kyoto Protocol.

[5] European Council SN79/14: Conclusions on 2030 Climate and Energy Policy Framework

1.2. Existing accounting options

1.2.1. Rules under the Kyoto Protocol

Kyoto Protocol accounting for LULUCF is based on an effort to reflect only those emissions and removals that are linked to direct human-induced activities. It is based on two paragraphs of the Protocol: Article 3.3 and Article 3.4. Accounting is mandatory for some activities, (Article 3.3) and voluntary (Article 3.4) for others. Afforestation, reforestation and deforestation and FM (for the 2nd commitment period) are mandatory. Other activities (cropland management, grazing land management, wetland, drainage and rewetting) can be accounted on a voluntary basis, but have to be accounted continuously in the future, once a decision to include these activities has been made. Table 1-1 shows the accounting rules for different activities and differences between commitment periods. Box 1-1 illustrates different accounting methods applied under the Kyoto Protocol.

Box 1-1: Illustration of accounting methods

Under the Kyoto Protocol different accounting methods exist. **Net-net accounting** is applied to several activities under Article 3.4, such as cropland and grazing land management and to all other sectors except LULUCF. They are accounted using the reported net emissions during the accounting period compared to net emissions in a base year (e.g. 1990, see Figure B1a)). A country with decreasing net emissions would generate credits under this approach; a country with a declining sink would have to accept debits (see example in Figure B1a)).

Gross-net accounting considers only emissions and removals during the commitment period. No comparison with any historic or future reference is made (actually it is compared to zero, see Figure B1b)). It is applied to deforestation and afforestation/reforestation under the Kyoto Protocol and was the accounting method for forest management in the first commitment period. A country with a declining sink would receive credits if the sink still exists in the commitment period (see example in Figure B1b)). Due to the fact that gross-net accounting of forest management includes large removals for many countries, a cap was introduced to limit excessive credits.

In the second Kyoto Protocol commitment period, a **reference level accounting approach** was adopted for forest management. It is applied by introducing a forest management reference level (FMRL), against which emissions and removals during the commitment period are compared. The FMRL is derived for most countries from forward looking scenarios (see FM projection in Figure B1c)).

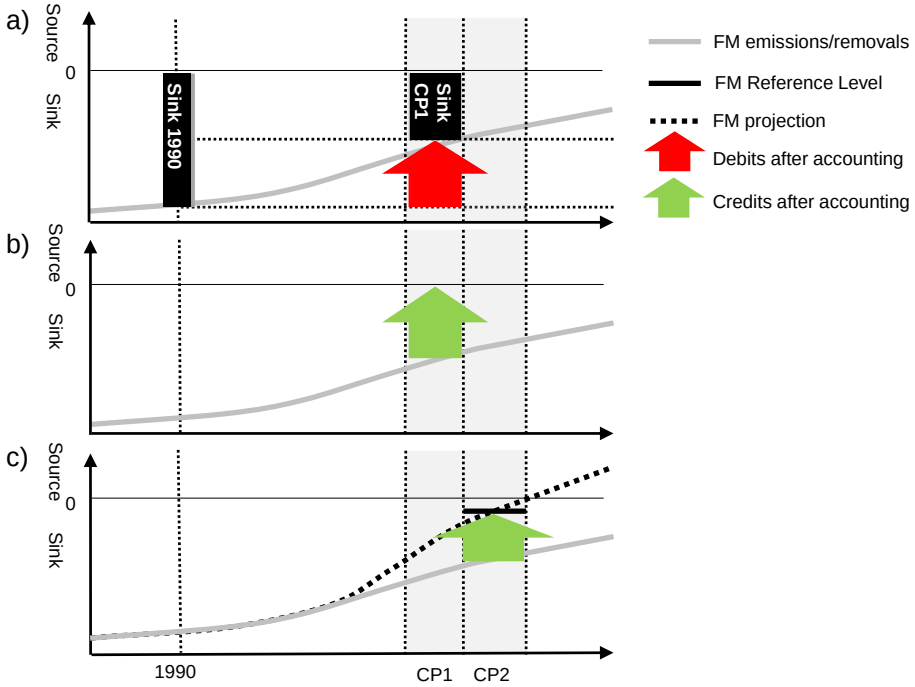

Figure B1: Illustration of different accounting methods existing under the Kyoto Protocol.

The different possibilities for accounting – net/net; gross/net; reference levels - bring advantages or disadvantages, depending on a country's particular LULUCF characteristics. For categories where gross-net accounting is applied (AR, D and FM in CP1) it is beneficial (i.e. more credits can be expected) if a large sink can be reported during the actual commitment period. In CP1 when FM was accounted for under this rule, countries with a large existing forest sink could easily gain credits up to the cap (if they had elected to include FM in their accounting). Only emissions and removals in the commitment period mattered and most EU countries reported a net sink in that period.

Table 2-1: Accounting options existing under the Kyoto Protocol in Commitment Period 1 (2008-2012, CP1) and 2 (2013-2020, CP2).

Activity	Accounting in CP1	Accounting in CP2
Afforestation, Reforestation, Deforestation (AR, D)	Mandatory Gross-net, absolute yearly changes, since 1990	Mandatory Gross-net, absolute yearly changes, since 1990
Forest Management (FM)	Voluntary Gross-net, with country-specific cap	Mandatory Compared against future reference (FMRL), with cap of 3.5% of total base year emissions
Grazing Land Management (GM)	Voluntary Net-net, compared to base year (1990)	Voluntary (mandatory if elected in CP1) Net-net, compared to base year (1990)
Cropland Management (CM)	Voluntary Net-net, compared to base year (1990)	Voluntary (mandatory if elected in CP1) Net-net, compared to base year (1990)

Source: Own compilation

In the Kyoto Protocol CP2, accounting against a FMRL was agreed. For accounting, countries compare the sum of emissions and removals during the commitment period to their FMRL. The FMRL should reflect expected emissions and removals from business-as-usual forest management. Factors that countries were supposed to consider in estimating reference levels include among others:

- historical removals or emissions from forest management (harvest rates are the main driver of the forest carbon balance in the short term);
- age-class structure (determines the medium to long-term carbon balance of forests);
- projected FM activities and policies under business as usual (December 2009 was the deadline for when existing policies on the use of forest resources could be included).

The proposed FMRLs were subject to a technical assessment coordinated by the UNFCCC to increase/enhance transparency.[6] The accounting method of comparing emissions and removals against a future reference level is controversial. Compared to gross-net accounting it reduces the amount of credits or debits to the difference between actual performance and the projected performance (as projected in the FMRL). The large sink of many EU countries due to forest age class structure is excluded with this method. Therefore it set more incentives to change current and future FM to store more carbon or avoid emissions, regardless of the forest being a declining or increasing net sink or source.[7] The total amount of credits from forest management is expected to be considerably lower.

[6] http://unfccc.int/bodies/awg-kp/items/5896.php

[7] Böttcher, H., Kurz, W. A., Freibauer, A. (2008): Accounting of forest carbon sinks and sources under a future climate protocol - factoring out past disturbance and management effects on age-class structure. Environmental Science and Policy 11 (8): 669-686.

The challenge is to set a reference level that ensures environmental integrity. Recently, harvest rates in EU countries have been increasing. One driver of this development is that EU policies to incentivise bioenergy have increased demand. Bioenergy emissions are accounted for as zero emissions in the energy sector. Harvested biomass for bioenergy that is included in the FMRL does not result in debits when FMRL and reported data are compared. Bioenergy emissions are therefore not "visible" in the accounting for any sector and can violate environmental integrity. FMRLs are based on projections of future forest management activities, and thus, despite the guidance, provide an opportunity to reduce the risk of debits by projecting larger harvest removals. Projections can hardly be scientifically validated. Therefore transparency and consistency are paramount.

1.2.2. Land versus activity based accounting

Accounting rules for the period 2021-2030 have not yet been agreed for any sector, including for LULUCF. However, countries have already chosen their accounting rules from the options available for LULUCF accounting in CP1 and CP2 of the Kyoto Protocol. There have also been discussions about whether a new climate agreement should try to overcome the parallel systems of Kyoto reporting/accounting and reporting under the UNFCCC. The IPCC Special Report on LULUCF describes the differences between the two approaches of land-based accounting (UNFCCC) and activity-based accounting (Kyoto Protocol) of land use activities. A 'land-based approach' to accounting takes as a starting point the total C stock changes in all carbon pools on all land areas. An 'activity-based' approach estimates the impact of C stock changes that can be attributed to designated activities and assigns the land areas to these activities. Under the Kyoto Protocol, an activity-based accounting approach was chosen. The parallel approaches exist because in the early stage of the Kyoto Protocol the focus was on including human activities, such as deforestation and afforestation. A narrow definition as activities was meant to avoid the inclusion of large emissions and removals, e.g. from existing forests. Due to the different concepts of how Kyoto Protocol LULUCF activities are defined, the emissions and removals estimated related to these activities are not the same as the emissions and removals reported in the LULUCF sector under the UNFCCC.

Examples for activities where these differences can be large include:

- Grazing land management (Kyoto Protocol) includes "lands used for production of herbaceous perennial vegetation (introduced or indigenous) for harvest by grazing, cutting, or both" (IPCC, 2013). The reporting under UNFCCC relates to grasslands and includes all land areas covered by herbaceous perennial vegetation independent of whether these grassland areas are used for grazing.
- Afforestation (Kyoto Protocol) is 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. Under UNFCCC reporting, 20 years after afforestation or reforestation land transitions from "land converted to forest land" to "forest land remaining forest land" while under the Kyoto Protocol this land continues to be reported as afforestation. This can have a big impact on the amount of credits available from LULUCF.

The more activities, pools and gases that are included under activity based accounting, the closer emissions and removals get to land-based accounting.

1.3. Aim of this study

This study quantitatively assesses the impact that different sets of accounting rules for the LULUCF sector would have on the ambition needed to reach the EU's 2030 target. The activity contributing the largest share to net LULUCF emissions is FM, and this is why it is the main variable that we have focussed on. Accounting against the FMRL will, most likely, reduce the total volume of potential credits that would have been created under a gross-net accounting system. At the same time, compared to CP1, it will become more uncertain whether FM will result in credits or debits because future projections might not be accurate. If FM is included in the ESD, it could still have a significant impact on the ambition needed to reach the 2030 target. The study also assessed whether impacts of FM's inclusion on the EU's 2030 target could be reduced if a base year or base year period were used for accounting emissions and removals from FM rather than a reference level, since the FMRL approach could potentially cancel out FM emissions due to increased harvesting for bioenergy, which could lead to 'missing emissions'.[8]

The report indicates the range of uncertainty to be expected based on the underlying data, based on previous EU and Member State submissions and other relevant reports. Finally, the report discusses the pros and cons of different options based on conclusions from the quantitative assessment.

[8] Greenglass, N. (2015) Forest-based biomass energy accounting under the UNFCCC: finding the 'missing' carbon emissions (Working Paper).

2. Methodology

1.4. Historical data

The report uses historical data (1990-2012) on LULUCF emissions for different categories based on data reported by Member States to the UNFCCC. We use the most recent data reported in 2014 as compiled in the Joint Research Centre (JRC) LULUCF tool.[9] The data include emissions and removals from the LULUCF activities: Afforestation and Reforestation (AR), Deforestation (D), Forest Management (FM), Cropland Management (CM), and Grazing Land Management (GM). In addition historical non-CO_2 emissions from Agriculture are taken from the tool. An overview of data used and their sources is given in Table 2-1.

1.5. Projection data

Different datasets exist which describe projected emissions from the LULUCF sector until 2030. Not all are publically available. We use data from the European Commission published in the Trends to 2050 Report.[10] It describes the so-called EU Reference scenario 2013, (referred to here as the "projection"), to differentiate it from the FMRLs set by countries. A core element of the projection is what Member States intend to include in their energy systems, notably, the level of bioenergy they plan to use. It includes current trends on population and economic development including the latest 2010 statistics and takes into account the highly volatile energy import price environment of recent years. It portrays economic decisions, which are driven by market forces in the energy and building sector and technology progress in the framework of concrete national and EU policies and measures adopted until spring 2012 and which are or will be implemented over the next years. The projection includes all binding targets set out in EU legislation regarding development of renewable energies and reductions of greenhouse gas emissions, as well as the latest legislation promoting energy efficiency. Regarding LULUCF the scenario considers population growth, income growth, demand for bioenergy, wood, food and feed as well as land use policies up to 2012.

The projected data included in the European Commission report span from the year 2005 to 2050. Reported data for the period of 2005-2012 overlaps with the projection for the years 2008 to 2050; this overlap can be used to assess accuracy of the projection to some degree. We compared average values of the historical and projected datasets for the period of 2008-2012. The emissions for this period from both datasets do not always agree. A mismatch does not necessarily imply inaccuracy of the projection. Differences occur due to methodological inconsistencies and updates of reported historical data. Still it is assumed that the reported data is more reliable. Therefore the projected emissions were scaled by adjusting the projected values in line with reported data. In the case of deforestation, a scaling factor was used to avoid reported emissions from this category being shifted to removals. This is a rather rough method to achieve a minimum of consistency between reported and projected data and also reflects the high uncertainties associated with the data.

[9] Version of May 2015, personal communication G. Grassi. An older version is available on the JRC website: ftp://mars.jrc.ec.europa.eu/Afoludata/Public/DS242.

[10] EC 2014: EU energy, transport and GHG emissions, trends to 2050 - Reference scenario 2013 http://ec.europa.eu/transport/media/publications/doc/trends-to-2050-update-2013.pdf

Table 2-1: Overview of data sources

Activity	Abbreviation	Data type and use	Source
Afforestation	AR	Historical emissions 2008-2012 reported under Kyoto Protocol	JRC LULUCF tool
		Historical 1990-2012 emission data based on UNFCCC reporting	JRC LULUCF tool
		Emissions projection 2012-2030; scaled to match historical data for overlapping period	EC 2014
Deforestation	D	Historical emissions 2008-2012 reported under Kyoto Protocol	JRC LULUCF tool
		Historical 1990-2012 emission data based on UNFCCC reporting	JRC LULUCF tool
		Emissions projection 2012-2030; scaled to match historical data for overlapping period	EC 2014
Forest Management	FM	Historical emissions 2008-2012 reported under Kyoto Protocol	JRC LULUCF tool
		Historical 1990-2012 emission data based on UNFCCC reporting	JRC LULUCF tool
		Emissions projection 2012-2030; scaled to match historical data for overlapping period	EC 2014
		Country specific FMRL 2020-2030	Durban decision
		Sensitivity analysis of different levels of reference to compare 2021-2030 emissions	Own assumption
Cropland Management	CM	Historical 1990-2012 emission data based on UNFCCC reporting	JRC LULUCF tool
		Emissions projection 2012-2030; scaled to match historical data for overlapping period	EC 2014
Grazing land Management	GM	Historical 1990-2012 emission data based on UNFCCC reporting	JRC LULUCF tool
		Emissions projection 2012-2030; scaled to match historical data for overlapping period	EC 2014
Agriculture	Agriculture	Historical 1990-2012 emission data based on UNFCCC reporting	JRC LULUCF tool
		Emissions projection 2012-2030; scaled to match historical data for overlapping period	EC 2014
Other Effort Sharing Decision	Other ESD	Other ESD emissions for 2021-2030	Own assumptions

1.6. ESD data

According to the European Council conclusions,[11] 2030 targets under the ESD are to be distributed among Member States according to Gross Domestic Product (GDP) per capita, applying the methodology for the 2020 ESD:

[11] European Council SN79/14: Conclusions on 2030 Climate and Energy Policy Framework

- The target for the Member State with the lowest GDP/cap (Bulgaria) is set to 0 per cent below 2005 and for the two Member States with the highest GDP/cap (Denmark and Luxembourg) is set to 40 per cent below 2005.
- All other Member States are distributed according to their GDP/cap ratio along a line between Bulgaria and Denmark.
- To achieve the overall reduction of 30 per cent the line is pulled down at the EU average,

Based on the Council Conclusions, these targets shall be relatively adjusted based on the cost-effective reduction potential for Member States with a GDP per capita above the EU average in a fair and balanced manner. 2030 targets for Member States adjusted for the cost-effective reduction potential were calculated for different options of such an adjustment. For an explanation and analysis of these options see Öko-Institut 2015.[12]

In addition to the 2030 target, Member States also have to comply with annual emission reduction limits in the ETS and the ESD for all years from 2021-2030. A linear target path is drawn between a starting point in the first year and the final target. If the approach used for the first effort sharing is applied again, the starting point in 2021 will be the average of the greenhouse gas emissions from sectors covered by the ESD in the years 2016-18. Based on Member States' projections published by the European Environment Agency (EEA), total emissions for the ESD II and the overall reduction effort were calculated for the purposes of this study. The total reduction effort is calculated as the difference between constant 2020 emissions and the linear target path for the years 2021-30.

1.7. Other data

In addition to the databases on historical and projected emissions, we used publically available country level information. One source of information is reports of the technical assessments of the FMRL submissions by EU Member States. These reports are available from the UNFCCC website[13] and are summarised in a synthesis report (UNFCCC 2011). We extracted information on what policy assumptions FMRLs of different countries include and what changes in the past were made to the FMRL due to technical corrections to get an idea about the uncertainty of such estimates for the future. This was used to choose what scenarios we should model in the situation where there are discrepancies in the FMRL.

1.8. Uncertainty of historical data and projections

The UNFCCC allows and encourages the improvement of methodologies for estimating emissions and removals and correcting already reported emissions and removals for historical periods. Recalculations of the reported data are then needed to ensure consistency, i.e. one consistent emission factor or model is used for the entire time series. Such recalculations cause changes in historical data that can be significant. Iversen et al. (2014)[14] reported changes of 10-20 per cent for Sweden as an example. Such corrections make predicting average emissions/removals over a commitment period difficult. Historical data as well as projections that rely on historical data can therefore only provide a momentary description of the sector.

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[12] 2030 Effort Sharing targets for EU Member States. Öko-Institut 2015, (forthcoming)

[13] http://unfccc.int/land_use_and_climate_change/lulucf/items/4129.php (last accessed 01.06.2015)

[14] Iversen P., Lee D., and Rocha M., 2014: Understanding Land Use in the UNFCCC. http://www.climateandlandusealliance.org/uploads/PDFs/Understanding_Land_Use_in_the_UNFCCC.pdf

Average uncertainties reported by Member States that are associated with estimates of the level of emissions and removals are relatively high (32 per cent) compared to emissions from fossil fuel combustion (1 per cent) for EU-15 countries. Since forest management emissions comprise less than 3 per cent of total gross greenhouse gas emissions, they do not significantly affect the overall uncertainty of the entire inventory, though the impact can be large in some Member States. Agricultural uncertainties are not only larger regarding their share of total gross emissions (10 per cent), but also more uncertain regarding emission levels (76 per cent), mostly due to uncertainty in nitrous oxide emissions from fertilizer application.

Projections are always highly uncertain, and “the future” often turns out differently than suggested. A comparison between historical reported data and projected estimates for an overlapping period can be used to assess the accuracy of the projection. The ability to reproduce past data is an important prerequisite for projection tools to be credible. Discrepancies between reported and projected data can be due to different pools or activities considered, differences in underlying emission factors, level of aggregation etc. The “accuracy” of assumptions being made about the future, however, cannot be assessed with this method. FMRLs submitted by Kyoto Parties were not reviewed by the UNFCCC as reported data is. Assumptions underwent a technical assessment which looked at consistency and plausibility of reference levels. The assessment led to revisions of FMRLs, and technical correction by a number of Member States (see Table 2-2). The revisions led to new FMRL estimates that were between 80 per cent higher and 47 per cent lower than the original submissions. The reasons why these corrections were needed are different for individual Member States, but are usually related to correction of calculation errors that were found or data updates (e.g. new inventory information became available after the submission). Such corrections are needed to achieve methodological consistency between reported data and FMRLs, and will continue to be made independent from UNFCCC assessments by those Member States that identify inconsistencies. They make an estimate of future credits and debits from accounting FM rather difficult as FMRLs become a moving target.

Table 2-2: Forest Management Reference Levels (FMRLs) submitted by EU Member States, estimates before technical assessment by UNFCCC and method for estimation[15]

Country	FMRL (including HWP[16] decay functions)	FMRL (assuming HWP instant oxidation)	FMRL before revision (including HWP decay functions)	FMRL before revision (assuming HWP instant oxidation)	Percent change with revision	FMRL estimation method
Austria	-6,516	-2,121				national estimate
Belgium	-2,499	-2,407	-2,527	-2,435	1%	JRC/IIASA/EFI
Bulgaria	-7,950	-8,168	-9,304	-9,522	17%	JRC/IIASA/EFI
Croatia		-6,289		-5,149		national estimate
Cyprus	-157	-164				Extrapolation
Czech Republic	-4,686	-2,697	-5,566	-3,577	19%	JRC/IIASA/EFI
Denmark	409	334	359	243	-12%	national estimate
Estonia	-1,742	-2,082	-2,728	-1,728	57%	JRC/IIASA/EFI
Finland	-20,466	19,300	-20,100	-19,300	-2%	national estimate
France	-63,109	-67,042	-62,741		-1%	JRC/IIASA/EFI
Germany	-22,410	2,070	-19,510		-13%	national estimate
Greece	-1,830	-800	-1,396	-800	-24%	1990–2009 average
Hungary	-1,000	-892	-630	-572	-37%	JRC/IIASA/EFI
Ireland	-142	-8	-207	-73	46%	national estimate
Italy	-22,166	-21,182	-15,315	-14,331	-31%	JRC/IIASA/EFI
Latvia	-16,302	-14,255	-16,340	-14,293	0%	JRC/IIASA/EFI
Lithuania	-4,552	-4,139				JRC/IIASA/EFI
Luxembourg	-418	-418				JRC/IIASA/EFI
Malta	-49	-49				Extrapolation
Netherlands	-1,464	-1,539	-1,578		8%	JRC/IIASA/EFI
Poland	-27,133	-22,750	-24,032	-22,750	-11%	national estimate
Portugal	-6,830	-6,480				national estimate
Romania	-15,793	-15,444	-28,393	-28,044	80%	JRC/IIASA/EFI
Slovakia	-1,084	358	-1,057		-2%	JRC/IIASA/EFI
Slovenia	-3,171	-3,033				national estimate
Spain	-23,100	-20,810	-23,725	-21,442	3%	JRC/IIASA/EFI
Sweden	-41,336	-36,057	-21,840		-47%	national estimate
UK	-8,268	-3,442				national estimate

Source: UNFCCC 2011

[15] Emissions are reflected with a '+' and removals with a '-'

[16] Harvested Wood Products, can be accounted for as „instantaneous oxidation" assuming all carbon is emitted when the wood is harvested or using decay functions that represent different classes of wood products into which carbon is transferred after harvest and then released with a certain rate. HWPs are left out of the analysis of this study for simplicity reasons.

1.9. Accounting options considered

The focus of this study is on the period after CP2; a hypothetical commitment period covering years 2021-2030. We calculate accounted emissions and removals under different combinations of accounting assumptions (see Table 2-3). Neither agreed rules nor projected FMRLs exist for this period. The basis for the assessment is the assumption that the rules agreed for CP2 will also be applied for accounting in the period 2021 – 2030 (see section 0). However, for the FMRLs we cannot assume the same value for the following two reasons:

- The FMRLs for CP2 can be subject to technical corrections if methodological inconsistencies with historical data occur, i.e. when historical data are updated. This will change the accountable amounts under FM. Countries are already in the process of calculating technical corrections. Theoretically such corrections can occur until the end of the commitment period, making final estimates of total accounts for CP2 more uncertain.
- The FMRLs were estimated for the period of 2013-2020 only. Due to the dynamics of harvest, forest growth, age class transitions and change in policies, the FMRL for a potential subsequent period from 2021-2030 will probably change.

As a first approximation we assume therefore that the FMRLs for 2021-2030 are consistent with the ones for CP2 and that they reflect the trend assumed in the projection (EC 2014). The FMRL for CP3 is the value of CP2 scaled by the rate of change of projected FM emissions between 2013-2020 and 2021-2030 (-240 Mt CO_2). This is accounting case A. This case assumes that those policies included in the EU projection (including the Renewable Energy Directive) are also reflected in the FMRL and no additional policies were implemented after December 2009 (cut-off date of the projection). CP2 rules also include a cap for forest management accounting that is at 3.5 per cent of total base year emissions.

From the comparison of reported and projected data, but also from looking at the order of magnitude of changes that have occurred during revisions and technical corrections to FMRLs so far (Table 2-2), it is important to vary assumptions for accounting to reflect obvious uncertainties. In alternative accounting cases we therefore assess impacts of different levels of FMRLs set by ember States on accounted emissions and removals from FM. We construct alternative cases by reinterpreting policy assumptions made for the construction of the reference level. Case B assumes FMRLs being comparably high (FMRL set to a level 20 per cent higher than case A), i.e. -289 Mt CO_2). A high FMRL describes the situation where countries planned relatively low harvest levels when setting the FMRL but introduced later (after the cut-off date) policies and measures causing wood harvest to increase. When it comes to accounting in the commitment period for these countries, the average sink during CP3 would be considerably lower than the FMRL. This case is expected to lead to relatively low volumes of credits, or even debits from FM.

Case C assumes instead a low FMRL (a reduction of the FMRL to -20 per cen of case A) level, i.e. -192 Mt CO_2). A low FMRL describes the situation where countries planned relatively high harvest levels when setting the FMRL, but were facing lower than expected harvest rates, e.g. due to economic downturn. When it comes to accounting in the commitment period for these countries, the average sink during CP3 would be considerably higher than the FMRL. This case is expected to lead to relatively high volumes of credits from FM.

Case D describes an accounting approach that compares FM emissions during 2021-2030 to a base period, i.e. the historic period 1990-1999 (-393 Mt CO_2). Accounting FM emissions against a historic base period is an alternative accounting option for FM that would be more similar to rules

applied for other activities in LULUCF and other sectors and would not require setting up hypothetical reference levels.

Beside FM, afforestation is another LULUCF activity that is very sensitive to accounting rules. CP2 rules include emissions and removals from afforestation and reforestation that occurred on land converted to forest since 1990. Under Kyoto Protocol reporting, the area is typically continuously increasing if afforestation rates are maintained. Gross-net accounting of AR removals in 2021-2030 under CP2 rules thus includes contributions of planted areas that were established more than 20 years ago. UNFCCC reporting, on the other hand, keeps newly planted areas in the afforestation category (land converted to forest land) for a period of only 20 years. Land covered with trees for more than 20 years moves to the category "forest land remaining forest land" under UNFCCC reporting rules. If post 2020, accounting rules would be applied that are more consistent to UNFCCC reporting, AR would be accounted for net-net (see also Box 1-1). In this case, the actual emissions and removals after 2020 are compared to a period 20 years before the commitment period. Areas planted more than 20 years ago would enter the FM category and be accounted for against an FMRL including also these areas planted with trees. The models used for the projection do not consider such a transition. Therefore this case cannot be modelled explicitly. However, we can approximate the impacts by comparing AR removals to a historic period to mimic the effect of excluding contributions of older planted areas. Case E describes this accounting case that applies net-net accounting of AR against a period 20 years before a commitment period after 2020, i.e. CP1.

Credits and debits resulting from the alternative accounting cases are compared to projected emissions from Agriculture and total ESD emissions averaged for the period 2021-2030.

Table 2-3: Accounting cases and assumed rules assessed in this report

Case	Description	AR, D	FM	CM, GM
A)	CP2 rules	gross-net	scaled FMRL of CP2	net-net, base year 1990
B)	CP2 rules – high FMRL	gross-net	**FMRL set to high value**	net-net, base year 1990
C)	CP2 rules – low FMRL	gross-net	**FMRL set to low value**	net-net, base year 1990
D)	CP2 rules – FM base period	gross-net	**net-net, base period 1990-1999**	net-net, base year 1990
E)	CP2 rules – alternative AR accounting	**net-net, base period CP1**	scaled FMRL of CP2	net-net, base year 1990
F)	CP2 rules	gross-net	scaled FMRL of CP2	**net-net, base year 2005**

2. Presentation of results

2.1. Development of LULUCF and agriculture emissions until 2030

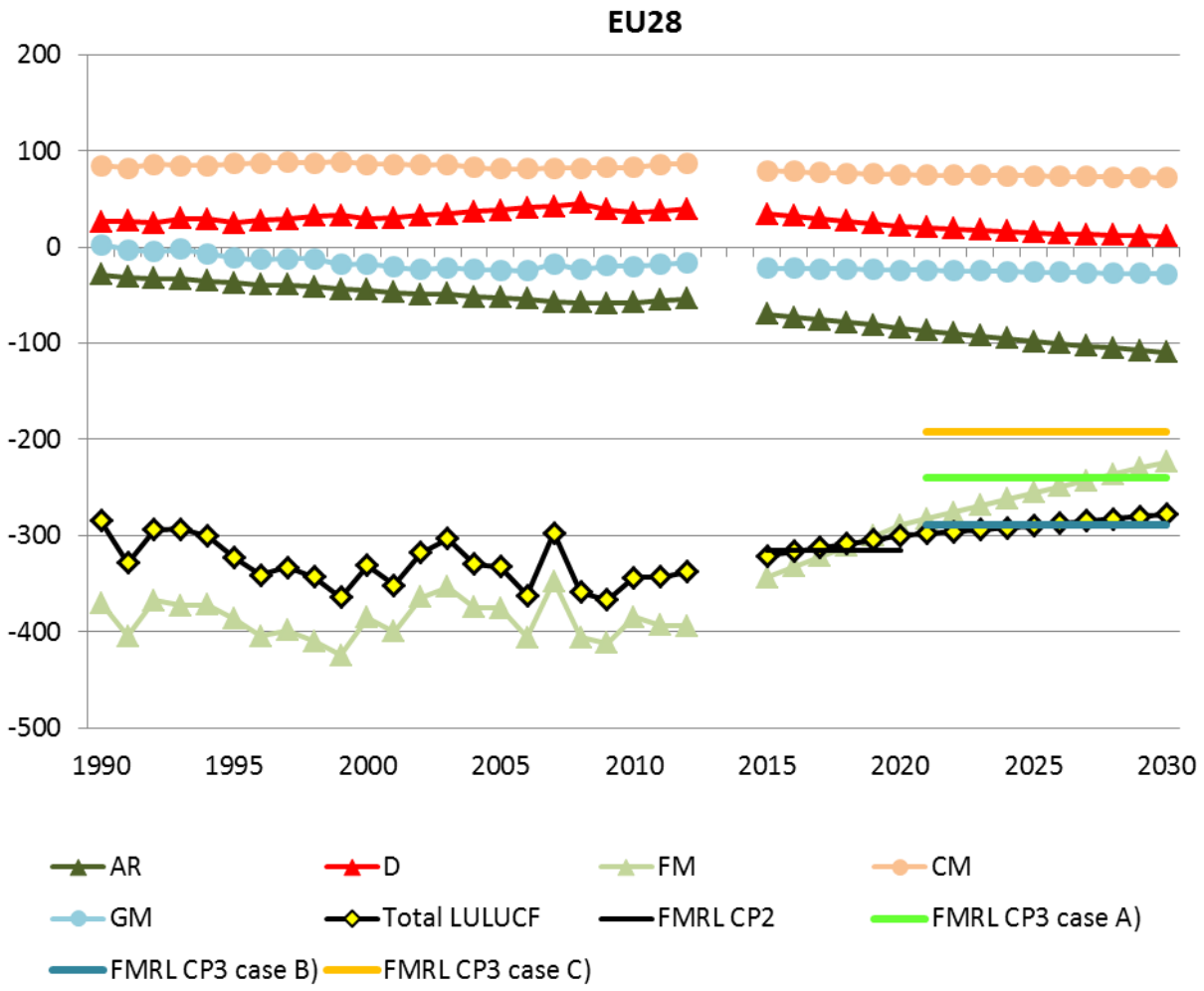
Figure 2-1 describes the development of emissions and removals of different activities in the LULUCF sector for the historic period 1990-2012 (based on reported data) and the projection 2015-2030 based on the EU projection (EC 2014). Between 1990-2005, net LULUCF emissions were a relatively stable net sink at around -300 to -350 Mt CO_2. The projection instead assumes a reversal of this trend and assumes the net sink declining rather constantly at a rate of 12 Mt CO_2 per decade, reaching 278 Mt CO_2 in 2030. This decline is the result of different, partly opposing trends of emissions and removals from different activities.

Deforestation emissions have been slowly increasing from 1990 (27 Mt CO_2) to 2010 (33 Mt CO_2). The projection does not continue this trend shown in the reported data. By 2030 deforestation emissions are assumed to sum up to only 11 Mt CO_2. The driver of Deforestation in the EU28 is mostly infrastructure. A decline of large infrastructure projects in EU countries is plausible and such a projection therefore not unlikely. Still, it is a reversal of the historic trend and other scenarios are imaginable.

Afforestation has been reported as a CO_2 sink with continuously increasing volumes of carbon stored over the reported period, but this sink is currently (2012) levelling off at about 55 Mt CO_2. It has to be noted that the UNFCCC data that forms the basis of historical data in Figure 2-1 represent land converted to forest. This is not identical with the Kyoto Protocol definition of afforestation since 1990 because under UNFCCC reporting, after a period of 20 years an area planted with trees is reported as forest remaining forest (FM), not afforestation. Compared to Kyoto Protocol reporting figures, removals from afforestation are therefore higher in the first half of the period (1990-2000) and lower after 2010. The projection, however, includes all areas afforested since 1990, which is why removals are again continuously increasing. In 2030, the net sink from AR is 110 Mt CO_2 with increases in carbon sinks through afforestation being highest in France, Germany, Italy and Spain.

The activity contributing the largest share to net LULUCF emissions is FM, and this is why it is the main variable that we have focussed on for the purposes of this study. Figure 2-1 also shows that it contributes most to annual variability of total LULUCF emissions. The net FM sink for the EU28 has remained relatively stable around 400 Mt CO_2 for the last 20 years without any clear trend. The projection sees the net FM sink declining steeply from that level to 237 Mt CO_2 in 2030. Such a decline is unprecedented in the past 25 years. The projection suggests forest ageing and increased harvest will be responsible for this new trend. FM emissions estimated in the projection are driven by the balance of harvest removals and forest increment rates (the growth of the biomass stored in a forest as a result of the growth of the trees with the age). The projection assumes that total harvest removals in the EU28 increase steadily over time. The projection also assumes that the share of wood harvested for energy generation increases. In 2030, removals of wood amounting to about 620 Mm^3 are assumed, of which about 17 per cent are assumed to be used for energy purposes. According to the definition of the scenario used for the projection, only policies implemented until end of 2009 are considered. This increase does not reflect policies that might have been implemented after that date, but includes e.g. increased demand for wood due to the Renewable Energy Directive. A further differentiation between factors driving the downward trend of the sink is not possible from the data that have been published.

Figure 2-1: EU28 development of historical and projected emissions and removals from LULUCF-sector activities [Mt CO_2 equivalent (CO_2e)]



Source: JRC LULUCF tool - historical data GHGI-2014, EC 2014 and own compilation

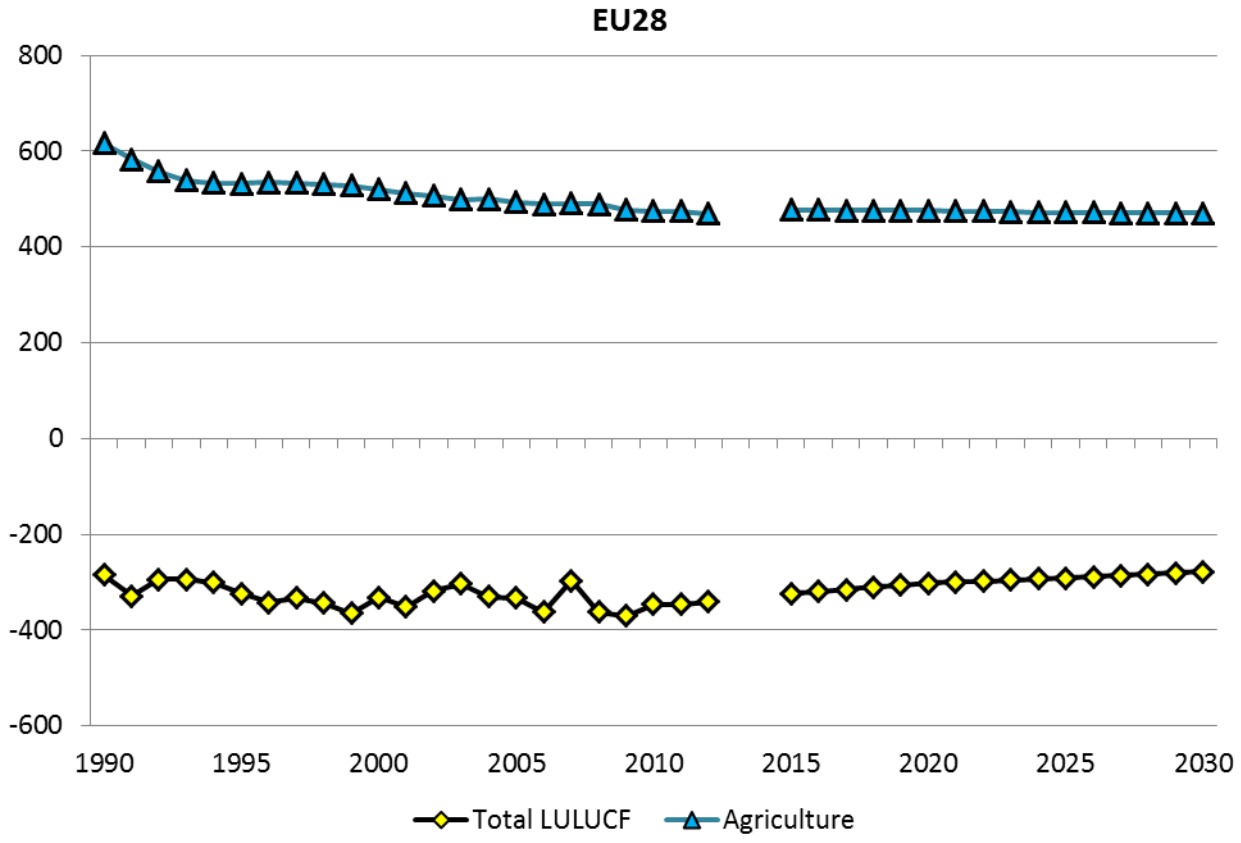
Cropland management has been a source of greenhouse gas emissions between 1990 and 2012 of about 85 Mt CO_2 (Figure 2-1). Cropland releases CO_2 when grassland with relatively high carbon stocks is ploughed and used for crop production. Also intensive management on organic (peat containing) soils leads to emissions of CO_2. Countries contributing most to the sum are France, Germany and the UK. In the EU projection it is assumed that fewer of these areas are taken under intensive management but also that much of the carbon content from grassland and peatlands already converted has already been released and that the rate of emissions will be slowing down.

Grazing land management is the only category in LULUCF of the selected activities where at EU28 aggregate, a change from source to sink occurred in the past. In 1990, grazing land management formed a source of about 2 Mt CO_2. Over the past 20 years this area has become a sink of -16 Mt CO_2 in 2012. The projection sees this trend continued over time: the sink is increasing further to -28 Mt CO_2 in 2030.

Figure 2-2 puts non-CO_2 emissions from agriculture in comparison to total net LULUCF emissions. Emissions from agriculture have been constantly, but slowly, declining and continue to do so,

according to the projection. While in 1990 the sector emitted 617 Mt CO_2e, it is projected that there will be 470 Mt CO_2e emissions in 2030. The main source of agricultural non-CO_2 greenhouse gases are Nitrous Oxide (N_2O) emissions from microbial processes in soils. They contribute to roughly half of agricultural non-CO_2 greenhouse gases in the EU28. A driver for reduced emissions from this activity is a declining trend in mineral fertilizer use and cattle numbers in the EU28. This trend is contrasted by an increase in Methane (CH4) emissions from dairy cows from increased milk production and the combined effect of a 10 per cent decline in animal numbers and a 30 per cent expected increase in the average milk yield per cow between 2005 and 2030 (numbers not shown, we refer to EC 2014). Except for the first reported years, the EU28 LULUCF sink represents about 60 per cent of the agriculture emissions over the entire historical and projected period. Both, agriculture emissions and the net LULUCF sink are slightly decreasing, forming this rather stable relationship.

Figure 2-2: EU28 development of historical and projected emissions from Agriculture and removals from LULUCF [Mt CO_2e]



Source: JRC LULUCF tool - historical data GHGI-2014 and EC 2014

2.2. Effect of accounting rules

When included, emissions and removals of the LULUCF sector will not directly impact the emission reduction target. Emissions and removals will be accounted for in the targets following specific accounting rules. In the following we examine different accounting cases (see Table 2-3) applied to

emissions and removals for the EU28. In order to be able to assess impacts of assumptions, we isolated on change: the level of the FMRL.

Table 2-1: EU 28 credits (positive values) and debits (negative values) from LULUCF and Agriculture emission reduction needed in 2030 using different accounting rules [Mt CO2]

Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
Afforestation	98.7	98.7	98.7	98.7	42.1
Deforestation	-15.1	-15.1	-15.1	-15.1	-15.1
Forest management	12.1	-36.0	60.2	-140.2	12.1
Cropland management	11.0	11.0	11.0	11.0	11.0
Grazing land management	28.3	28.3	28.3	28.3	28.3
Total LULUCF	135.0	86.9	183.1	-17.3	78.4
Impact on effort needed to reach target (%)					
Avg. total ESD reduction	47.6	30.6	64.5	-6.1	27.6
Avg. total emission reduction	11.7	7.5	15.9	-1.5	6.8
Avg. agriculture reduction	145.9	93.9	197.9	-18.8	84.7
2030 reduction target if LULUCF included (%)					
Avg. total emission reduction target	35.3	37	33.6	40.6	37.2
Avg. total ESD target	15.7	20.8	10.6	31.8	21.7

2.2.1. Accounting case A – scaled FMRL of CP2

When applying CP2 rules with a scaled FMRL (see green line in Figure 2-1 for a graphical presentation of the FMRL) to emissions and removals projected for 2021-2030, LULUCF results in a credit of 135 Mt CO_2 (Table 2-1 and Figure 2-3). Almost 100 Mt CO_2 originate from gross-net accounting of afforestation. Also cropland and grazing land management form a credit. As the projected sink is larger (-253 Mt CO_2) than in the scaled FMRL for this period (-240 Mt CO_2), FM accounting also generates credits, despite the assumption of a declining sink (see Figure 2-1). Emissions from deforestation are the only debit-generating activity in this accounting case due to gross-net accounting. Table 2-1 and Figure 2-4 put credits and debits resulting from the accounting cases in perspective to emission reductions needed. The impact is presented as percentage of the respective average emission reduction determined by the target (-40 per cent for total, -30 per cent for agriculture and -22 per cent for ESD) by dividing annual LULUCF credits or debits by the annual emission reduction needed in 2030 compared to 1990 (in the case of agriculture and total emissions), or 2020 (in the case of the ESD). LULUCF credits would correspond to more than 146 per cent of emission reduction needed in the agriculture sector to reach the non-ETS target of -30 per cent in 2030, 48 per cent of ESD reduction efforts and still 12 per cent of a 40 per cent emission reduction of total emissions in 2030.

In case A) the FMRL values of CP2 were scaled to reflect reported changes in net emissions from FM. This is a rather rough simplification. To reflect the high level of uncertainty as to what FMRLs will be applied (if at all) for the accounting period 2021-2030, we have chosen to test different possible FMRLs to observe the impact on total LULUCF.

2.2.2. Accounting case B) - constructed high FMRL

The FMRLs for the period 2021-2030 have not been submitted, yet. Interpreting policy assumptions based on experience to date, one possible assumption for a hypothetical FMRL for 2021-2030 is a rather constant or even decreased harvest rates, e.g. due to increased imports or reduced demand for woody biomass for energy generation. In accounting case B) the FMRL is set to a 20 per cent higher value (-289 Mt CO_2, see also blue line in Figure 2-1). Contrary to the EU's projection, this scenario is based on the case where Member States' projections underlying the FMRL do not assume increased harvest rates related to EU bioenergy policies.

If policies do change and forest management projections in 2021-2030 become reality (i.e. countries do increase harvest and the sink declines), actual FM emissions would be accounted against the high FMRL. Accounting increases in FM emissions as included in the EU's hypothetical projection against our accounting case would result in a debit of -36 Mt CO_2 (Table 2-1 and Figure 2-3), i.e. FM would result in an accounted emission. Since other activities (esp. accounting rules for afforestation) remain unchanged compared to case A) LULUCF would still deliver credits of about 87 Mt CO_2. LULUCF credits would correspond to 94 per cent of agriculture emissions needed to achieve a 40 per cent reduction in 2030 compared to 1990, about 31 per cent of the ESD effort and 8 per cent of total emission reduction emissions needed (Table 2-1 and Figure 2-4).

2.2.3. Accounting case C) - constructed low FMRL

A case can also be made for an interpretation of existing policies leading to the opposite hypothetical assumption, describing the situation where countries' FMRLs assumed higher volumes for bioenergy and wood production than they would eventually realise during the CP. Case C) assumes FMRLs for 2021-2030 reflecting an interpretation of EU policies that would result in actual harvest rates above those assumed in the EU projection. The FMRL in this case is set at

only 80 per cent of the size of the level assumed in case A), i.e. -192 Mt CO_2. When comparing this FMRL with the sink assumed for FM in the EU projection, FM accounting would yield 60 Mt CO_2 of credits (Table 2-1 and Figure 2-3). Total LULUCF credits (leaving accounting for the other activities unchanged) would then amount 183 Mt CO_2. In this case, LULUCF credits would correspond to more than double the agriculture emission reductions required under the 2030 target, almost 65 per cent of the reduction efforts needed under the ESD and 16 per cent of total emissions to be reduced until 2030 (Table 2-1 and Figure 2-4).

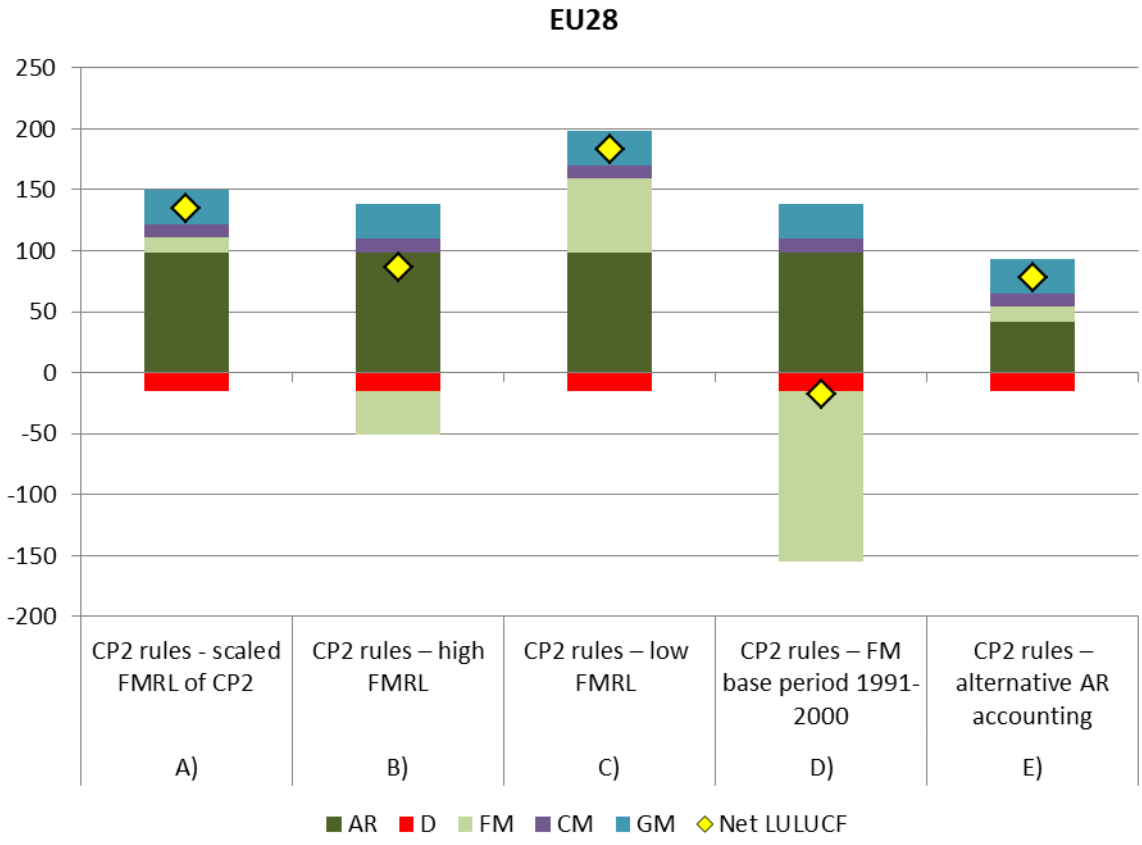
2.2.4. Accounting case D) - historical reference period for FM (1991-2000)

Accounting case D) looks at alternative accounting of FM and compares emissions and removals from that activity with a historic base period, i.e. 1991-2000. During that period, FM in the EU28 formed an annual sink of -393 Mt CO_2 (Figure 2-1). Comparing this figure with the EU projection for FM would result in a reduction of the sink to -253 Mt CO_2 in 2021-2030 which in turn would result in a debit of 140 Mt CO_2. This would cancel out all credits gained through AR, CM or GM (Table 2-1 and Figure 2-3). LULUCF net debits of -17 Mt CO_2 in this case would correspond to 19 per cent of agriculture emission reductions, -6 per cent of total ESD emission reductions, and still -1.5 per cent of total emission reductions in 2030 (Table 2-1 and Figure 2-4).

2.2.5. Accounting case E) - alternative AR accounting

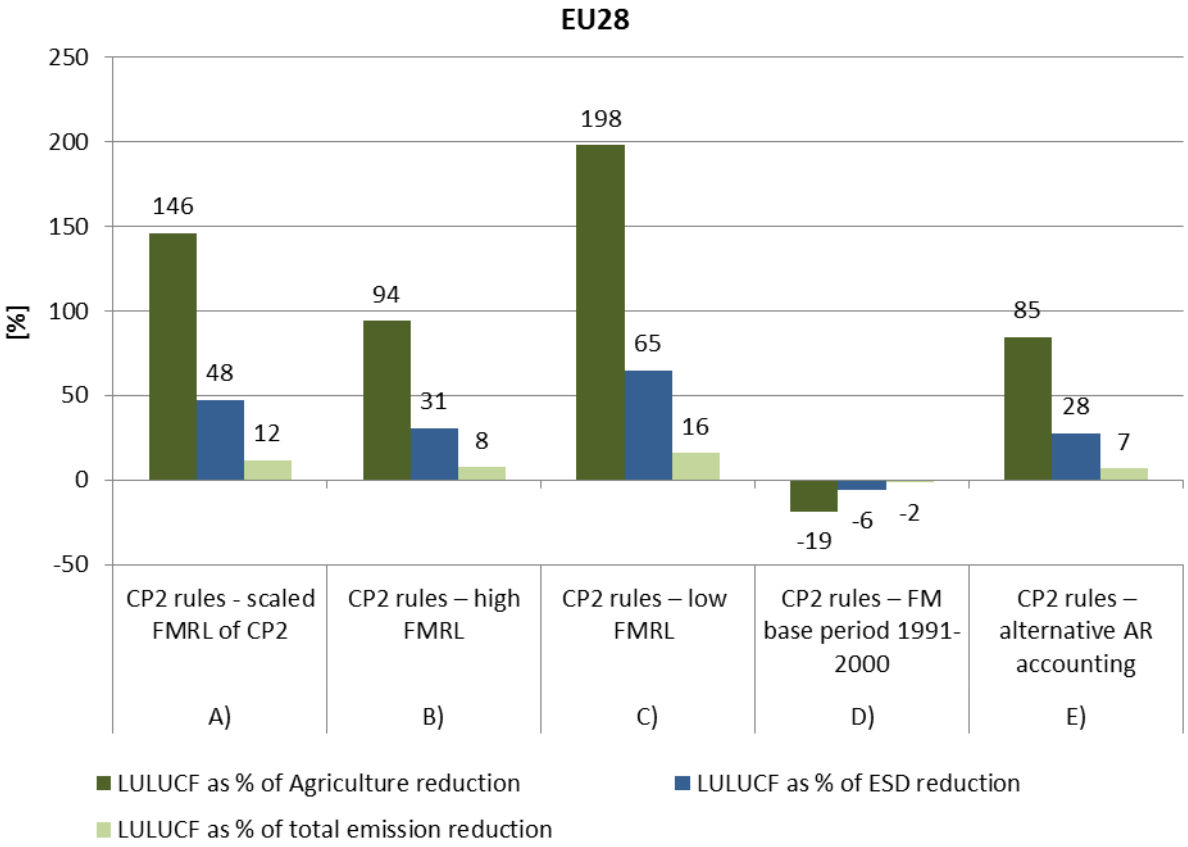
Beside FM, in all accounting cases looked at above, credits from afforestation form a large share of net LULUCF emissions and removals. In case E) the rule of gross-net accounting of afforestation since 1990 is changed to an accounting against a historic period (2008-2012). This period was chosen because it is located about 20 years before the period 2021-2030. When accounting against the historic sink of AR we construct an accounting rule that resembles an accounting not based on Kyoto Protocol, but UNFCCC reporting, where afforested areas enter the category of forest land remaining forest land after 20 years. Leaving all other activities accounted as in case A), this option would reduce credits from LULUCF to 109 Mt CO_2 because AR credits are reduced by 60 per cent. This would reduce the relative size of LULUCF credits compared to agriculture, ESD and total emission reductions in 2030 to 85 per cent, 28 per cent and 7 per cent, respectively (Table 2-1 and Figure 2-4).

Figure 2-3: EU 28 credits (positive values) and debits (negative values) from LULUCF using different accounting rules [Mt CO2]



Source: Own calculation based on JRC LULUCF tool - historical data GHGI-2014 and EC 2014

Figure 2-4: Relative size of EU28 LULUCF emissions and removals using different accounting rules compared to agriculture, ESD and total emission reductions needed to achieve the 40% reduction target in 2030 [%]



Source: Own calculation based on JRC LULUCF tool - historical data GHGI-2014 and EC 2014

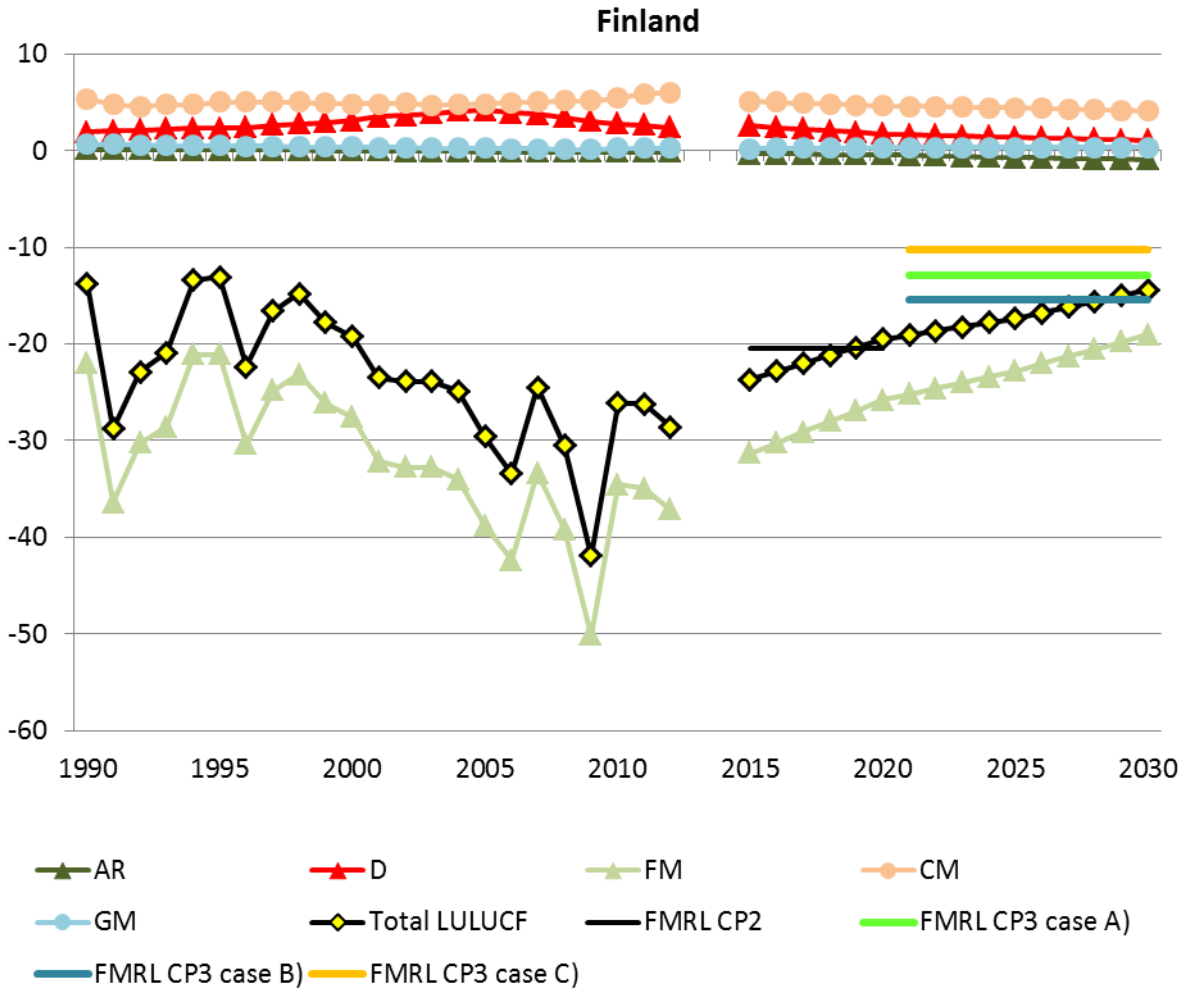
2.3. Country examples

2.3.1. Finland

Finland currently applies a FMRL which is lower than in the EU projection (Figure 2-5). Also the projection sees the FM sink declining in Finland. When applying accounting rules of CP2 with a scaled FMRL for 2021-2030, FM would generate credits of about 2.5 Mt CO_2 for the country (Figure 2-6), which is the value of the cap. In total LULUCF would generate credits of 3 Mt CO_2, which is almost 50 per cent of the relatively low 6.6 Mt CO_2e emissions from agriculture in Finland in 1990 (not shown). Characteristic for Finland are relatively high emissions from deforestation (1.4 Mt CO_2) in the period 2021-2030. Finland has the highest forest cover in Europe. This means infrastructure projects and the expansion of settlements and shifting agriculture further north lead to relatively high deforestation, compared to other Member States with lower forest cover.

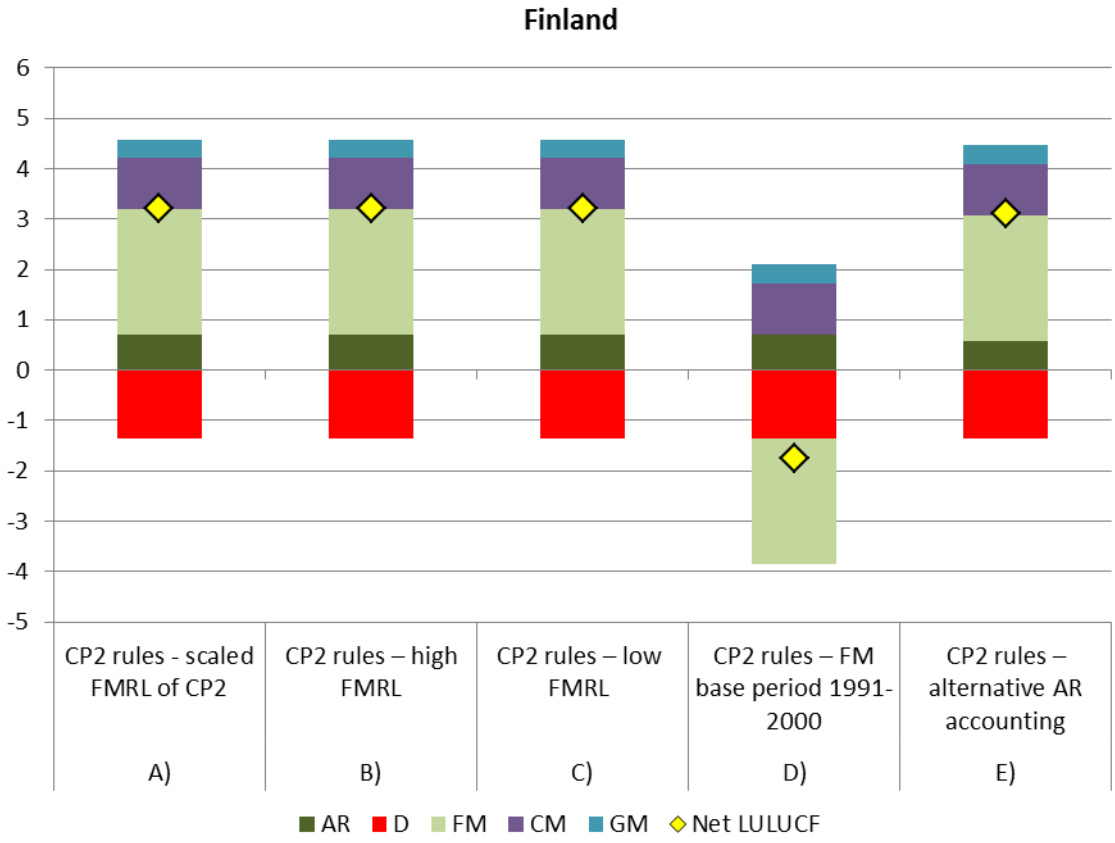
Assuming a high FMRL (case B)) would hypothetically cause LULUCF credits of a similar order of magnitude from FM. Opposite to cases A), B), and C) is case D) where accounting against a high sink in the past would cause large debits from FM. The afforestation area after 1990 is small in Finland and alternative accounting of AR therefore does not cause large difference to the base case A).

Figure 2-5: Emissions and removals of LULUCF activities for Finland [Mt CO_2]



Source: JRC LULUCF tool - historical data GHGI-2014 and own compilation

Figure 2-6: Credits (positive values) and debits (negative values) for Finland from LULUCF using different accounting rules [Mt CO2]



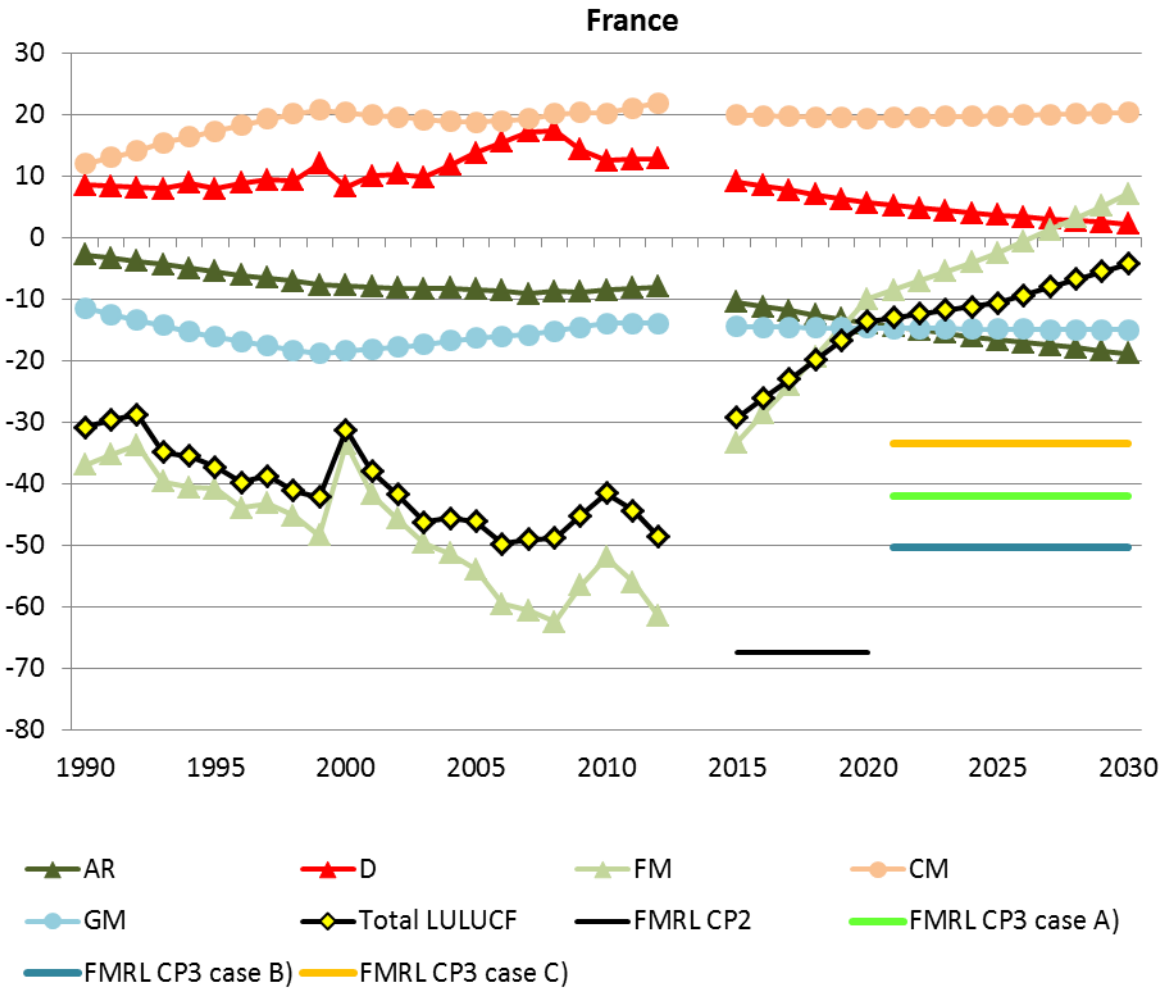
Source: JRC LULUCF tool - historical data GHGI-2014 and own compilation

2.3.2. France

France has a relatively high FMRL for CP2 (-67 Mt CO_2), which assumes a continuation of the trend of an increasing sink that France reported in the past (Figure 2-7). The EU emission projection for France, however, sees the forest carbon sink decreasing. It is difficult to anticipate what a potential FMRL for the period 2021-2030 for France could be. The accounting case A) still reflects the assumption of a relatively high FMRL. This leads to FM accounting resulting in large debits of -20 Mt CO_2 from FM. The cap applied prevents larger debits. The same applies to the other two cases (B) and C) where debits from FM more than compensate net credits (especially AR of about 17 Mt CO_2) reduces net debits to 11 Mt CO_2.

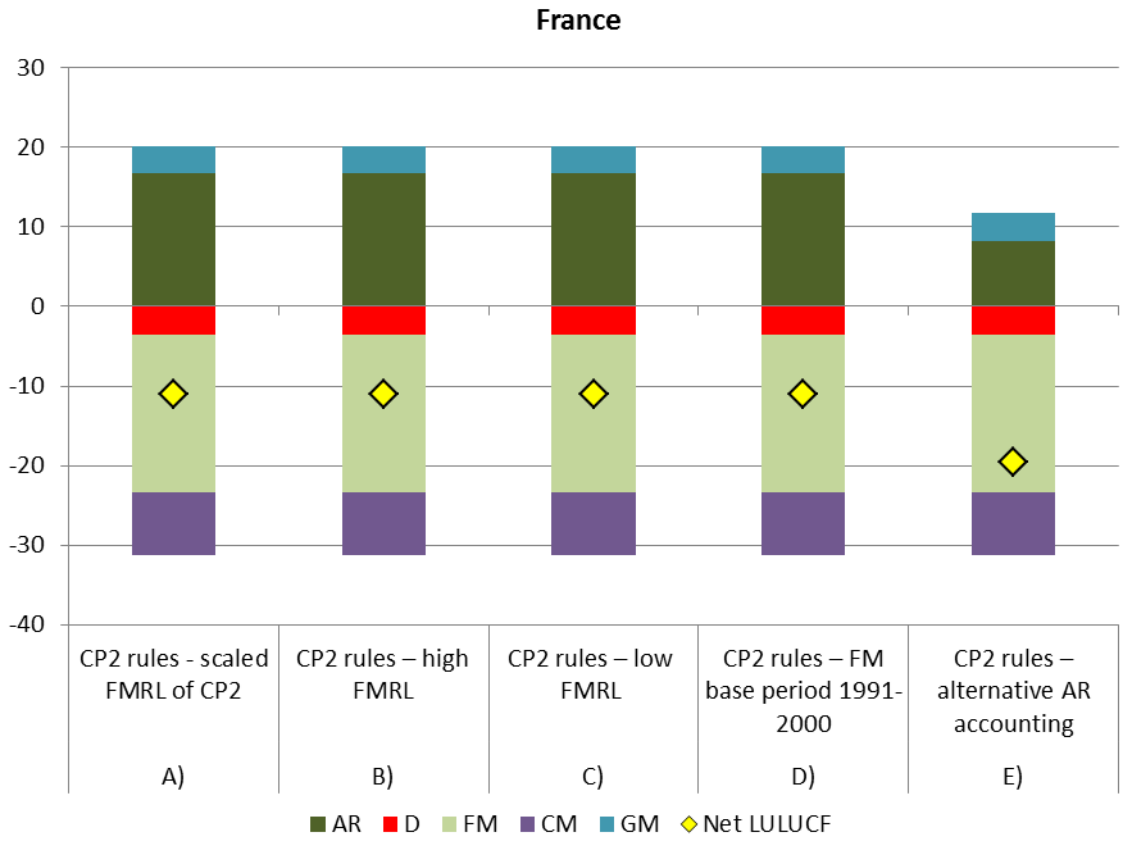
AR is an important category for France according to reported and projected data, as is also visible in case E) (alternative AR accounting), where AR credits are cut in half if older afforestation areas are accounted for as forest remaining forest, instead of using afforestation accounting rules for these areas afforested more than 20 years ago. Also a later reference year for cropland management would affect accounted emissions for France, in this case leading to a smaller debit.

Figure 2-7: Emissions and removals of LULUCF activities for France [Mt CO_2]



Source: JRC LULUCF tool - historical data GHGI-2014 and own compilation

Figure 2-8: Credits (positive values) and debits (negative values) for Finland from LULUCF using different accounting rules [Mt CO2]



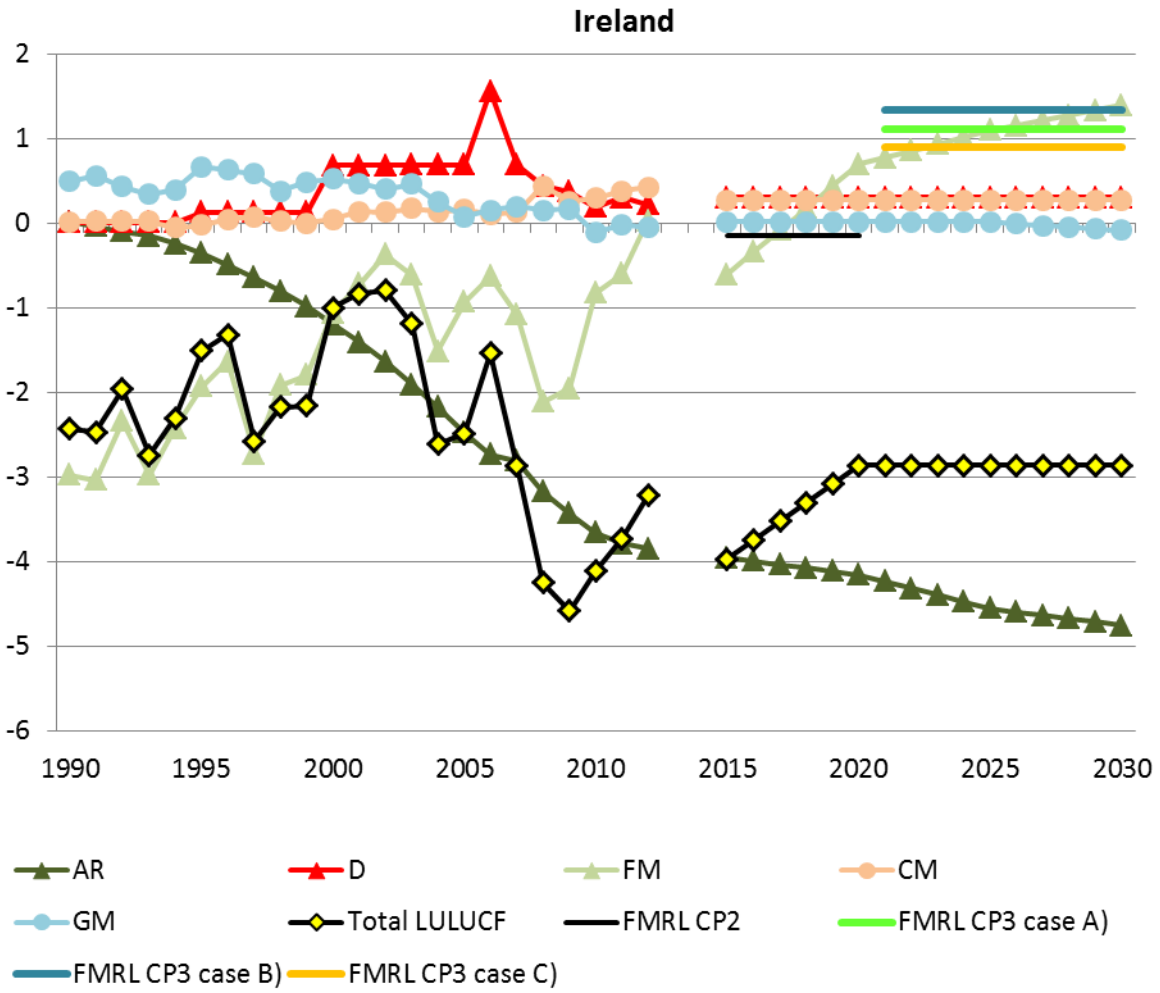
Source: JRC LULUCF tool - historical data GHGI-2014 and own compilation

2.3.3. Ireland

Ireland is another Member State where the rules for afforestation accounting are particularly important, since historically it has engaged in high levels of afforestation, and this is projected to continue. CP2 accounting rules allow for all afforestation that has occurred since 1990 to be accounted for using gross-net emissions/removals accounting (see Box 1-1). Accounting case E) is based on an alternative accounting for AR that resembles UNFCCC reporting. Instead of gross/net accounting for all areas afforested since 1990, this scenario calculates the outcome if areas afforested more than 20 years ago are accounted for using accounting rules for the category forests remaining forests. This leaves only the most recent afforestation areas in gross-net accounting. For Ireland, afforestation dominates projected LULUCF emissions in 2021-20103 (Figure 2-9), but also accounted emissions and removals under CP2 rules for this period (Figure 2-10). There are only small differences for the different FM accounting options we looked at (except for accounting FM against a historic reference where FM debits occur and LULUCF net credit would be reduced to less than 3 Mt CO_2 instead of more than 4 Mt CO_2). If afforestation land would not be kept in the afforestation category, but move (e.g. after every accounting period or after 20 year as in UNFCCC reporting) into FM, the strong effect of the new planted areas would disappear (case E) in Figure 2-10). Older afforestation area would then enter FM and be accounted for against the FMRL. The projection data do not allow this transition explicitly. There are expected effects on FM emissions and removals (increased sink) that cannot be displayed with

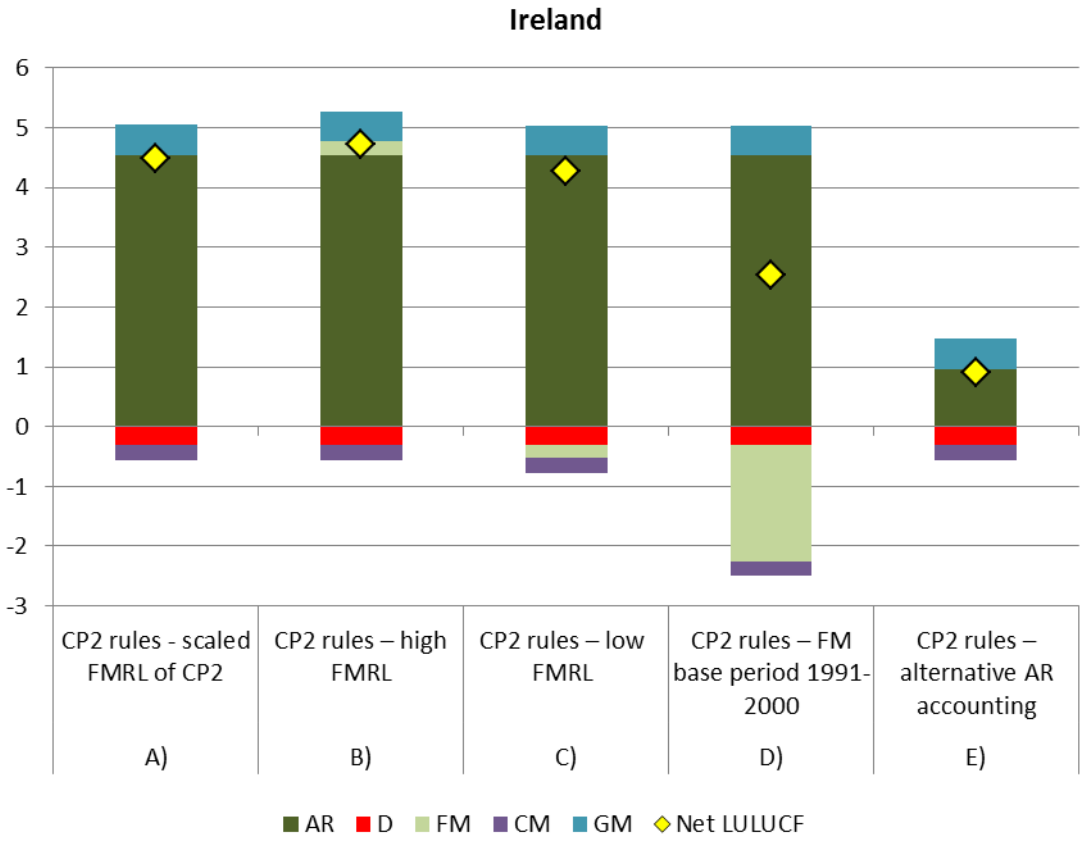
this data. However, the areas would also be included in the FMRL to be methodologically consistent and the net effect would therefore be limited.

Figure 2-9: Emissions and removals of LULUCF activities for Ireland [Mt CO_2]



Source: JRC LULUCF tool - historical data GHGI-2014 and own compilation

Figure 2-10: Credits (positive values) and debits (negative values) for Ireland from LULUCF using different accounting rules [Mt CO2]



Source: JRC LULUCF tool 2015 and own compilation

2.4. Discussion of alternative options for inclusion of LULUCF

Table 2-1 summarises impacts of LULUCF credits and debits on agriculture ESD and total emission reduction efforts. The effect on the 40 per cent reduction target is calculated by comparing the maximum value of credits and debits for LULUCF generated by the different accounting cases and the total emission reductions needed to achieve an overall 40 per cent reduction target (see also Figure 2-4).

Option 1 (LULUCF pillar)

This option seems to be most appropriate to include a sector that is different from all other sectors regarding its dynamics of emissions and removals and regarding risks of accounting since it is the only option that could envisage a separate target for LULUCF that would either entirely remove, or at the very least reduce the risk of LULUCF diluting ambition of the overall target, and could be the only option where ambition is actually increased. This would be achieved if there was zero flexibility between this pillar and other instruments and if a separate target was set for this pillar. The pillar can be designed to best reflect LULUCF specific particularities (e.g. lack of permanence, long time-cycles, high natural inter-annual variability) and can ensure that learning and improvements over time as well as international developments can be fully reflected. As a separate pillar future amendments are much easier than a reform of the entire ESD. Potential risks for

Member States of non-compliance and for overall environmental integrity are limited for this option compared to the two alternatives. Most importantly, this option ensures continuity with respect to the ESD. In any of the other options, this would require an amendment, which could lead to uncertainty.

Option 2 (Agriculture Forestry and Land Use (AFOLU) pillar)

If forced into a pillar with agriculture, the sink effect in LULUCF would in almost all scenarios (except case D) fully impact the need to reduce emissions in non-CO_2 agriculture.

Pulling agriculture out of the ESD and putting it into a separate pillar with LULUCF would additionally bring many questions. To not affect the agreed 30 per cent reduction target, agriculture in the new Land Use pillar would have to adopt the same target. Any other assumption would water down Member State ambition. This would be especially true when applying an accounting against reference scenario for agriculture that could foresee increased emissions and yield net credits.

Option 3 (Effort sharing)

Impacts of LULUCF accounting under the overall 40 per cent target could be large. Translating accounting rules and FMRL to 2021-2030 would mean that LULUCF could form more than 100 per cent of agriculture emission reduction efforts needed (case A)). An inclusion in the ESD would affect 47 per cent of ESD emission reduction efforts (case A). These effects could even be doubled when assuming more extreme results from LULUCF accounting. The impacts of FM inclusion on the target can potentially be reduced when a historic base period is used for FM rather than a reference level (comparing cases D) and A)). This applies for the EU28 under the assumed trends and data sets used. The situation is different for individual Member States. Such an accounting, however, would not exclude adequately indirect human-induced effects (age-classes) and could also be considered as back-sliding in terms of methodology.

Due to the fact that this option would describe the most integrated approach, it also increases complexity and raises methodological issues, including concerns related to environmental integrity and technical compliance. An integration of LULUCF into ESD would require re-thinking the notion of cost-effectiveness in the agreed effort sharing formula and of the cost-effective split between ETS and non-ETS due to the uneven distribution of cost-effective potentials across Member States. An integration applying current accounting rules would require an upgrade of the target if the level of ambition is not to be lowered. Until accounting rules are finally decided, the impact of LULUCF on the ESD target remains fairly unclear. Even after accounting rules are decided, challenges like setting appropriate FMRLs remain and make contributions of the sector unpredictable.

Table 2-2: Summary of pros and cons of the three options

	Pros	Cons
Option 1 (LULUCF pillar)	Reflects best LULUCF specific particularities (e.g. lack of permanence, long time-cycles, high natural inter-annual variability)	Agricultural and LULUCF continue to be addressed by different policy tools, reducing coherence and increasing complexity
	Ensures that learning and improvements over time as well as international developments can be fully reflected because a future LULUCF Decision is easier to amend than the entire ESD.	Less incentive for mitigation action in the sector unless an ambitious target is set
	Potential risks for Member States' ESD compliance and for overall environmental integrity therefore rather limited	
	Does not imply further adjusting the ESD as it does not alter its scope	
	Could avoid LULUCF diluting effort in other sectors, particularly if there is no flexibility	
Option 2 (AFOLU pillar)	Increases potentially visibility of agriculture (assuming that it has a target)	Less flexibility between sectors within ESD. There is the risk of non-compliance for Member States that have difficulties achieving the reductions in agriculture and LULUCF.
		There is no such strong link between non-CO_2 emissions from agriculture to LULUCF to justify integrating the two sectors. Agricultural emissions are directly linked to human activities; LULUCF emissions and removals follow a much more indirect logic
		Accounting rules for agriculture are in line with the other ESD sectors whereas LULUCF rules are not
		Reduced action for agriculture with possibility that it no longer has a numerical target
Option 3 (Effort sharing)	Increase flexibility for MS to achieve overall target	Increases complexity and raises methodological issues, including concerns related to environmental integrity and technical compliance
		Integration of LULUCF would require re-thinking the notion of cost-effectiveness in the agreed effort sharing formula and of the cost-effective split between ETS and non-ETS due to the uneven distribution of cost-effective potentials in this sector across Member States
		Net sink from LULUCF in ESD would decrease EU ambition if target is not upgraded Until accounting rules are not finally decided impact on ESD target unclear; even after accounting rules are decided uncertainties due to data quality
		Annual variability of LULUCF not compatible with linear target path

3. Conclusion

The environmental integrity of the 2030 Climate and Energy Framework would best be achieved by creating a separate LULUCF pillar. There are a number of prerequisites that need to be established to ensure environmental integrity and stringency of the overall target.

- The LULUCF pillar would have to have a separate target to incentivise removals and improve on the status quo, with no or reduced flexibility with other instruments in the 2030 climate and energy framework such as the ESD
- Safeguards must be applied to ensure broad environmental integrity, including of biodiversity
- The sector requires a clear strategy for reducing greenhouse gas emissions which sets out mid- and long-term objectives which ensure that land use policies addressing food security and other services of the sector do not oppose climate targets
- Clear guidance for the construction of FMRLs is needed to avoid the inclusion of emissions from bioenergy and to achieve consistency of FMRLs between countries. Methods for accounting for afforestation should be improved, namely that UNFCCC rules are used instead of rules currently used by the Kyoto Protocol.

Annex

Table A-1: Results of LULUCF accounting per Member State

Table A-1: Results of LULUCF accounting per Member State for different accounting cases and impacts on Agriculture, ESD and total emission reduction needed to meet 40% target in 2030 [Gg CO2e]. AR – Afforestation/Reforestation, D - Deforestation, FM – Forest management, CM – Cropland management, GM – Grazing land management. Red figures indicate where changes of accounting rules are effective. Cyprus and Malta were not estimated.

Country	Activity	A)	B)	C)	D)	E)
		CP2 rules - scaled FMRL of CP2	CP2 rules – high FMRL	CP2 rules – low FMRL	CP2 rules – FM base period 1991-2000	CP2 rules – alternative AR accounting
EU28	AR	98,699	98,699	98,699	98,699	42,108
	D	-15,122	-15,122	-15,122	-15,122	-15,122
	FM	12,127	-35,957	60,212	-140,190	12,127
	CM	11,006	11,006	11,006	11,006	11,006
	GM	28,261	28,261	28,261	28,261	28,261
	Net LULUCF	**134,972**	**86,887**	**183,056**	**-17,346**	**78,381**
	Agriculture reduction	92,506	92,506	92,506	92,506	92,506
	Other ESD reduction	191,250	191,250	191,250	191,250	191,250
	Total ESD reduction	**283,756**	**283,756**	**283,756**	**283,756**	**283,756**
	LULUCF as % of Agriculture reduction	145.9	93.9	197.9	-18.8	84.7
	LULUCF as % of ESD reduction	47.6	30.6	64.5	-6.1	27.6
	LULUCF as % of total emission reduction	11.7	7.5	15.9	-1.5	6.8
Austria	AR	3,172	3,172	3,172	3,172	1,190
	D	-148	-148	-148	-148	-148
	FM	-2,767	-2,767	-2,767	-2,767	-2,767
	CM	-158	-158	-158	-158	-158
	GM	-160	-160	-160	-160	-160
	Net LULUCF	**-61**	**-61**	**-61**	**-61**	**-2,043**
	Agriculture reduction	1,284	1,284	1,284	1,284	1,284
	Other ESD reduction	3,639	3,639	3,639	3,639	3,639
	Total ESD reduction	**4,922**	**4,922**	**4,922**	**4,922**	**4,922**
	LULUCF as % of Agriculture reduction	-4.8	-4.8	-4.8	-4.8	-159.2
	LULUCF as % of ESD reduction	-1.2	-1.2	-1.2	-1.2	-41.5
	LULUCF as % of total emission reduction	-0.4	-0.4	-0.4	-0.4	-12.9
Belgium	AR	384	384	384	384	100
	D	-126	-126	-126	-126	-126
	FM	-721	-980	-461	-2,397	-721
	CM	-375	-375	-375	-375	-375
	GM	966	966	966	966	966
	Net LULUCF	**129**	**-130**	**389**	**-1,547**	**-155**
	Agriculture reduction	1,716	1,716	1,716	1,716	1,716
	Other ESD reduction	4,667	4,667	4,667	4,667	4,667
	Total ESD reduction	**6,382**	**6,382**	**6,382**	**6,382**	**6,382**

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
	LULUCF as % of Agriculture reduction	7.5	-7.6	22.7	-90.2	-9.0
	LULUCF as % of ESD reduction	2.0	-2.0	6.1	-24.2	-2.4
	LULUCF as % of total emission reduction	0.4	-0.4	1.3	-5.3	-0.5
Bulgaria	AR	2,455	2,455	2,455	2,455	1,736
	D	0	0	0	0	0
	FM	-306	-1,382	770	-4,270	-306
	CM	-166	-166	-166	-166	-166
	GM	112	112	112	112	112
	Net LULUCF	**2,094**	**1,018**	**3,170**	**-1,870**	**1,376**
	Agriculture reduction	2,666	2,666	2,666	2,666	2,666
	Other ESD reduction	-397	-397	-397	-397	-397
	Total ESD reduction	**2,269**	**2,269**	**2,269**	**2,269**	**2,269**
	LULUCF as % of Agriculture reduction	78.6	38.2	118.9	-70.1	51.6
	LULUCF as % of ESD reduction	92.3	44.9	139.7	-82.4	60.6
	LULUCF as % of total emission reduction	8.6	4.2	13.0	-7.7	5.6
Croatia	AR	1,301	1,301	1,301	1,301	1,120
	D	-2	-2	-2	-2	-2
	FM	-1,096	-1,096	-1,096	-1,096	-1,096
	CM	-5	-5	-5	-5	-5
	GM	77	77	77	77	77
	Net LULUCF	**274**	**274**	**274**	**274**	**93**
	Agriculture reduction	658	658	658	658	658
	Other ESD reduction	1,055	1,055	1,055	1,055	1,055
	Total ESD reduction	**1,713**	**1,713**	**1,713**	**1,713**	**1,713**
	LULUCF as % of Agriculture reduction	41.7	41.7	41.7	41.7	14.1
	LULUCF as % of ESD reduction	16.0	16.0	16.0	16.0	5.4
	LULUCF as % of total emission reduction	4.4	4.4	4.4	4.4	1.5
Czech Republic	AR	533	533	533	533	230
	D	-53	-53	-53	-53	-53
	FM	699	1	1,398	-3,426	699
	CM	1,204	1,204	1,204	1,204	1,204
	GM	350	350	350	350	350
	Net LULUCF	**2,734**	**2,036**	**3,432**	**-1,392**	**2,431**
	Agriculture reduction	2,446	2,446	2,446	2,446	2,446
	Other ESD reduction	4,643	4,643	4,643	4,643	4,643
	Total ESD reduction	**7,089**	**7,089**	**7,089**	**7,089**	**7,089**
	LULUCF as % of Agriculture reduction	111.8	83.2	140.3	-56.9	99.4
	LULUCF as % of ESD reduction	38.6	28.7	48.4	-19.6	34.3
	LULUCF as % of total emission reduction	7.0	5.2	8.8	-3.6	6.3

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
Denmark	AR	375	375	375	375	338
	D	-23	-23	-23	-23	-23
	FM	2,426	2,426	2,426	2,426	2,426
	CM	1,772	1,772	1,772	1,772	1,772
	GM	-198	-198	-198	-198	-198
	Net LULUCF	**4,353**	**4,353**	**4,353**	**4,353**	**4,316**
	Agriculture reduction	1,879	1,879	1,879	1,879	1,879
	Other ESD reduction	1,235	1,235	1,235	1,235	1,235
	Total ESD reduction	**3,114**	**3,114**	**3,114**	**3,114**	**3,114**
	LULUCF as % of Agriculture reduction	231.7	231.7	231.7	231.7	229.7
	LULUCF as % of ESD reduction	139.8	139.8	139.8	139.8	138.6
	LULUCF as % of total emission reduction	31.4	31.4	31.4	31.4	31.1
Estonia	AR	922	922	922	922	894
	D	-62	-62	-62	-62	-62
	FM	856	570	1,141	-1,492	856
	CM	70	70	70	70	70
	GM	-125	-125	-125	-125	-125
	Net LULUCF	**1,660**	**1,374**	**1,946**	**-687**	**1,632**
	Agriculture reduction	477	477	477	477	477
	Other ESD reduction	230	230	230	230	230
	Total ESD reduction	**706**	**706**	**706**	**706**	**706**
	LULUCF as % of Agriculture reduction	348.4	288.4	408.3	-144.2	342.5
	LULUCF as % of ESD reduction	235.0	194.6	275.5	-97.3	231.1
	LULUCF as % of total emission reduction	19.5	16.1	22.8	-8.1	19.2
Finland	AR	707	707	707	707	588
	D	-1,366	-1,366	-1,366	-1,366	-1,366
	FM	2,485	2,485	2,485	-2,485	2,485
	CM	1,019	1,019	1,019	1,019	1,019
	GM	370	370	370	370	370
	Net LULUCF	**3,215**	**3,215**	**3,215**	**-1,755**	**3,096**
	Agriculture reduction	982	982	982	982	982
	Other ESD reduction	2,066	2,066	2,066	2,066	2,066
	Total ESD reduction	**3,048**	**3,048**	**3,048**	**3,048**	**3,048**
	LULUCF as % of Agriculture reduction	327.3	327.3	327.3	-178.6	315.1
	LULUCF as % of ESD reduction	105.5	105.5	105.5	-57.6	101.6
	LULUCF as % of total emission reduction	22.6	22.6	22.6	-12.4	21.8
France	AR	16,756	16,756	16,756	16,756	8,276
	D	-3,594	-3,594	-3,594	-3,594	-3,594
	FM	-19,737	-19,737	-19,737	-19,737	-19,737

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
	CM	-7,906	-7,906	-7,906	-7,906	-7,906
	GM	3,452	3,452	3,452	3,452	3,452
	Net LULUCF	**-11,030**	**-11,030**	**-11,030**	**-11,030**	**-19,510**
	Agriculture reduction	15,101	15,101	15,101	15,101	15,101
	Other ESD reduction	28,931	28,931	28,931	28,931	28,931
	Total ESD reduction	**44,032**	**44,032**	**44,032**	**44,032**	**44,032**
	LULUCF as % of Agriculture reduction	-73.0	-73.0	-73.0	-73.0	-129.2
	LULUCF as % of ESD reduction	-25.0	-25.0	-25.0	-25.0	-44.3
	LULUCF as % of total emission reduction	-9.8	-9.8	-9.8	-9.8	-17.3
Germany	AR	9,416	9,416	9,416	9,416	4,198
	D	-731	-731	-731	-731	-731
	FM	27,015	21,921	32,109	-11,434	27,015
	CM	-210	-210	-210	-210	-210
	GM	3,045	3,045	3,045	3,045	3,045
	Net LULUCF	**38,535**	**33,441**	**43,629**	**86**	**33,317**
	Agriculture reduction	13,173	13,173	13,173	13,173	13,173
	Other ESD reduction	48,774	48,774	48,774	48,774	48,774
	Total ESD reduction	**61,947**	**61,947**	**61,947**	**61,947**	**61,947**
	LULUCF as % of Agriculture reduction	292.5	253.9	331.2	0.7	252.9
	LULUCF as % of ESD reduction	62.2	54.0	70.4	0.1	53.8
	LULUCF as % of total emission reduction	15.6	13.6	17.7	0.0	13.5
Greece	AR	989	989	989	989	850
	D					
	FM	-318	-615	-21	-550	-318
	CM	-550	-550	-550	-550	-550
	GM	734	734	734	734	734
	Net LULUCF	**854**	**557**	**1,151**	**623**	**715**
	Agriculture reduction	1,682	1,682	1,682	1,682	1,682
	Other ESD reduction	3,179	3,179	3,179	3,179	3,179
	Total ESD reduction	**4,862**	**4,862**	**4,862**	**4,862**	**4,862**
	LULUCF as % of Agriculture reduction	50.8	33.1	68.4	37.0	42.5
	LULUCF as % of ESD reduction	17.6	11.5	23.7	12.8	14.7
	LULUCF as % of total emission reduction	4.0	2.6	5.4	2.9	3.3
Hungary	AR	2,158	2,158	2,158	2,158	1,010
	D	-35	-35	-35	-35	-35
	FM	380	372	387	-2,243	380
	CM	1,769	1,769	1,769	1,769	1,769
	GM	-128	-128	-128	-128	-128
	Net LULUCF	**4,143**	**4,136**	**4,151**	**1,520**	**2,995**

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
	Agriculture reduction	2,274	2,274	2,274	2,274	2,274
	Other ESD reduction	2,189	2,189	2,189	2,189	2,189
	Total ESD reduction	**4,462**	**4,462**	**4,462**	**4,462**	**4,462**
	LULUCF as % of Agriculture reduction	182.2	181.9	182.5	66.9	131.7
	LULUCF as % of ESD reduction	92.8	92.7	93.0	34.1	67.1
	LULUCF as % of total emission reduction	18.0	17.9	18.0	6.6	13.0
Ireland	AR	4,536	4,536	4,536	4,536	956
	D	-306	-306	-306	-306	-306
	FM	10	234	-213	-1,946	10
	CM	-252	-252	-252	-252	-252
	GM	506	506	506	506	506
	Net LULUCF	**4,495**	**4,719**	**4,272**	**2,539**	**915**
	Agriculture reduction	2,945	2,945	2,945	2,945	2,945
	Other ESD reduction	-622	-622	-622	-622	-622
	Total ESD reduction	**2,323**	**2,323**	**2,323**	**2,323**	**2,323**
	LULUCF as % of Agriculture reduction	152.6	160.2	145.0	86.2	31.1
	LULUCF as % of ESD reduction	193.5	203.2	183.9	109.3	39.4
	LULUCF as % of total emission reduction	40.4	42.4	38.4	22.8	8.2
Italy	AR	12,382	12,382	12,382	12,382	5,938
	D	-631	-631	-631	-631	-631
	FM	810	-2,817	4,437	-3,826	810
	CM	-713	-713	-713	-713	-713
	GM	8,132	8,132	8,132	8,132	8,132
	Net LULUCF	**19,979**	**16,353**	**23,606**	**15,343**	**13,536**
	Agriculture reduction	6,124	6,124	6,124	6,124	6,124
	Other ESD reduction	27,867	27,867	27,867	27,867	27,867
	Total ESD reduction	**33,992**	**33,992**	**33,992**	**33,992**	**33,992**
	LULUCF as % of Agriculture reduction	326.2	267.0	385.4	250.5	221.0
	LULUCF as % of ESD reduction	58.8	48.1	69.4	45.1	39.8
	LULUCF as % of total emission reduction	19.3	15.8	22.8	14.8	13.1
Latvia	AR	538	538	538	538	234
	D	-261	-261	-261	-261	-261
	FM	-907	-907	-907	-907	-907
	CM	366	366	366	366	366
	GM	743	743	743	743	743
	Net LULUCF	**479**	**479**	**479**	**479**	**175**
	Agriculture reduction	890	890	890	890	890
	Other ESD reduction	225	225	225	225	225
	Total ESD reduction	**1,115**	**1,115**	**1,115**	**1,115**	**1,115**

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
	LULUCF as % of Agriculture reduction	53.8	53.8	53.8	53.8	19.7
	LULUCF as % of ESD reduction	43.0	43.0	43.0	43.0	15.7
	LULUCF as % of total emission reduction	9.2	9.2	9.2	9.2	3.4
Lithuania	AR	1,717	1,717	1,717	1,717	574
	D	-3	-3	-3	-3	-3
	FM	1,730	1,730	1,730	1,730	1,730
	CM	2,232	2,232	2,232	2,232	2,232
	GM	1,142	1,142	1,142	1,142	1,142
	Net LULUCF	**6,818**	**6,818**	**6,818**	**6,818**	**5,675**
	Agriculture reduction	1,543	1,543	1,543	1,543	1,543
	Other ESD reduction	96	96	96	96	96
	Total ESD reduction	**1,639**	**1,639**	**1,639**	**1,639**	**1,639**
	LULUCF as % of Agriculture reduction	441.7	441.7	441.7	441.7	367.7
	LULUCF as % of ESD reduction	415.9	415.9	415.9	415.9	346.2
	LULUCF as % of total emission reduction	69.0	69.0	69.0	69.0	57.4
Luxembourg	AR	160	160	160	160	88
	D	-272	-272	-272	-272	-272
	FM	-48	-75	-21	-264	-48
	CM	-22	-22	-22	-22	-22
	GM	-26	-26	-26	-26	-26
	Net LULUCF	**-206**	**-233**	**-180**	**-423**	**-279**
	Agriculture reduction	111	111	111	111	111
	Other ESD reduction	521	521	521	521	521
	Total ESD reduction	**633**	**633**	**633**	**633**	**633**
	LULUCF as % of Agriculture reduction	-185.1	-209.0	-161.2	-379.0	-250.1
	LULUCF as % of ESD reduction	-32.6	-36.8	-28.4	-66.8	-44.1
	LULUCF as % of total emission reduction	-7.8	-8.8	-6.8	-16.0	-10.6
Netherlands	AR	1,624	1,624	1,624	1,624	1,028
	D	-584	-584	-584	-584	-584
	FM	1,056	819	1,293	-336	1,056
	CM	-754	-754	-754	-754	-754
	GM	685	685	685	685	685
	Net LULUCF	**2,026**	**1,789**	**2,263**	**635**	**1,430**
	Agriculture reduction	3,383	3,383	3,383	3,383	3,383
	Other ESD reduction	7,535	7,535	7,535	7,535	7,535
	Total ESD reduction	**10,918**	**10,918**	**10,918**	**10,918**	**10,918**
	LULUCF as % of Agriculture reduction	59.9	52.9	66.9	18.8	42.3
	LULUCF as % of ESD reduction	18.6	16.4	20.7	5.8	13.1
	LULUCF as % of total emission reduction	4.8	4.2	5.3	1.5	3.4

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
Poland	AR	5,075	5,075	5,075	5,075	2,480
	D	-100	-100	-100	-100	-100
	FM	5,657	884	10,431	-151	5,657
	CM	2,621	2,621	2,621	2,621	2,621
	GM	918	918	918	918	918
	Net LULUCF	**14,172**	**9,398**	**18,945**	**8,363**	**11,576**
	Agriculture reduction	8,149	8,149	8,149	8,149	8,149
	Other ESD reduction	10,388	10,388	10,388	10,388	10,388
	Total ESD reduction	**18,538**	**18,538**	**18,538**	**18,538**	**18,538**
	LULUCF as % of Agriculture reduction	173.9	115.3	232.5	102.6	142.1
	LULUCF as % of ESD reduction	76.4	50.7	102.2	45.1	62.4
	LULUCF as % of total emission reduction	12.6	8.3	16.8	7.4	10.3
Portugal	AR	9,108	9,108	9,108	9,108	3,294
	D	-1,548	-1,548	-1,548	-1,548	-1,548
	FM	2,105	2,105	2,105	1,478	2,105
	CM	3,501	3,501	3,501	3,501	3,501
	GM	1,253	1,253	1,253	1,253	1,253
	Net LULUCF	**14,420**	**14,420**	**14,420**	**13,793**	**8,605**
	Agriculture reduction	1,218	1,218	1,218	1,218	1,218
	Other ESD reduction	3,197	3,197	3,197	3,197	3,197
	Total ESD reduction	**4,415**	**4,415**	**4,415**	**4,415**	**4,415**
	LULUCF as % of Agriculture reduction	1,184.1	1,184.1	1,184.1	1,132.6	706.6
	LULUCF as % of ESD reduction	326.6	326.6	326.6	312.4	194.9
	LULUCF as % of total emission reduction	119.9	119.9	119.9	114.7	71.5
Romania	AR	3,156	3,156	3,156	3,156	390
	D	-1,547	-1,547	-1,547	-1,547	-1,547
	FM	-2,717	-3,747	-1,688	-8,959	-2,717
	CM	74	74	74	74	74
	GM	-462	-462	-462	-462	-462
	Net LULUCF	**-1,496**	**-2,526**	**-467**	**-7,738**	**-4,263**
	Agriculture reduction	5,506	5,506	5,506	5,506	5,506
	Other ESD reduction	2,104	2,104	2,104	2,104	2,104
	Total ESD reduction	**7,610**	**7,610**	**7,610**	**7,610**	**7,610**
	LULUCF as % of Agriculture reduction	-27.2	-45.9	-8.5	-140.5	-77.4
	LULUCF as % of ESD reduction	-19.7	-33.2	-6.1	-101.7	-56.0
	LULUCF as % of total emission reduction	-2.9	-4.9	-0.9	-15.1	-8.3
Slovakia	AR	461	461	461	461	88
	D	-22	-22	-22	-22	-22
	FM	2,522	2,522	2,522	-2,281	2,522

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
	CM	247	247	247	247	247
	GM	50	50	50	50	50
	Net LULUCF	**3,258**	**3,258**	**3,258**	**-1,545**	**2,885**
	Agriculture reduction	1,084	1,084	1,084	1,084	1,084
	Other ESD reduction	1,842	1,842	1,842	1,842	1,842
	Total ESD reduction	**2,926**	**2,926**	**2,926**	**2,926**	**2,926**
	LULUCF as % of Agriculture reduction	300.5	300.5	300.5	-142.5	266.1
	LULUCF as % of ESD reduction	111.3	111.3	111.3	-52.8	98.6
	LULUCF as % of total emission reduction	22.6	22.6	22.6	-10.7	20.0
Slovenia	AR	1,936	1,936	1,936	1,936	1,098
	D	-758	-758	-758	-758	-758
	FM	712	712	712	712	712
	CM	107	107	107	107	107
	GM	-275	-275	-275	-275	-275
	Net LULUCF	**1,722**	**1,722**	**1,722**	**1,722**	**884**
	Agriculture reduction	320	320	320	320	320
	Other ESD reduction	1,041	1,041	1,041	1,041	1,041
	Total ESD reduction	**1,361**	**1,361**	**1,361**	**1,361**	**1,361**
	LULUCF as % of Agriculture reduction	538.0	538.0	538.0	538.0	276.2
	LULUCF as % of ESD reduction	126.6	126.6	126.6	126.6	65.0
	LULUCF as % of total emission reduction	42.3	42.3	42.3	42.3	21.7
Spain	AR	11,259	11,259	11,259	11,259	2,654
	D	-2,339	-2,339	-2,339	-2,339	-2,339
	FM	-234	-4,243	3,775	-3,176	-234
	CM	912	912	912	912	912
	GM	4,086	4,086	4,086	4,086	4,086
	Net LULUCF	**13,683**	**9,674**	**17,692**	**10,741**	**5,079**
	Agriculture reduction	5,649	5,649	5,649	5,649	5,649
	Other ESD reduction	15,252	15,252	15,252	15,252	15,252
	Total ESD reduction	**20,901**	**20,901**	**20,901**	**20,901**	**20,901**
	LULUCF as % of Agriculture reduction	242.2	171.3	313.2	190.1	89.9
	LULUCF as % of ESD reduction	65.5	46.3	84.6	51.4	24.3
	LULUCF as % of total emission reduction	23.6	16.7	30.5	18.5	8.8
Sweden	AR	4,301	4,301	4,301	4,301	1,888
	D	-775	-775	-775	-775	-775
	FM	-1,319	-2,525	2,525	-2,525	-1,319
	CM	925	925	925	925	925
	GM	369	369	369	369	369
	Net LULUCF	**3,501**	**2,294**	**7,345**	**2,294**	**1,088**

Country	Activity	A) CP2 rules - scaled FMRL of CP2	B) CP2 rules – high FMRL	C) CP2 rules – low FMRL	D) CP2 rules – FM base period 1991-2000	E) CP2 rules – alternative AR accounting
	Agriculture reduction	1,357	1,357	1,357	1,357	1,357
	Other ESD reduction	2,730	2,730	2,730	2,730	2,730
	Total ESD reduction	**4,087**	**4,087**	**4,087**	**4,087**	**4,087**
	LULUCF as % of Agriculture reduction	258.0	169.1	541.3	169.1	80.2
	LULUCF as % of ESD reduction	85.7	56.1	179.7	56.1	26.6
	LULUCF as % of total emission reduction	24.3	15.9	50.9	15.9	7.5
United Kingdom	AR	3,278	3,278	3,278	3,278	868
	D	-333	-333	-333	-333	-333
	FM	5,293	4,159	6,426	-976	5,293
	CM	5,296	5,296	5,296	5,296	5,296
	GM	2,645	2,645	2,645	2,645	2,645
	Net LULUCF	**16,178**	**15,045**	**17,311**	**9,909**	**13,768**
	Agriculture reduction	9,768	9,768	9,768	9,768	9,768
	Other ESD reduction	27,875	27,875	27,875	27,875	27,875
	Total ESD reduction	**37,642**	**37,642**	**37,642**	**37,642**	**37,642**
	LULUCF as % of Agriculture reduction	165.6	154.0	177.2	101.5	141.0
	LULUCF as % of ESD reduction	43.0	40.0	46.0	26.3	36.6
	LULUCF as % of total emission reduction	10.4	9.7	11.1	6.4	8.9