# A new role for forests and the forest sector in the EU post-2020 climate targets

Gert-Jan Nabuurs, Philippe Delacote, David Ellison, Marc Hanewinkel, Marcus Lindner, Martin Nesbit, Markku Ollikainen and Annalisa Savaresi

# Contents



ISSN 2343-1229 (print)
ISSN 2343-1237 (online)

ISBN 978-952-5980-20-2 (print)
ISBN 978-952-5980-21-9 (online)

Editor in chief: Lauri Hetemäki
Managing editors: Rach Colling, Minna Korhonen
Layout: Grano Oy / Jouni Halonen
Printing: Grano Oy



Recommended citation: Gert-Jan Nabuurs, Philippe Delacote, David Ellison, Marc Hanewinkel, Marcus Lindner, Martin Nesbit, Markku Ollikainen and Annalisa Savaresi. 2015. A new role for forests and the forest sector in the EU post-2020 climate targets. From Science to Policy 2. European Forest Institute. https://doi.org/10.36333/fs02

# SUMMARY


EU forests and the forest sector play a significant role in the EU greenhouse gas balance. These forests and their products reduce emissions, enhance sinks, store carbon and provide a continuous stream of ecosystem services, including wood products, energy and biodiversity conservation. In all their variety, it is estimated that EU forests and the forest sector currently produce an overall climate mitigation impact that amounts to about 13% of the total EU emissions. This includes both the action of forests and harvested wood products as a **carbon sink and carbon stock**, and the **substitution** effect of forest products for **fossil-based raw materials and products.**

Over the past two decades, the mitigation potential of forests and the forest sector has been progressively included in the international climate regime. Existing rules are rather complicated and provide limited incentives for mitigation in the forest sector in developed countries. But as the Parties to the Kyoto Protocol negotiate a new climate agreement to be adopted in Paris in December 2015, a new bottom-up approach to emission reduction commitments has emerged. This has opened the door to new approaches to using the forest sector's mitigation potential in developed countries. Better use of this potential could also provide a host of additional benefits, including revenue-generation and biodiversity conservation.

The EU has already decided that emissions and removals from Land Use, Land Use Change and Forestry (LULUCF) are to be included in its 2030 climate policy framework, with a decision on exactly how to do so expected in 2016. This study aims to support EU policy-makers in answering this complex question by:

- Determining whether and how to use forests' sinks and substitution effects as a means to meet the EU's post-2020 targets, without decreasing the overall level of ambition,
- Identifying new principles and measures to reap the potential of the forest sector to contribute to climate change mitigation in the EU, in synergy with other regional priorities in the land use sector.


## Policy implications

- The potential for EU forests to contribute to climate change mitigation and adaptation is currently not used in an optimal way and is not incentivised under EU policies. Looking ahead, however, there is great scope to enhance the role of EU forests in tackling climate change. **If adequately incentivised, Member States could achieve a combined additional effect of as much as 400 Mt $CO_2$/y by 2030 on top of the existing sink and substitution. With the existing sink and substitution this comes to an equivalent of about 22% of the current EU $CO_2$ emissions.**

- Given recent developments in the policy arena, **the EU should decide an overall EU-wide target for removals in the forest sector.** This target could gradually be raised well beyond the current sink. The target would not only be geared towards increasing the forest sink, but also in ways that increase the GDP contribution of the forest sector and contribute sustainably to EU energy security.

- **The timetable for achieving targets should be longer than 2030, with an initial learning and implementation phase.** This would allow for possible adjustment and an examination of how carbon policy in forests impacts, in particular, on land allocation between forestry and agriculture. Gradually, full land-based accounting with a 'net' approach could be incorporated in the overall accounting, avoiding loopholes between the energy and LULUCF sectors.

- **The EU should decide how to share the effort of meeting the EU-wide target across the EU Member States.** The optimal approach would be to pursue cost-efficiency, possibly based on considerations of fairness and GDP. If this new forestry LULUCF pillar is set up separately from the existing Effort Sharing Decision (ESD), then it would need to be recognised that limited additional incentives would

be created for Member States unless the separate pillar is linked to a country's own (larger) target.

Linking a forestry pillar to the ESD could potentially weaken incentives for mitigation action in the ESD sectors. If forestry targets form part of or are linked to the ESD, the total emissions permitted under the ESD should be reduced by an amount that reflects the new availability of the cost-effective mitigation potential in the forestry sector.

- **EU and national policies relevant to forestry should be reviewed with respect to their climate impacts.** EU policies like the Common Agricultural Policy, the Renewable Energy Directive and Forest Strategy all have climate impacts. These impacts need to be revisited and analysed in light of climate policy targets, and the shifts in policies proposed in order to improve the synergies with climate mitigation potential.

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

The climate problem is important and urgent enough to require every sector to make its contribution. No sector can solve the problem on its own or within a short time frame. Quick fixes should not be expected from any sector. **With the right incentives and investments, however, a significant contribution can be expected from EU forests, forestry and the forest-based industries.**

# 1. Purpose and background: time for a fresh look at forest sinks

There is no doubt that forests across the world play an important role in the global climate. Their role in acting as $CO_2$ sinks and $CO_2$ reservoirs and in providing a source of products and renewable energy is recognised in the international climate change regime. The different roles played by forests and land uses in the northern hemisphere (where forests largely act as $CO_2$ sinks) and the southern hemisphere (where emissions associated with deforestation tend to be concentrated) justified the 1997 Kyoto Protocol's approach to forest emissions and sinks.

Parties to the Kyoto Protocol committed to reducing greenhouse gas emissions, setting reduction targets for a group of developed countries for the periods 2008–2012 and 2013–2020. **Developed** countries were allowed to achieve these targets with land use related activities only to a limited extent. The reason for this limitation was that land sinks were perceived to be unstable and mostly determined by past activities, and therefore would accrue mitigation that would have occurred anyway. There was, furthermore, the widespread conviction that the land use sector was difficult to regulate and that it would achieve little in the way of emission reductions.

This state of affairs has changed greatly in recent years. As the Parties to the climate regime negotiate a new climate agreement to be adopted in Paris in December 2015, a new bottom-up approach to mitigation commitments has emerged. This has opened the way to greater flexibility for Parties to use forest activities to mitigate climate change. New data has also enabled scientists to understand how to better use the forest sector in tackling climate change. **Developing** countries have increasingly taken up commitments to reduce emissions in the forest sector. More generally, several Parties support the adoption of a more comprehensive approach to emissions from land use in international climate policy after 2020.

These developments justify taking a fresh look at the forest sector's contribution to tackling climate change. The EU has already decided that emissions and removals from Land Use, Land Use Change and Forestry (LULUCF) are to be included in its 2030 climate policy framework, with a decision on exactly how to do so expected in 2016. This study aims to support EU policy-makers in answering this complex question by:

- Determining whether and how to use forests' sinks and substitution effects as a means to meet the EU's post-2020 targets, without decreasing the overall level of ambition,
- Identifying new principles and measures to reap the potential of the forest sector to contribute to climate change mitigation in the EU, in synergy with other regional priorities in the land use sector.

Ultimately, this study aims to identify **a fair and simple, long term strategy for European forests that is beneficial to the climate, creates incentives specific to the circumstances of each Member State and guarantees the fulfilment of other forest functions**, including raw material provision, biodiversity protection and recreation.

# 2. Forests and the forest sector in international and EU climate policy

## International climate policy

When the Kyoto Protocol was adopted in 1997, the emission targets set for developed countries recognised the role of the land use sector to some degree. The 2000 IPCC Special Report on LULUCF estimated that removals in the land use sector were potentially very high, in the range of 1–2.5 Gt C/y, or up to 30% of global emissions from the burning of fossil fuels. However the report also cautioned about complexities in the land use sector, including: variations amongst countries' potential; the challenge of accounting for emissions and removals; and the permanence of sinks. The IPCC therefore warned in 2007 that forest-based mitigation activities would need to avoid negative impacts associated with competition between land uses.

These complexities led Parties to the climate regime to adopt a rather cautious approach to meeting emission targets under the Kyoto Protocol through LULUCF activities. Instead, it was considered preferable to concentrate on emissions from other sectors and to limit the possibility of using forest management activities to meet developed countries' targets.

Currently, the rules concerning measurement and emission reduction obligations differ in the frequency and level of detail required from developed and developing countries. While the possibility to use LULUCF activities to meet **developed countries' targets** was capped in the Kyoto Protocol's first commitment period (2008–2012), this approach was discarded for the second commitment period (2013–2020).

Instead, developed countries were asked to identify a Forest Management Reference Level (FMRL). The FMRL is a value of average annual net emissions and removals from forest management, against which the net emissions and removals reported for forest management during the second commitment period will be compared for accounting purposes. Only an additional sink above this FMRL may be accounted, up to an agreed maximum level.

Accounting is mandatory for some activities, namely emissions and removals from afforestation, reforestation, deforestation and forest management. It is voluntary for cropland management, grazing land management, re-vegetation and wetland drainage and rewetting. Emissions of non-$CO_2$ gases (e.g. methane and nitrous oxide) from agricultural practices (e.g. burning of crop residues, fertiliser application, rice cultivation and livestock) must be accounted under 'Agriculture'. Emissions from energy use in support of agriculture and the forest industry are accounted in the energy sector. Emissions from bioenergy are accounted in the LULUCF sector, at the time of harvest of the wood. To avoid double counting, the burning of wood is accounted as zero emissions.

Therefore, the land use sector has, over time, been progressively included in a more comprehensive fashion in developed countries' reporting obligations under the Kyoto Protocol.

In contrast, developing countries can only contribute to emission reductions in the land use sector on a voluntary basis, through the Clean Development Mechanism (CDM) – limited to afforestation and reforestation project-based activities – and REDD+. This encompasses avoided deforestation and forest degradation as well as the sustainable management of forests and the enhancement of carbon stocks. Developing countries still have looser reporting obligations, both in terms of frequency and detail. The adoption of rules on REDD+ has nevertheless undoubtedly marked a significant step towards greater incorporation of the land use sector in developing countries' reporting obligations, and possibly in their emission reduction commitments post-2020.

Yet, the approach to emissions from land use in the climate regime remains divided. This was historically motivated both by political controversies and scientific uncertainty, resulting in a complex set of rules that do not provide incentives to mitigate climate change in the land use sector in a homogenous way. Most importantly, this piecemeal approach to land use changes in combination with subsidies on bioenergy has already engendered perverse outcomes. For example, targets concerning the production of renewable energy in the EU have led to the import of wood pellets, with arguably no short-term climate benefits and the distortion of competition in raw material markets.

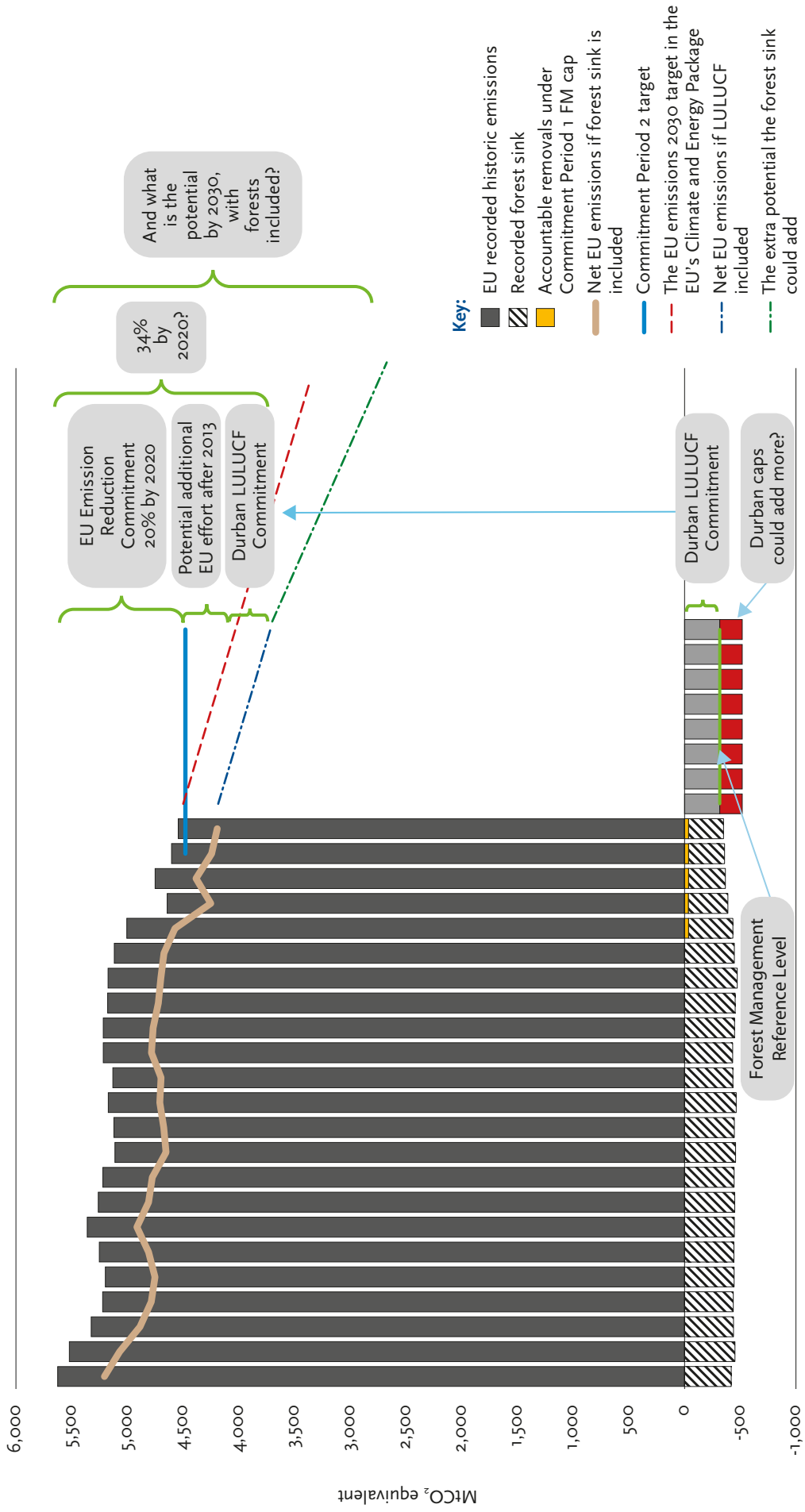


**Figure 1.** Development of the EU's net emissions 1990–2014 and projected emission reduction commitment until 2030 when forests are included (Based on Ellison et al. 2014).

In the lead up to the Paris climate change conference, where a new post-2020 climate agreement is expected to be adopted, numerous Parties and observers have advocated for a reformed and more unitary approach to emissions and removals from land use. Parties have also adopted a much more bottom-up approach to their commitments post-2020: each one provides nationally determined pledges for reduced emissions in its Intended Nationally Determined Contribution (INDCs). This opens the door for greater flexibility on how emissions from land use and the forest sector may be used to achieve Parties' commitments.

## EU climate policy

The EU decided not to rely on removals from LULUCF activities to reach its targets under the Kyoto Protocol for the period up to 2020. Approximately 45% of the EU's emissions are covered by the EU Emissions Trading System (ETS), encompassing more than 11,000 large installations in power generation and manufacturing industries across Member States. Emissions from sectors not included in the EU ETS are addressed in the Effort Sharing Decision (ESD). The ESD establishes binding annual greenhouse gas emission targets for Member States for the period 2013–2020. These targets concern emissions from most sectors not included in the ETS, such as transport (except aviation and international maritime shipping), buildings, non-$CO_2$ agriculture and waste. In contrast to sectors in the EU ETS, which are regulated at EU level, it is the responsibility of Member States to define and implement national policies and measures to limit emissions from the sectors covered by the ESD.

At present, $CO_2$ emissions and removals from LULUCF are included neither under the EU ETS nor in the ESD. There are two reasons for this exclusion.

First, at the **global level**, the EU was sceptical about using LULUCF sinks to meet targets for developed countries under the Kyoto Protocol. This scepticism was based partly on concerns about the accuracy of reporting on emissions and sinks, partly on the robustness with which changes could be attributed to human activity and partly on the risk that the inclusion, particularly of 'unearned' mitigation from sinks, could significantly weaken incentives for emission reductions in other sectors. The EU's position was that although concerns about the accuracy of reporting and the accuracy of attribution to human activities could in theory be dealt with by a rigorous approach to reporting, this did not answer concerns about the permanence of mitigation, or the displacement of effort from other sectors.

Second, at the **EU level**, the inclusion of LULUCF removals in targets was feared to lead to unfair advantages, due to the uneven distribution of LULUCF abatement potential across EU Member States (see section 4). The inclusion of LULUCF removals would also have entailed factoring in the role of the forest sector in the so-called 'burden-sharing' arrangement which establishes how the overall EU-level reduction commitment is shared among all Member States until 2020.

Removals from the forest sector were not only excluded from the scope of eligible activities to meet EU targets. The EU also decided that credits from forest projects in developing countries could not be traded with those generated in the EU ETS. While in principle it was possible to allow the trading of credits generated from afforestation and reforestation projects under the Clean Development Mechanism, there was a concern that such credits would be relatively cheap and undermine price signals in the EU ETS.

Now with negotiations on a new international climate agreement and the new bottom-up approach to Parties' emission reduction commitments, the EU is in the process of considering how to meet its targets for the 2020–2030 period (see section 5). This opens new opportunities to explore the potential of forests and the forest sector to contribute to climate change mitigation in the EU. As illustrated in Figure 1, the current and future role of LULUCF in the EU is large, and through management measures, it can potentially be much larger. **With the inclusion of LULUCF and appropriate incentives, an overall EU reduction target of -50% by 2030 could be feasible.**

# 3. Climate change mitigation: a systems understanding

Forests impact net greenhouse gas (GHG) balances in two ways. First, they retrieve carbon dioxide from the atmosphere and sequester carbon in biomass, thus **acting as a carbon sink**. Subsequently part of this carbon is transferred into soils through litterfall, or through harvesting into a variety of products. Forest management tools such as improved silviculture, afforestation, reforestation and reduced deforestation increase net carbon sequestration in forests. In addition, carbon sequestration in long-lived wood products, wood structural frames for instance, delays carbon release into the atmosphere (sequestration lever in Figure 2).

Second, fuelwood and bioenergy (e.g. pyrolysis oil and second generation biodiesel) can **substitute fossil fuels**, and timber products can **substitute other more energy- and emissions-intensive materials**. Emissions linked to wood product consumption are generally lower than those created by the consumption of non-wood substitute products. Wood product consumption (substituting for products coming from other materials for building, insulation, packing, furniture, etc.) consequently may enable a reduction in fossil energy emissions (substitution lever in Figure 2). Moreover, wood products can **store carbon** for decades or even centuries.

Forests and the use of forest products can therefore contribute to climate change mitigation by increasing sequestration and through substitution effects, via appropriate policies and measures. It is interesting and important to note that, although both effects represent potential contributions to climate change mitigation, they have different implications in terms of forest management and harvesting.

While the sequestration effect is maximised in the short term by a lower intensity of forest harvesting, enhanced use of the substitution effect implies an intensification of forest harvesting. In larger areas of forests, both mitigation options do not necessarily conflict with each other, as it is possible to balance carbon stocks in the forest biomass and (over larger areas) simultaneously use the biomass for wood products and fossil fuel and material substitution. At the regional and national level, it is possible and meaningful to combine both mitigation options.

The evaluation of forest-based climate change mitigation effects therefore requires careful consideration of **scale** and **system boundaries**. When emissions are compared at the forest stand level, it is always beneficial to protect the stand and to maximise the carbon sink in the growing forest biomass. Any harvest activity leads to partial emissions of the $CO_2$ that has been accumulated in the forest biomass, and only a variable fraction of the carbon pool can be used to substitute fossil fuels or alternative materials. Increased harvest removals to generate

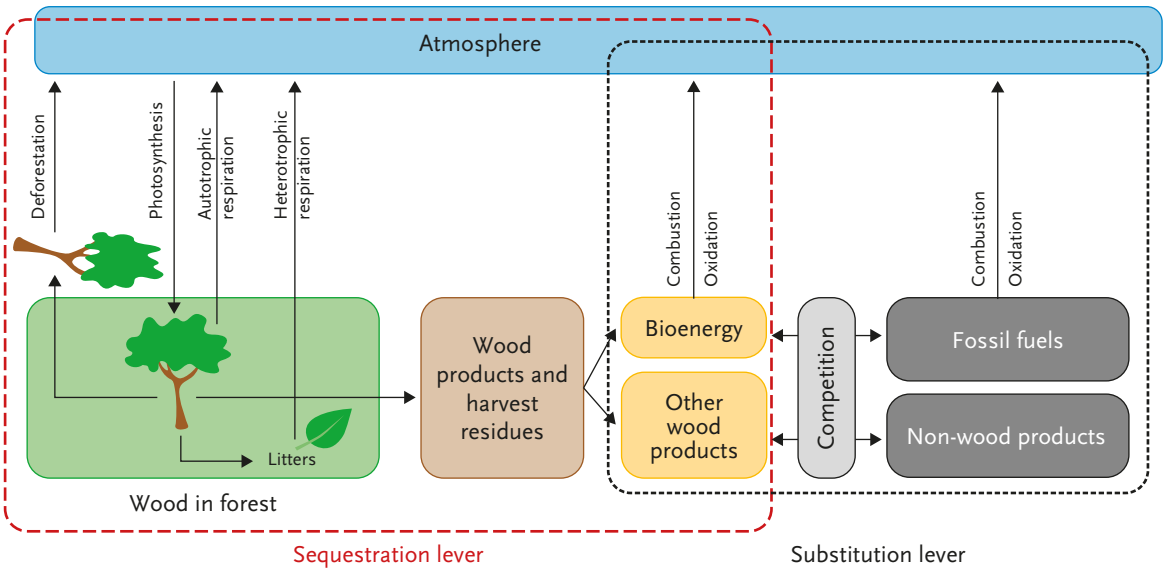


**Figure 2.** Simplified diagram of carbon stocks in reservoirs and flows between the atmosphere, biosphere and fossil reservoir. The two mitigation levers are depicted here.

bioenergy create a carbon debt that can take decades or even centuries to be compensated by new carbon sequestration in forest regeneration.

When comparing alternative resource management options at a regional level, any immediate loss of carbon from a harvest tends to disappear, because at a regional level you tend to find all the different forest age-classes simultaneously, and the carbon removal of the harvested forest stands is compensated by the carbon sequestration of the remaining growing stands. While time lags are dampened at the regional level, it is still possible that certain management interventions which result in long-term increases in carbon sequestration are associated with short-term net carbon release – for example in the case of salvage cutting of stands damaged by disturbances.

Due to the dynamic nature of forest growth cycles, forest carbon sinks and sources are not stable. In the EU, the forest carbon sink has been increasing over many decades, mostly because areas and increments have increased and harvesting has remained rather stable. Over the same time period, there has also been an increase in the area of forest reserves where forest management is not allowed.

Equally important as scale effects are proper considerations of system boundaries. If the system boundary is limited to forest ecosystems, changes in carbon storage in wood products are not accounted for. More importantly, it is crucial to include other fuels and materials and their associated greenhouse gas emissions, because if the use of forests is limited to maximising carbon in the forest biomass, fewer wood products can be harvested and consequently there will be an increasing demand to substitute wood products with fossil fuels and more energy-intensive materials.

Energy substitution based on the use of harvest residues results in larger climate change mitigation than the direct application of stemwood for energy purposes, because the residues would decompose relatively fast if they were left in the forest. However, aspects such as cost efficiency, biodiversity issues, soil carbon and nutrient balances also need to be considered when extracting residues.

The conversion efficiency of woody biomass into energy products has to be taken into account as well. For example, using wood in a modern Combined Heat and Power plant may have a higher efficiency when compared to producing transport fuels from it.

# 4. The role of EU forests in the current EU greenhouse gas balance

## More knowledge about EU forests is available

The information base on emissions and removals from the forest sector has increased enormously over the last two decades due to technological and institutional developments. It is now possible to gather better quality data at an ever more detailed level. International and national efforts to gather this data, integrate it in international statistics and develop LULUCF reporting, have been huge. This has led to great advancements in the understanding of the forest sector's contribution to climate change mitigation. Forest management reference levels for greenhouse gas reporting have been set up in a comparable way with large-scale scenario growth models for Europe, such as the European Forest Information Scenario Model (EFISCEN) and the Global Forest Model (G4M), as well as the national modelling of carbon budgets. Monitoring and reporting has improved and is now supported by new methods such as airborne remote sensing and terrestrial measurement sources, such as National Forest Inventories (NFIs), which are now available for many Member States. Repeated NFIs deliver a basis for forest growth in the EU and therefore the dynamics of the potential forest sink. These developments in technology will still make big steps forward in the coming decades.

Modelling approaches have also been extended to quantify major disturbances at the national and the EU level. This has reduced uncertainty concerning the threat of potential greenhouse gas sources from forests. In terms of data accuracy, certainty and the permanence of measurements, the LULUCF sector of the EU is currently not worse in data certainty than most other sectors. In other sectors, uncertainty over the effectiveness of measures still exists: for example, achieved fuel efficiency in the transport sector can within a few years be fully nullified again by increased kilometres driven, or the effectiveness of measures in the energy sector can also be counteracted by low oil prices.

## Current significance of EU forests

Forests in EU Member States cover about 159 million ha, equal to 37% of the total EU land area. Since 1990 this area has increased by 7%. On a global scale, EU forests are exceptional, as they are predominantly (85%) managed and available for wood supply. This makes the EU one of the main world producers of roundwood with 442 million $m^3$ in 2014. On the other hand, some 3 million ha of EU forests are presently 'without active intervention'.

Approximately 75% of the annual increment is harvested, resulting in annual additions to the carbon sink in EU forests of around 435 Mt $CO_2$/y for the years 1990 to 2012. **This represented almost 10% of total EU emissions in 2012**. When the sector's impact on the sink via harvested wood products (HWP) is also taken into account, this adds another 44 Mt $CO_2$ i.e. about an additional 1% of total emissions, or 10% of the amount of sink in the forests. The material substitution effect of the production of durable wood products can be estimated to help to avoid some 2% (or 90 Mt $CO_2$/y) of EU greenhouse gas emissions. Therefore, EU forests and the forest sector are estimated to produce an overall climate mitigation of about 13% of the total EU emissions. In addition, biomass (which is woody to a large extent) provides 6% of the 2013 EU consumption of energy.

The EU forest carbon sink has been continuously increasing over the last four to five decades until recently when the first signs of saturation have been observed. This is due to a decreasing rate of increment, intensified land use and increased losses from natural disturbances such as storm, fire, pest and diseases. Until now, natural disturbances have played a relatively small role in the EU, with annually 6% of the area affected, for example, by grazing, but not destroyed. In the worst storm year observed to date, 1999, only 1% of the total growing stock of EU forests was affected and even that was used to a large extent. However, the regional and periodic impacts of disturbances can be large.

If historical harvesting levels are maintained, we might expect the harvested wood products carbon pool to grow for at least the next couple of decades. With improved incentives and structural changes – for example with the increased use of wood construction and declining paper consumption – it may be possible to move well beyond the saturation points currently envisioned. Growing demand for wood products could reduce sinks in the forest while enhancing carbon sinks in harvested wood products. In the long term, this may also lead to increased forest area and higher increments of the rejuvenated forests. It would also create larger substitution effects.

Managing EU forests and the forest sector for climate change mitigation is therefore a many-sided endeavour, with substantial regional variation in options.

## Variety across EU Member States creates opportunities

The EU is characterised by great variety in regional climate, forest resources, the forest sector and its importance for the national economy (see Figure 3). Member States vary in how they deal with their forest resource and the associated resource demands and uses. Based on current data, Figure 3 illustrates a positive correlation between the contribution of the forest sector to national GDP and the $CO_2$ sink. This runs contrary to the common assumption that these functions of the forest are mutually exclusive.

Forest ecosystems in the EU are very diverse, spanning three major biogeographic zones (boreal, temperate and Mediterranean), with different species (Figure 4), growth rates and contrasting

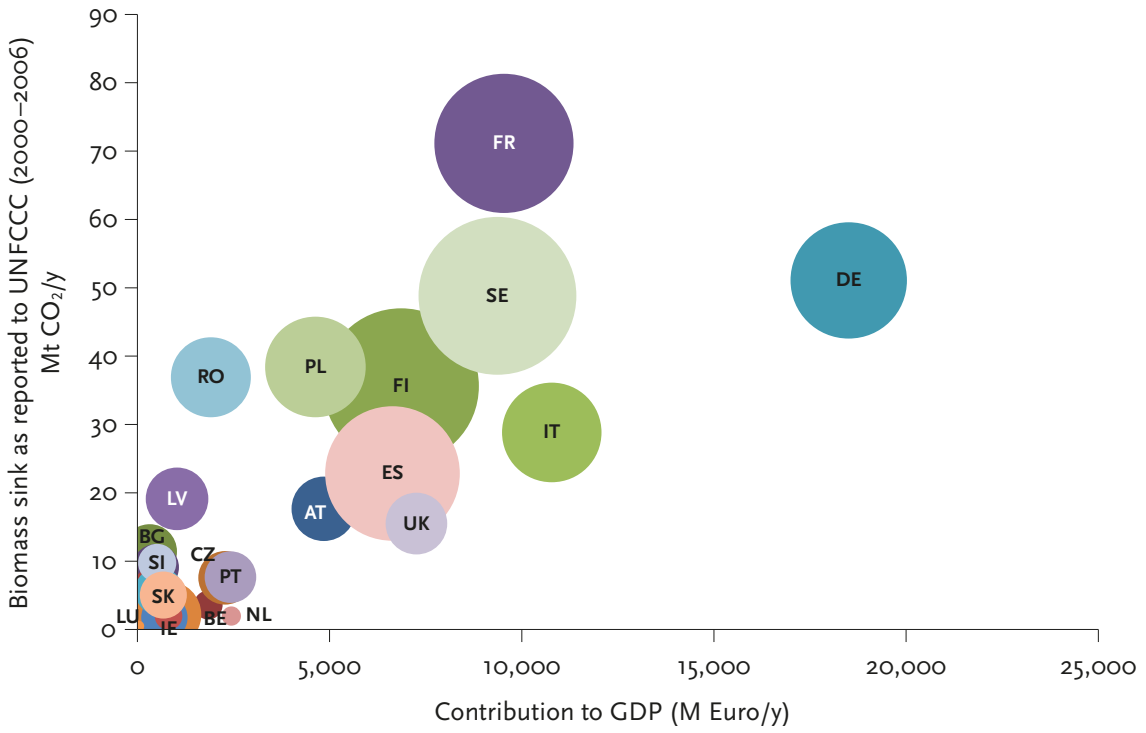


**Figure 3.** Correlation of national GDP and the CO2 sink in the 28 EU Member States' forests and forest sectors for the period 2000–2006. Ball size indicates the area of forest available for wood supply (FAWS). The graph suggests a positive correlation between strengthening the contribution of forests to GDP and the relative size of the $CO_2$ sink given the current structures. Eastern European countries tend to be relatively high in the scatter of balls, i.e. having a higher sink per Euro unit of GDP than the average in the EU countries. Western European countries, apart from France, tend to be more closely distributed along the diagonal. Large net importers tend to be more at the GDP side of scatter. Note that some small countries fall away behind larger balls.

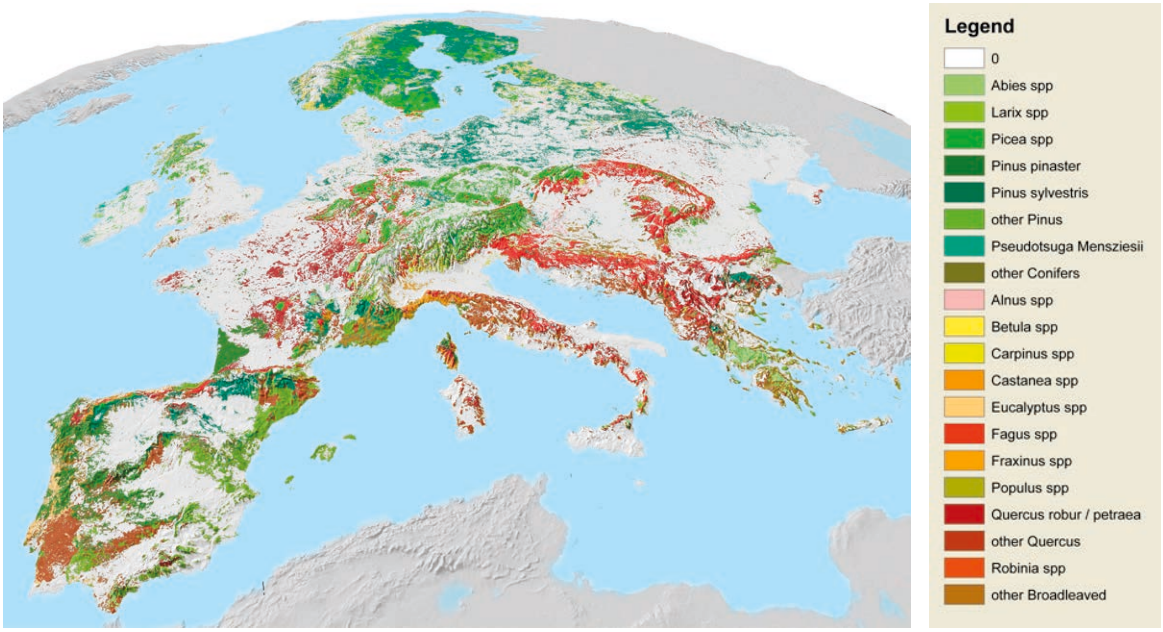


**Figure 4.** Tree species map of European forests showing one form of variety across Europe (Brus et al. 2011). This and other varieties are an opportunity to use the many different ways that the Member States' forest sectors can contribute to climate change mitigation.

management traditions. Management regimes typically include, for example, clear-cut harvesting in the Nordic countries, plantation forestry in some parts of southern Europe, and close-to-nature silviculture and forests without active management in a number of central European locations. About 50% of forests in the EU are privately owned, with fragmentation in several countries leading to a large number of small ownerships (see Figure 6) and a total of about 16 million private forest owners. **The resulting variation in growth potential and in forest utilisation rates in the various value chains creates a wide range of options for climate change mitigation across the EU Member States.**

It is important to note that national averages may disguise large regional differences. France, for example, has areas with intensive wood production, but also areas with traditional coppice systems that mainly produce non-commercial fuelwood. Some areas where forests are hardly managed at all, like Spain, Portugal and the UK, also have contrasting conditions for plantation forests and other woodlands, where the former act as a productive source of wood and the latter mainly as a carbon sink.

In southern Europe, large areas of forests are not primarily managed for timber production, but rather for non-timber forest products or agroforestry. Illegal logging and non-sustainable use of forest resource is a problem in some eastern European countries, especially after restitution of former state-owned forests. Fragmented property ownership (see Figure 6) in small holdings and a lack of infrastructure are factors that constrain the current management and use of some regional forest resources. Forests in regions with low accessibility or already high biodiversity values may be better suited for setting up reserves and storing large stocks of carbon.

## Opportunities for Climate Smart Forestry

**The examples above of variation in EU Member State forest sectors illustrate how they can contribute in different ways to climate change mitigation**. The fact that the EU Member States have very different mitigation potentials in the forest sector should not prevent us from taking advantage of the opportunities for using EU policy to enhance forestry's role in mitigation. There is a wide range of mitigation

## Bioenergy and carbon sinks: trade-offs or not?

Increasing demand for forest biomass for bioenergy creates a challenge in forest policy discussions in the EU. For example, it has been argued that it could result in a reduced forest sink and mitigation potential. However, as indicated in section 3, the conclusions on this issue also depend on the system boundaries and the timescale used for assessment. The current scientific literature provides very different views on this issue.

Figure 5 can be interpreted as showing that contrary to common expectations, the data as such does not necessarily indicate a trade-off between bioenergy, wood product production and the biomass sink in forests. Countries with significant amounts of woody biomass-based energy production (Germany, Sweden) exhibit both large sinks in forest biomass and the largest felling amounts: wood energy production is primarily based on domestic and not imported woody biomass. A large share of bioenergy is produced from by-products, harvest residues and low-quality thinning wood. These quantities are also directly related to the magnitude of fellings. Interestingly, the felling/increment or forest utilisation ratios (see Figure 7) are close to the European average in most countries with large forest sectors; i.e. these countries simultaneously use their forests for wood and bioenergy production, and successfully manage to maintain their carbon sinks.

While there may be marginal trade-offs in some countries between the rate of increase in the carbon sink and the rate of forest utilisation, the rate of fossil fuel substitution and increases in the harvested wood products carbon pool may either partially or fully compensate for these.

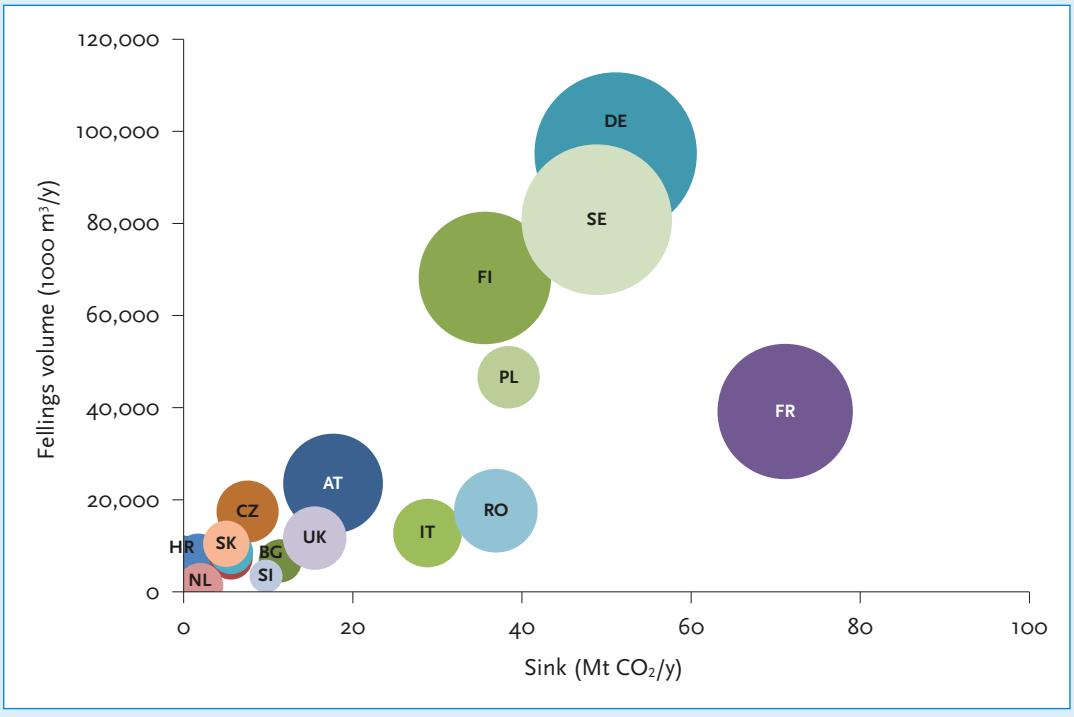


**Figure 5.** The 28 EU Member States' forest sectors in the intersection of $CO_2$ forest sink, wood products production (fellings), and woody biomass bioenergy production (size of the ball). Data from FOREST EUROPE. Note that some small countries fall away behind larger balls.

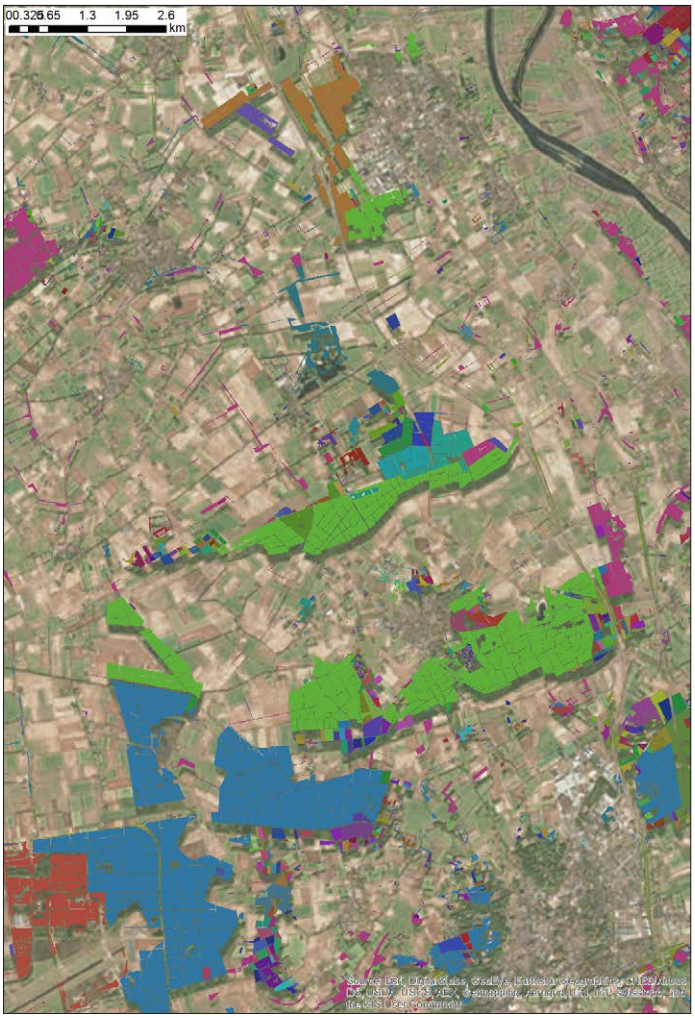


**Figure 6.** Forest ownership fragmentation is an important challenge for policy makers when trying to implement climate mitigation measures in forests in Europe. The average holding size for the EU is 2.7 ha. In this cadastral data picture, fragmented forest ownership is expressed by a unique colour per forest owner in a rural area in Atlantic Europe. Even though there are many owners, only a few of them own by far the largest share. The chances of successful and cost-efficient implementation of climate mitigation measures in forests are much higher with owners of larger properties than with owners of small properties. The total forest area shown is approximately 2,300 ha (Cadastral data).

potential across Member States in nearly all sectors in the EU economy, for example, in terms of opportunities for decarbonising energy supply. This has not prevented the EU from adopting targets related to renewable energy generation, for example. There is no reason why the forest sector could not be treated in the same way, with the establishment of a policy framework that enables Member States to use their diverse potential to contribute to climate change mitigation. In addition, the Forest Management Reference Level is very different from country to country, based on past historical growth and on future forest use potential. This presumably places countries on a somewhat equal footing.

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

## The future of the sink in European forests

The future of forests in the EU and their ability to mitigate climate change by forming a sustainable sink is subject to a variety of uncertainties. In recent decades, increments (i.e. volume growth) have been significantly larger than fellings in most of the EU countries (see Figure 7). Whether this trend will continue will strongly depend on the impact of changes in temperature and precipitation due to

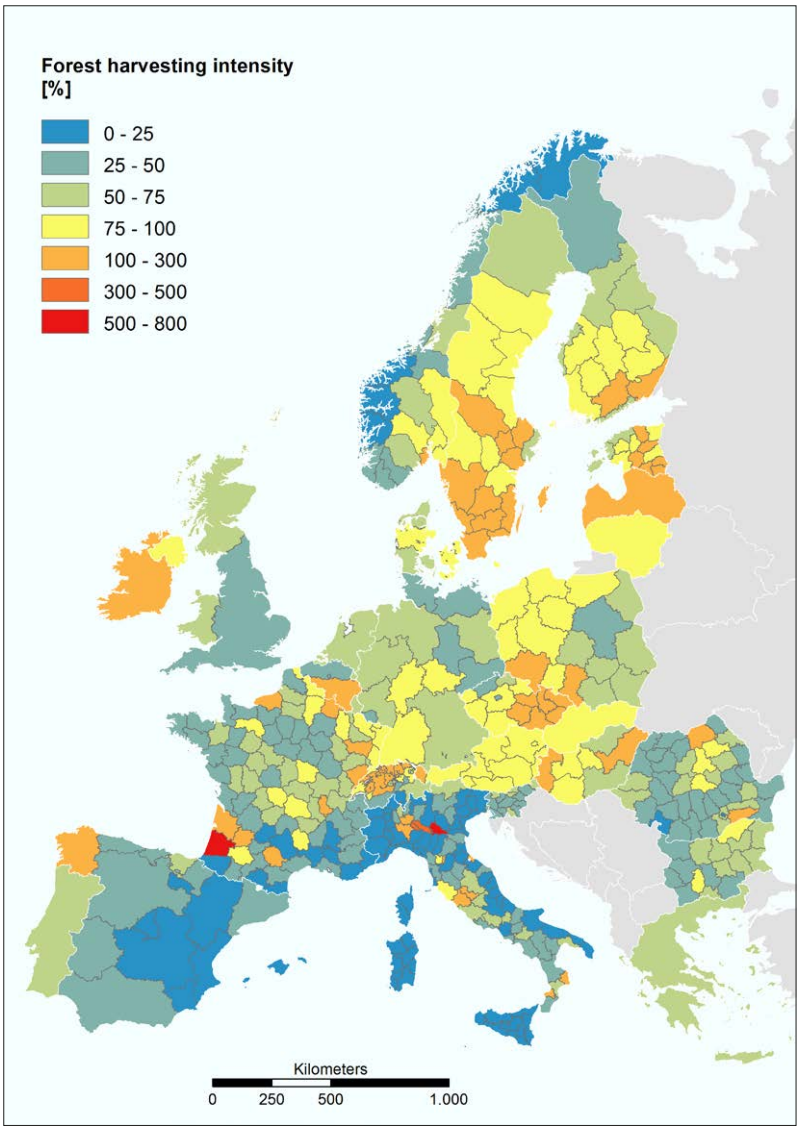


**Figure 7.** Regional variation of forest harvest intensity (in % of volume increment) in the EU and EFTA, showing the average for 2000–2010 (Levers et al. 2014). This is another type of variation that provides different opportunities for climate smart forestry. Note that colours per region may slightly vary from year to year. The highest harvesting intensities are found in southern and eastern parts of Finland and Sweden, the Baltic countries, Ireland and the mountain ranges of central and eastern Europe. The extremely high harvesting levels in southwest France are due to a series of extreme storm events.

climate change, and on the variety of forest management impacts and intensities, as well as on policies adopted in the EU (see Figure 8).

Uncertainty is linked to the projected increase in extreme events, either as abiotic disturbances (fire, storm) or as periods of extreme drought that will affect growth and therefore carbon sequestration. As a general trend, longer vegetation periods and higher temperatures are expected to enhance forest growth especially in northern parts of the EU, while in southern and continental EU countries, the lack of precipitation and increasing risk of drought may lead to growth reductions and changes in tree species composition.

Wood demand from the forest and bioeconomy sectors in the different regions of the EU is difficult to forecast. It is subject to many uncertainties and depends, for example, on how forest bioenergy is viewed in the post-2020 EU climate policy or how and to what extent the ongoing structural changes in global forest products markets (e.g. declining production for some products in the EU) and roundwood markets (new capacity increasingly based on southern hemisphere plantation forests) and new forest-based bioeconomy products (e.g. chemicals, textiles and biofuels) are going to impact on the demand.

What the net impact of woody biomass demand on EU forests and forest management will be remains to be seen. Likewise, how much more additional demand can be biophysically, ecologically and socio-economically supplied to new biorefineries


**Figure 8.** EU climate and energy policies do influence forest management. Much discussed are possible $CO_2$ leakages related to the imports of woody biomass from, for example, the USA because the USA has not ratified the Kyoto Protocol. Here, the Enviva pellet mill in Ahoskie, NC, USA is shown, which produces pellets partly for the EU market. The production (and definitely the exports) is stimulated by the EU Renewable Energy Directive. On the left, the raw materials can be seen: low-quality logs as well as sawdust and chips. Solid biomass criteria are being discussed to assure sustainable sourcing and low carbon debt. Pellet production in southeastern USA has sharply increased in the past five years, but is still relatively small with some 7 million tonnes in 2014. The pellet market is a new commodity that allows mobilisation of woody material and its transport over long distances.

and bioenergy plants, and whether traditional forest industries will maintain or change their current consumption patterns, remains uncertain.

All these developments, including EU climate policy, will affect the future carbon sinks in forests and harvested wood products. The net balance of these changes is difficult to predict. Indeed, there is an urgent need to make new assessments of the impacts of the ongoing changes, and create scenarios for possible future policy impacts, on the demand and supply of forest-based biomass in the EU.

## How could Climate Smart Forestry strengthen the sink?

- Forest resource projections with alternative management and policy assumptions indicate that forest carbon storage in EU forests could continue to increase from 2010 to 2030 by around 20%, providing additional sequestration of up to 170 Mt $CO_2$ /y by 2050.
- A study on farmland in the EU revealed that potentially 12–17 Mha of farmland could be abandoned by2030. If this area were afforested, it could provide an additional sink of almost 70 Mt CO2 /y and an additional wood production of 100 Mm3 per year, i.e. almost 25% more than currently produced.
- EU domestic woody biomass/residues/low-quality thinning wood could probably cover 3–5% of total EU energy needs– an avoidance of another 180 Mt $CO_2$.

Naturally, these numbers should be regarded as indicative, since they are subject to many uncertainties (see above). Yet, they help to point to the still unused potential of the EU forests and forest sector to contribute more to climate mitigation.

Within this quantitative total estimate, a large variety of potential solutions to enhance carbon sequestration and substitution in EU forests and the forest sector are represented. **Optimal solutions are in any case regionally specific and are most likely to work**

**when they find synergies with other issues locally at stake**. This is the core of **Climate Smart Forestry**, which seeks to find ways in which the regional characteristics of EU Member States can be best harnessed for climate mitigation, while at the same time targeting other important objectives (wood production, biodiversity, minimising disturbances, etc.).

For example, counteracting the loss of carbon from drained peat soils, or enhanced $CO_2$ sequestration by using improved tree genetic resources (through tree breeding), or the selection of species and provenances more resilient to climatic change are regionally specific measures. Tree species that are better adapted to climate change are likely to yield a more even flow of woody raw materials in comparison to species that are more vulnerable to disturbances.

Further synergies can also be found by the mitigation of the projected disturbance risks from fire or storms, but also by the enhanced implementation of forest reserves and halting forest degradation. These could have large additional regional potential for the forest sector to contribute to climate mitigation. An example of synergies with regional development can be found in central European regions where outgrown coppice is only used for non-commercial fuelwood and burned in local stoves at low energy efficiency.

Other opportunities exist outside forests to enhance sinks in harvested wood products: for example, through the increased use of wood in the construction sector or by developing strategies for the cascading use of wood with energy conversion only following after multiple cycles of material use of the woody biomass.

# 5. Towards a new role for EU forests and the forest sector in the climate regime

Emissions and removals from LULUCF will be included in the EU's 2030 climate policy framework. But **how** this will be done has yet to be decided. Two key questions for policy discussion are presently on the table:

- What would be the most appropriate policy framework for stimulating additional emission reductions in the forest sector in the EU?
- What principles and policy instruments should be used to enhance the role of European forests in climate change mitigation?

## The EU policy framework on LULUCF post-2020

Existing rules under the Kyoto Protocol limit the extent to which credits from forest management can be used to compensate debits from other activities pre-2020 (see section 2). In 2013, the EU adopted accounting rules and action plans on greenhouse gas emissions and removals resulting from LULUCF activities for the first time. This was a preliminary step towards the inclusion of LULUCF in the EU's emission reduction commitments post-2020.

The EU has already discarded the option of including LULUCF emissions in the EU Emissions Trading System (ETS). Inclusion in the ETS would in fact require land holdings to be subject to rules, monitoring and reporting comparable to those of emissions from installations covered by the ETS. The Intergovernmental Panel on Climate Change (IPCC) guidance for monitoring LULUCF, however, is designed for national inventory systems and is not applicable to monitoring at the farm/land holding level. The European Commission has therefore preferred to discard the inclusion of credits generated by LULUCF activities in the ETS. This decision is based on considerations related to the impracticality of developing a new monitoring system on all types of land and the impossibility of guaranteeing the compatibility and consistency of holding level estimates with those of national data as well as the projected monitoring and administrative costs of the system. This seems like a reasonable conclusion, although there have been examples where forest sector credits have been included in ETS systems, such as in New Zealand.

### Lessons learned: New Zealand

New Zealand integrated the forestry sector in its national climate policy in 2007. New Zealand adopted a strategy in which two schemes co-exist. First, the Permanent Forest Sink Initiative (PFSI) imposes limitations on clearance and clear-fell harvesting as well as a requirement for 99-year maintenance of forest cover. Second, the New Zealand Emissions Trading Scheme (NZ ETS) focuses exclusively on carbon, with almost no consideration of co-benefits (here mainly environmental ones). Forest owners may voluntarily choose either scheme for forests planted after 1989.

As of 2011, the number of participants in NZ ETS has increased from the original 35 in 2007 to 1847, and 25 times more hectares of forest are involved. The PFSI is not compensated by a higher price for carbon credits. Nonetheless, it is interesting to observe that outside the national market, PFSI credits carry a potential price premium (up to 25%) because they are considered 'greener'.

In general, this illustrates that a scheme at forest holding level can exist (although small) and that two possible schemes can co-exist, even though one of the schemes is more demanding in terms of co- benefit management. For example, Denmark specifically bought PFSI credits for its Kyoto compliance and not NZ ETS because they did not like their attributes, specifically, non-permanence.

Having discarded the option of including LULUCF in the EU ETS, EU policy makers are currently focusing on three main options for including emissions and removals from LULUCF in the EU climate change mitigation framework post-2020:

- Developing specific LULUCF rules,
- Including LULUCF in the Effort Sharing Decision (ESD),
- Developing a separate EU land sector pillar.

### Option 1 — 'Status quo'

**This option would continue the treatment of LULUCF emissions separate from non-$CO_2$ emissions from agriculture, which are already included in the Effort Sharing Decision.**

However, this would not necessarily imply a 'no–action' scenario.

The major perceived disadvantage of this option is that LULUCF and agriculture emissions would continue to be addressed by different policy tools, potentially reducing policy coherence, cost-efficiency and rendering the design of incentives for action more complex.

### Option 2 — Effort Sharing Decision

**This option would include all LULUCF activities under the Effort Sharing Decision, potentially allowing the tradability of units between sectors and enhancing cost-efficiency.**

Relative to option 1, the challenge is that trading would increase complexity and raise methodological issues, including concerns related to environmental integrity and technical questions (e.g. how to reconcile the fact that the Effort Sharing Decision is based on annual compliance cycles, whereas LULUCF removals and emissions are measured based on longer reporting time lags).

However, trading would provide more flexibility to Member States on where best to achieve their targets.

### Option 3 — Land sector pillar

**This option would create a new pillar in EU climate policy, including both LULUCF and non-$CO_2$ emissions. This could be done with or without the adoption of mitigation targets.**

The advantage of this option is that it provides a policy framework which reflects the land sector's particularities (e.g. permanence, long time-cycles and high natural inter-annual variability).

Relative to option 2, it would lack the potential flexibility of creating tradeable units between sectors within the Effort Sharing Decision.

**Figure 9.** Options for the inclusion of emissions and removals from LULUCF in the EU's post-2020 climate change mitigation framework, as identified by the European Commission in SWD (2014).

Option 1, **'status quo'**, would continue the present division between LULUCF emissions and non-$CO_2$ emissions from agriculture. However, it would leave open the option to adopt targets or other measures to facilitate emission reductions within the constraints identified by the recently adopted EU accounting rules, and by any new rules concerning accounting which may be adopted under a Paris Agreement and/or the Kyoto Protocol post-2020.

Option 2, **Effort Sharing Decision**, would include LULUCF activities among those eligible to achieve the targets of Member States under the ESD. If flexibility is allowed, rendering emissions and removals from LULUCF interchangeable with those from other sectors included in the ESD could be a significant challenge. The European Council has already decided that Member State targets for the non-ETS sectors will be calculated on the basis of relative

GDP per capita in a fair way. This criterion, however, does not necessarily take into account the very diverse capacity of EU Member States to achieve mitigation in the forest sector (see section 4). As forests provide many other ecosystem services, this type of inclusion would require strong safeguards guaranteeing that mitigation efforts are not made at the expense of reducing those services.

Option 3, **land sector pillar**, would have the advantage of creating a tailored approach to the specificities of the LULUCF sector, although it would require the merging of forestry net emissions with those from farmland, as well as non $CO_2$ emissions from agriculture. This option would not *per se* create additional incentives to increase removals or reduce emissions, unless specific LULUCF targets are adopted. These targets, however, would be kept separate from those in the Effort Sharing Decision. A key question would be how targets for any combined land sector pillar would be set.

National circumstances need to be carefully considered in all the options, to avoid creating 'unfair' advantages for some Member States in achieving their targets. From the perspective of the forest sector, the main difference between these options is the Member States' flexibility in trading credits between sectors and in achieving any targets that may be set. Currently, however, there is no indication that any targets will be adopted.

Adopting either Option 2 or Option 3 would involve merging LULUCF emissions with non $CO_2$ emissions from agriculture, which are presently regulated as part of the Effort Sharing Decision. These emissions would continue to be accounted for separately in inventory terms, but would be part of a single pool of emissions for compliance purposes.

# 6. Inclusion of EU forests and the EU forest sector in post-2020 targets via Climate Smart Forestry

## An EU-wide target for forest sector removals

The EU could enhance the role of forests and the forest sector in achieving its climate policy targets. The first step in this process would be to decide an **overall EU-wide target for removals in the forest sector**. This target could be cumulatively increased for the forest sector and larger than the current sink. A target would have to be set in such a way that it strengthens both sequestration and substitution levers (see section 3) with the aim of increasing the forest sink, but also in ways that increase GDP and contribute sustainably to EU energy security. As highlighted in section 4, there is considerable potential for an additional ~400 Mt $CO_2$ per year by 2030 on top of the current role of forests and the forest sector (including forest sink, harvested wood products and energy).

## Timescale

Given the long time span of forestry, **the timetable for the achievement of targets could be longer than 2030 for this sector**, with an initial learning and implementation phase to allow for possible adjustment and examination of how climate policy impacts on land allocation between forestry and agriculture. Gradually, land-based accounting under a 'net' approach could be incorporated in the overall accounting. Currently Kyoto lands (land that meets the Kyoto Protocol requirements) are also expanding: more activity types are included, afforestation areas are increasing, and as a result, more and more land is being accounted for. Full land use accounting would avoid loopholes between the energy and LULUCF sectors. This approach would also allow time to overcome some of the concerns about the environmental integrity of a LULUCF mitigation target, both in terms of the reality and longevity of the mitigation impacts, and in terms of the wider environmental impacts.

## Effort sharing

The next step would be to decide how to share the effort of meeting the EU-wide target across the EU Member States. The optimal approach would be to pursue cost-efficiency, possibly based on considerations of fairness and GDP. The target should be determined based on each Member State's mitigation potential, set, for example, by forest area, forest productivity, timber prices and the role of forest industry. Fairness would be ensured by taking into account GDP and per capita emissions.

There is no doubt that the decision on an effort-sharing arrangement would be laborious, and potentially controversial; it should therefore be based on thorough analysis. **Targets must be much larger than the current caps of the second commitment period for EU Member States, to provide an incentive to reduce the marginal costs of reducing emissions or increasing sinks.**

If a new LULUCF pillar is set up separately from the existing Effort Sharing Decision (ESD), it would create limited additional incentives for Member States to enhance mitigation in the forest sector, unless it includes a specific emission reduction target.

Including forest targets in the ESD, however, could potentially weaken incentives for mitigation action in other sectors. It would be important, therefore, to ensure that the inclusion of the forest sector in the ESD adds to the overall EU ambition on climate mitigation, reflecting a more comprehensive range of sectors. We therefore propose that, if forestry targets are included in the ESD, total emission reductions under the ESD should be reduced by an amount corresponding to the cost-effective mitigation potential in the forestry sector.

## Programmes and instruments

It would then be up to EU Member States to create programmes and instruments to comply with their targets. Possible national policies could include the introduction of:

- Various forms of subsidies or taxes,
- Stimulus for collaboration among forest owners – for example, subsidies only available for properties larger than some agreed size (hectares),
- Stimulus for an improved forest-wood chain and towards longer-lasting forest products (carbon storage factor).

The implementation of taxes and subsidies can be interpreted as a way of introducing carbon pricing (see below).

The implementation of these steps would be closely linked to the implementation of existing Rural Development Programmes and the Common Agricultural Policy. The Forest Strategy and its follow-up Forest Action Plan could also facilitate implementation.

**As a result of these arrangements, EU Member States would incentivise Climate Smart Forestry in line with the circumstances of each country, and pursue win-win solutions to achieve climate change mitigation.** This Climate Smart Forestry approach would be unique in the world, going much further, for instance, than the New Zealand emissions trading programme both in ambition and coverage.

## Carbon pricing

Carbon pricing has been discussed at length in economics literature. Although it is far from being taken up in international climate policy, there is increasing pressure from governments, the corporate sector, international organisations and scientists to increasing and scaling up the use of carbon pricing measures at national and international levels. Many national and regional governments (responsible for roughly half of global greenhouse gas emissions), and more than 1,000 companies and investors have expressed support for putting a price on carbon in one way or another. The IMF, OECD, World Bank and IPCC have also voiced the need for it. These petitions are very much a reaction to the failure over the last two decades to achieve significant progress in climate change mitigation.

Given the failure of the UNFCCC processes following Kyoto, a number of eminent economists published papers in 2015, which proposed an approach focusing on 'how' the global climate negotiations should be structured. They propose an international commitment to a carbon price, and suggest different types of incentives for countries to commit to this. The important thing is that the discussion has moved to a new level, which seeks to answer the question of **how** a new, effective and politically feasible solution to global climate policy and negotiations can be designed. Our proposed incentivisation of European forests and the forest sector (locally specific) is basically also one form of carbon pricing.

### How would pricing work in the forest-wood chain?

In the case of forests, carbon pricing might consist of a tax on carbon emissions for the wood-processing industry and timber harvesting while at the same time subsidising sequestration in growing forest stands. Calculating the impact of such a policy on the forest sector is complex. For example, a carbon subsidy in standing forests and a tax on emissions would tend to reduce timber harvesting; while only a subsidy on wood products would make harvesting more intensive. Moreover, as wood products tend to have a better carbon balance than many of their substitutes (e.g. using more wood and less concrete in construction may imply lower carbon emissions), a carbon tax would be beneficial to timber harvesting and wood industry. But in carbon pricing of forests and the forest sector, many open questions still remain, and there is a need for more research.

However, the use of carbon pricing could be extended to the LULUCF sector in the future, and the forest sector would need to take this possibility into account. Currently, in the climate policy forums (LULUCF or COP21) there is hardly any discussion of this possibility and its implications. Yet, for the longer term development of climate policies in the LULUCF sector, it is necessary to start to think and be prepared for the possibility of an international carbon price.

## Climate Smart Forestry examples: incentives based on synergies

The core of Climate Smart Forestry is that the sustainable adaptation and mitigation of climate change is mainstreamed in forestry policy and forest management in Europe – but adapted to locally specific circumstances and challenges. This can be achieved throughout Europe and could make a large contribution in synergies with other policy areas.

Dozens of measures can be developed. For example, more stimulation of forest owner cooperation is needed in order to harvest and plant better adapted provenances. Other measures could be aimed at the maintenance of peat, afforestation via rural development programmes or the stimulation of local markets and local bioenergy chains. Measures can also be geared to regionally optimal forest strategies which aim to establish reserves in some regions or intensify forestry sustainably in others. Measures can be geared towards research and outreach at the regional level, or for example, at stimulating drought resistant species together with measures aimed at reducing fire risk, soil conservation and reduced erosion. Below we give a few further developed examples.

### A high forest stocked central European country

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

### An industrial forestry-oriented country

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

### A fire-prone country

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

### An eastern European country

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

### A Balkan country

Large areas of **outgrown coppice** exist in the Balkan region. Here, partly restoring coppice regimes with local use of biomass can be a means to stimulate rural development, for example, through innovation in new products.

### An urbanised region

Urbanised regions usually show some deforestation through urban sprawl. Measures should be aimed at stopping deforestation, establishing new forests and providing recreation opportunities for a healthy society.

**Examples and combinations of mainstreaming climate change in forest policy and forestry can be thought of in dozens of ways and together can cover the majority of European forests.**

# 7. Policy implications

**EU forests and the forest sector play a significant role in the EU greenhouse gas balance.** These forests and their products reduce emissions, enhance sinks, store carbon and provide a continuous stream of ecosystem services, including wood products, energy and biodiversity conservation. In all their variety, it is estimated that EU forests and the forest sector currently produce an overall climate mitigation impact that amounts to about 13% of the total EU emissions. This includes both the action of forests and harvested wood products as a **carbon sink and carbon stock** and the **substitution** effect of forest products for **fossil-based raw materials and products.** At the Member State level, there is a good correlation between achieving a sink on the one hand, and providing wood products and energy on the other.

The potential for EU forests to contribute to climate change mitigation and adaptation is currently not used in an optimal way and is not incentivised under EU policies. Looking ahead, however, **there is great scope to enhance the role of EU forests in tackling climate change. If adequately incentivised, Member States could achieve a combined additional effect of as much as 400 Mt $CO_2$/y by 2030 on top of the existing sink and substitution. With the existing sink and substitution this comes to an equivalent of about 22% of the current EU $CO_2$ emissions.**

- Given recent developments in the policy arena, the **EU should decide an overall EU-wide target for removals in the forest sector.** This target could gradually be raised well beyond the current sink. The target would not only be geared towards increasing the forest sink, but also doing so in ways that increase the GDP of the forest sector, and which contribute sustainably to EU energy security.

- **The timetable for achieving targets should be longer than 2030 with an initial learning and implementation phase.** This would allow for possible adjustment and an examination of how carbon policy in forests impacts, in particular, on land allocation between forestry and agriculture. Gradually, full land-based accounting with a 'net' approach could be incorporated in the overall accounting, avoiding loopholes between the energy and LULUCF sectors.

- **The EU should decide how to share the effort of meeting the EU-wide target across the EU Member States.** The optimal approach would be to pursue cost-efficiency, possibly based on considerations of fairness and GDP. If a new forestry LULUCF pillar is set up separately from the existing Effort Sharing Decision (ESD), then it would need to be recognised that limited additional incentives would be created for Member States unless the separate pillar is linked to a country's own (larger) target. Linking a forestry pillar to the ESD could potentially weaken incentives for mitigation action in the ESD sectors. If forestry targets form part of, or are linked to, the ESD, the total emissions permitted under the ESD should be reduced by an amount that reflects the new availability of the cost-effective mitigation potential in the forestry sector.

- **EU and national policies relevant to forestry have to be reviewed with respect to their climate impacts.** EU policies like the Common Agricultural Policy, the Renewable Energy Directive and Forest Strategy all have climate impacts. These impacts need to be revisited and analysed in light of climate policy targets, and the shifts in policies proposed in order to improve the synergies with climate mitigation potential.

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

The climate problem is important and urgent enough to require every sector to make its contribution. No sector can solve the problem on its own, or within a short time frame. Quick fixes should not be expected from any sector. **With the right incentives and investments, however, a significant contribution can be expected from EU forests, forestry and the forest-based industries.**

# Glossary

**Cap**: a limit on either emissions (of e.g. a Member State) or on the amount of forest sink that may be used to reach an emission reduction. Often used in 'cap and trade', which means that emissions are allowed to a certain maximum, but if a Party to the Kyoto Protocol stays under that limit, it can trade or exchange credits with other Parties.

**Carbon price commitment**: a system in which a group of governments (national or possibly regional), agree to price greenhouse gas emissions at an agreed-upon uniform floor price. It is different from a carbon tax or 'cap and trade', because it allows pricing under either system as well as bonus-malus (rewards and penalties) schemes.

**Climate Smart Forestry**: an approach that mainstreams climate mitigation by using forests and the forest sector and related policies and measures in a way that utilises the different regional characteristics and circumstances of the EU Member States. It looks for synergies with other policies impacting the forest sector, such as rural policies, industrial policies, energy policies and biodiversity policies. This may also mean changes to these policies, to enhance climate objectives.

**Durban LULUCF commitment**: the 2011 United Nations Climate Change Conference (COP17) was held in Durban, South Africa. It set decisions and guidance on how the land use sector was to be accounted for in the Second Commitment Period (CP2; 2013–2020) of the Kyoto Protocol. Forest management reference levels were decided, i.e., a baseline sink above which some credits could be used to achieve the overall national emission reduction commitment. These were capped ('Durban cap').

**ETS (EU ETS)**: the Emissions Trading System (or Scheme) set up by the EU under the Kyoto Protocol. It covers about half of the EU's emissions, but the price of its permits has been volatile and often quite low (under €10). This has been caused by oversupply of credits e.g. from the former eastern European energy sectors which quickly collapsed after 1990.

**Effort Sharing Decision (ESD)**: this establishes binding annual greenhouse gas emission targets for Member States for the period 2013–2020. These targets concern emissions from most sectors not included in the EU Emissions Trading System (EU ETS), such as transport (except aviation and international maritime shipping), buildings, agriculture and waste. 'Effort sharing' refers to the fact that overall emissions reductions in these sectors need to be shared amongst these sectors. It is not decided yet whether LULUCF will be part of the ESD.

**EU Climate and Energy Framework**: the 2030 climate and energy framework sets three key targets for the EU for the year 2030: at least 40% cuts in greenhouse gas emissions (from 1990 levels); at least 27% share for renewable energy; at least 27% improvement in energy efficiency.

**Forest Management Reference level (FMRL)**: a baseline sink for forest management in each EU Member State projected from 2013-2020.

**INDC**: an Intended Nationally Determined Contribution. A bottom-up approach in which countries pledge themselves to commit to a certain level of emission reductions by 2030 regardless of other countries' commitments. This is different from the Kyoto Protocol and its follow up negotiation processes where global targets were set and negotiated. The INDC process was initiated at the COP20 in Lima. For the EU, the Climate and Energy Package 2030 is the INDC.

**IPCC**: Intergovernmental Panel on Climate Change. A scientific body under the auspices of the United Nations which reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change.

**LULUCF**: Land use, Land Use Change and Forestry sector. One of the sectors which countries use to report their greenhouse gas balance. It includes sinks and emissions from the land and its use. It excludes non $CO_2$ gases from e.g., livestock.

**UNFCCC process**: United Nations Framework Convention on Climate Change. This entered into force in 1994, and has been ratified by 195 countries. The work of the UNFCCC was extended by the 1997 Kyoto Protocol which commits its 192 Parties by setting internationally binding emission reduction targets.

# Recommended reading

Böttcher, H. and J. Graiche, J. 2015. Impacts on the EU 2030 climate target of including LULUCF in the climate and energy policy framework. Öko-Instiut e.V. Report for FERN and IFOAM. http://www.oeko.de/oekodoc/2320/2015-491-en.pdf

Brus, D.J., Hengeveld, G.M., Walvoort, D.J.J., Goedhart, P.W., Heidema, A.H., Nabuurs, G.J. and Gunia, K. 2011. Statistical mapping of tree species over Europe. European Journal of Forest Research. 131: 145-157. https://doi.org/10.1007/s10342-011-0513-5

Caurla S., Delacote, P., Lecocq, F., Barthès, J. and Barkaoui, A. 2013. Combining an inter-sectoral carbon tax with sectoral mitigation policies: impacts on the French forest sector. Journal of Forest Economics 19: 450–461. https://doi.org/10.1016/j.jfe.2013.09.002

Cramton, P., MacKay, D.J.C., Ockenfels, A. and Stoft, S. (eds.) 2015. Global carbon pricing. We will if you will. carbon-price.com/wp-content/uploads/Global-Carbon-Pricing-cramton-mackay-okenfels-stoft.pdf

Eggers, J., Lindner, M., Zudin, S., Zaehle, S. and Liski, J. 2008. Impact of changing wood demand, climate and land use on European forest resources and carbon stocks during the 21st century. Global Change Biology 14:1–16. https://doi.org/10.1111/j.1365-2486.2008.01653.x

Ellison, D., Lundblad, M. and Petersson, H. 2014. Reforming the EU Approach to LULUCF and the Climate Policy Framework. Environmental Science & Policy, 40: 1-15. https://doi.org/10.1016/j.envsci.2014.03.004

Ellison, D., Petersson, H., Lundblad, M. and Wikberg, P-E. 2013. The Incentive Gap: LULUCF and the Kyoto Mechanism Before and After Durban, Global Change Biology. Bioenergy 5: 599–622. https://doi.org/10.1111/gcbb.12034

FAO. 2013. Climate Change Guidelines for Forest Managers. FAO Forestry Paper 172. www.fao.org/3/i3383e.pdf

Hanewinkel, M., Cullmann, D.A., Schelhaas, M.J., Nabuurs, G.J. and Zimmermann, N.E. 2013. Climate change may cause severe loss in economic value of European forestland. Nature Climate Change 3: 203207. https://doi.org/10.1038/nclimate1687

Levers, C., Verkerk, P.J., Müller, D., Verburg, P.H., Butsic, V., Leitão, PJ., Lindner, M. and Kümmerle, T. 2014. Drivers of forest harvesting intensity patterns in Europe. Forest Ecology and Management 315: 160-172. https://doi.org/10.1016/j.foreco.2013.12.030

Nabuurs, G.J., Lindner, M., Verkerk, P.J., Gunia, K. Grassi, G., Michalak, R. and Deda, P. 2013. First signs of carbon sink saturation in European forest biomass. Nature Climate Change. https://doi.org/10.1038/NCLIMATE1853

## Authors

Gert-Jan Nabuurs is senior researcher European forests at Alterra, Wageningen UR and Special Professor European forests at Wageningen University, the Netherlands.

Philippe Delacote is a senior researcher at the Laboratory of Forest Economics (INRA, France) and at the Climate Economics Chair.

Marc Hanewinkel is Professor of Forest Economics and Forest Management in the Faculty of Environment and Natural Resources, University of Freiburg, Germany.

David Ellison is a climate policy expert at the Swedish University of Agricultural Sciences, Umeå, Sweden.

Marcus Lindner is Head of the Sustainability and Climate Change Programme at the European Forest Institute.

Martin Nesbit is a Senior Fellow and Head of the Environment and Climate Governance Programme at the Institute for European Environmental Policy (IEEP), UK.

Markku Ollikainen is Professor of Environmental and Resource Economics in the Department of Economics and Management, University of Helsinki, Finland.

Annalisa Savaresi is a Teaching Fellow in Global Environmental Law at Edinburgh Law School, University of Edinburgh, UK.

## Acknowledgements

The report is based to a large extent on a synthesis of published documents and peer-reviewed studies. The manuscript's synthesis and implications drawn from these studies, however, received constructive comments and suggestions from the following external reviewers: Hannes Böttcher (Öko-Institute) and Lucia Perugini (Euro-Mediterranean Centre for Climate Change, CMCC). We wish to thank them for their valuable insights.

We are living in a time of accelerated changes and unprecedented global challenges: energy security, natural resource scarcity, biodiversity loss, fossil-resource dependence and climate change. Yet the challenges also demand new solutions and offer new opportunities. The cross-cutting nature of forests and the forest-based sector provides a strong basis to address these interconnected societal challenges, while supporting the development of a European bioeconomy.

The European Forest Institute is an unbiased, science-based international organisation that provides the best forest science knowledge and information for better informed policy making. EFI provides support for decision-takers, policy makers and institutions, bringing together cross-boundary scientific knowledge and expertise to strengthen science-policy dialogue.

This work and publication has been financed by EFI's Multi-Donor Trust Fund for policy support, which is supported by the Governments of Austria, Finland, France, Germany, Ireland, Italy, Norway and Sweden.

EUROPEAN FOREST INSTITUTE

www.efi.int