SolidStandards

Enhancing the implementation of quality and sustainability standards and certification schemes for solid biofuels (EIE/11/218)

D5.1d

Contextual review of sustainability criteria recommended by the EC for solid biomass

INTELLIGENT ENERGY EUROPE

The SolidStandards project

The SolidStandards project addresses ongoing and recent developments related to solid biofuel quality and sustainability issues, in particular the development of related standards and certification systems. In the SolidStandards project, solid biofuel industry players will be informed and trained in the field of standards and certification and their feedback will be collected and provided to the related standardization committees and policy makers.

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About this document

This document is Deliverable 5.1d for Work Package 5.1 of the SolidStandards project. Refer to “Reading Guide for Work Package 5.1” for more information about Work Package 5.1.This document was prepared in October 2012 by:

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Intelligent Energy Europe

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Contents

Important notes:

1. All data and information were collected as of June and July 2012. There is a range of parallel processes taking place at present concerning the development of certification schemes, for e.g. IWPB.
2. A large part of the information is presented in cartography. The original blank map is a royalty free image taken from Bruce John Design Inc. (2009).

1. Introduction

1.1 The RED criteria in relation to solid biomass

When assessing the sustainability requirement for solid biofuels, an important aspect to consider is the context of the criteria. It is crucial to point out that in the beginning, the RED criteria were designed specifically for liquid biofuels, mostly produced from agricultural feedstock. Besides greenhouse gas emission reduction criterion, it specializes in land use changes criteria. This is particularly relevant to liquid biofuels given the fact that the expansion of agriculture for biofuels production leads to the risk of converting high value lands, such as natural forests to agricultural lands.

On the other hand, solid biomass is mainly harvested from permanent stands. In fact, currently most of the traded solid biofuels, particularly wood pellets are produced from residues. Therefore, it is unlikely that land use changes occur on a large scale. However, it is equally important to avoid (excessive) harvesting biomass from high value forests. A few land types are addressed in the criteria; they are primary forests, protected areas and grasslands with high biodiversity value. The first two criteria deemed very relevant to preclude the production of biomass from protected forests. However, the other criteria only indicate that biomass should not source from high value lands (wetlands, wooded land and peatlands) that no longer have their status. At first sight, this may create confusion that solid biomass from these lands can be used without other limitations as long as they keep their status, especially exposing certain types of high value natural forests, peat forests and wetland forests to risk. In other words, other disturbance such as those on biodiversity may not be taken into the account. We note that the criteria “preservation of protection areas” may address this issue, but it relies heavily on laws and regulations beyond the criteria framework. Furthermore, including voluntary conservation areas under this category might create confusions. Therefore it is important to examine the criteria for including components to maintain the biodiversity in forests.

At this moment, some of the land conversion criteria seem irrelevant to the production of solid biofuels from forests. However, in view of the rapid development of biofuels, there might be more short rotation wood or other crops plantations, or even forest plantation in the future that use up more lands.

At the time of writing (September 2012) the European Commission had still not decided whether it is going to introduce mandatory sustainability criteria for solid biomass, and if so, whether these would differ substantially from the RED criteria for liquid biofuels. For the reasons cited above, this can be expected; on the other hand, it is likely that these criteria will deviate as little as possible from the criteria for liquid biofuels for consistency reasons. Despite the uncertainties, this report provides a contextual review of the RED sustainability criteria in the European context, to examine the relevance of these criteria to each country. The impact could be significant, if we consider the local conditions and definitions of land types (particularly type of forests) that might be different from country to country. However, in this report the definitions from FAO were mainly used, unless indicated otherwise. This report is also an attempt to inventorize the distribution of forests and other major land types in Europe, which are illustrated in cartograms. Also, the relative coverage of the SFM schemes is examined, tracing them with the land distribution maps, to see how well these lands are covered by relevant SFMs. For example, only PEFC covers wetlands, and therefore its coverage map was traced with the wetland distribution map, result in a map showing relative coverage indices. These relative coverage indices are only indicative for general analytical purpose, and do not involve any calculations. Lastly, to get the best understanding, this report should be studied together with deliverable Work Package D5.1-2.

1.2 Forests and certified forests distribution in Europe

***What is forest? FAO Definition of "Forest"*:** Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

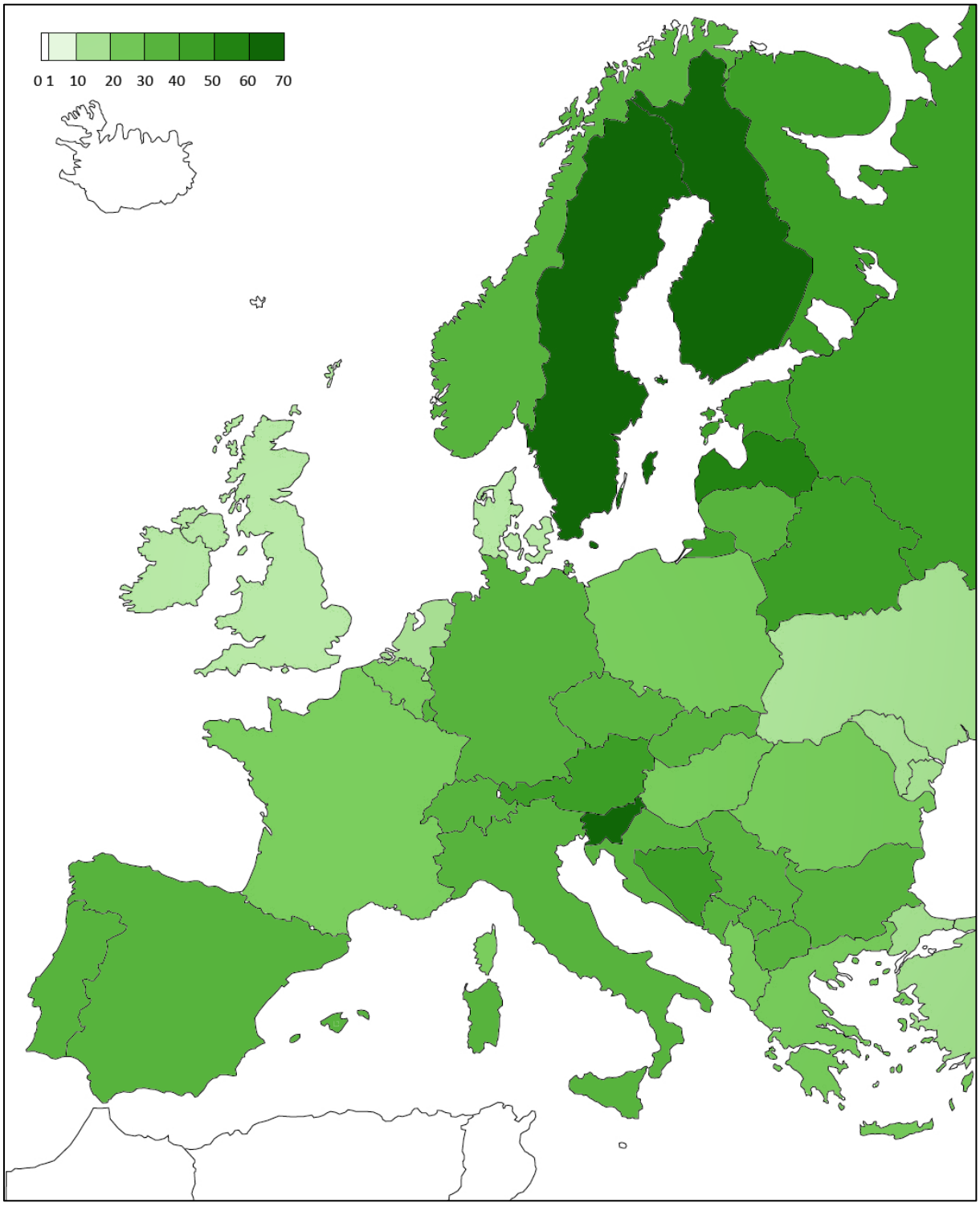

Fig. 1 Distribution of forests in Europe and Turkey (percentage of forest per total land area).
* North Africa, Cyprus and countries smaller than Luxembourg are not included
(Source: FAO, 2010)

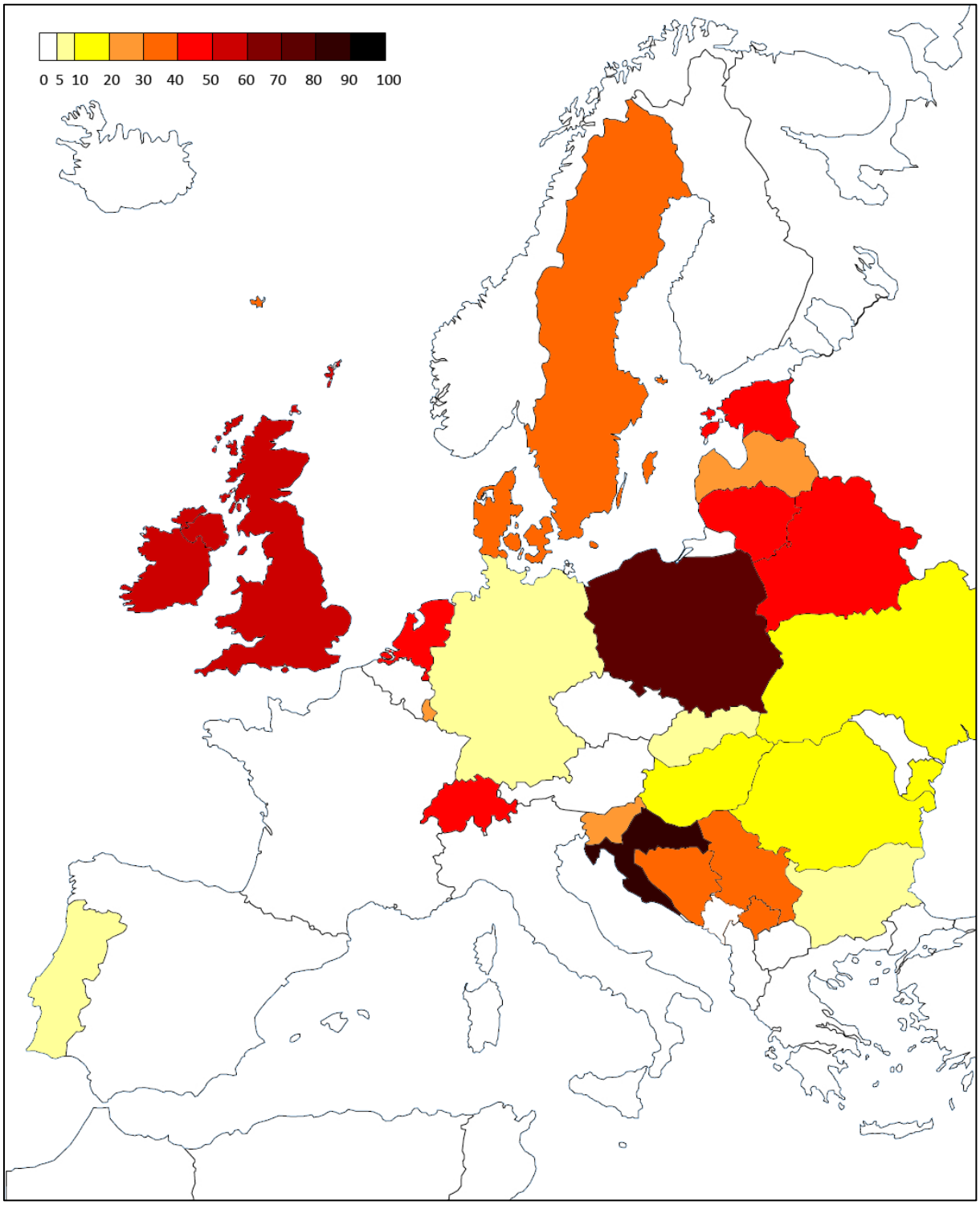

Fig. 2 Coverage of FSC in Europe and Turkey (percentage of FSC certified forest per total forest area in particular countries) (As of 15 June 2012) (Source: FSC, 2012)
* North Africa, Cyprus and countries smaller than Luxembourg are not included

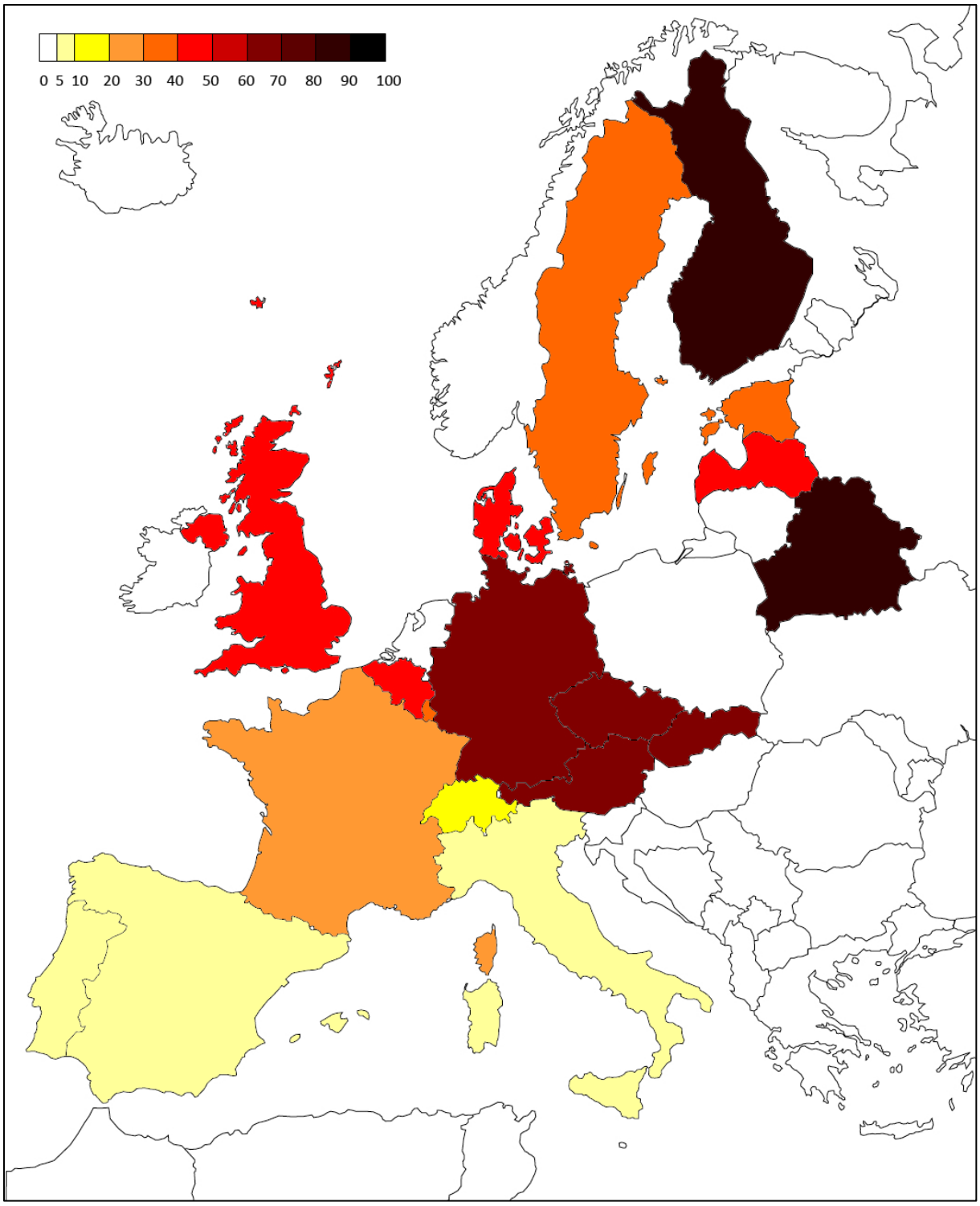

Fig. 3 Coverage of PEFC in Europe and Turkey (percentage of PEFC certified forest per total forest area in particular countries) (As of 15 June 2012)
(Source: PEFC)
* North Africa, Cyprus and countries smaller than Luxembourg are not included

2. Criterion 1: Reduction in greenhouse gas emissions

Criteria	The use and production of biomass must give rise to a reduction in greenhouse gas emissions when compared to fossil fuels
RED Article	17.2 – Reduction in greenhouse gas emissions when compared to fossil fuels
Requirement	The reduction in greenhouse gas emissions resulting from the use of biomass shall be at least 60% Note (Dutch BP): (i) For biofuels this is 35%, gradually increasing to 60% for new installations after 1 January 2018. (ii) Greenhouse gas emissions (reductions) shall be calculated in accordance with the methodology outlined in the February 2010 Commission report, and not be based on the methodology specified in RED).
Detailed description of requirement	The reduction in greenhouse gas emissions resulting from the use of biomass shall be calculated in accordance with Annex I of the European Commission Report on Sustainability Requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling (25 February 2010)

Accountings of greenhouse gas emissions due to activity related to energy use and along the supply chain (waste management, agricultural production, and land use and forestry management) are required for reporting. These gases include CO_2, N_2O and CH_4. Fig. 4 shows the flow chart of carbon emission along the bioenergy system compared with fossil energy system. There are various GHG calculation tools available for different sectors (or cross sectors) and different parts of the supply chain. The following explanation for GHG and energy balances is adapted from another SolidStandards deliverable (Goh and Junginger, 2011), which is available at:
http://www.solidstandards.eu/images/modules/solidstandards_module-sustainability_eng.pdf
Greenhouse gases (GHG) include water vapour, CO_2, methane, nitrous oxide, etc. CO_2 is the largest component in GHG gases besides water vapour. Bioenergy is generally regarded as carbon neutral because CO2 released during combustion of biomass was in first instance fixed from the atmosphere, and (under sustainable conditions) is captured by newly-planted trees and crops again. Hence, it should therefore not contribute to the overall accumulation of carbon in the atmosphere. This emission-free characteristic is one of the main drivers for the promoting of bioenergy by policy makers. However, due to input of fossil fuel during the production and distribution phases, bioenergy is not entirely GHG emission free. In certain parts of the supply chain, fossil fuels are used to supply electricity, heat and transportation fuels. Emission from these inputs should be taken into consideration to evaluate the GHG savings performed by bioenergy. By conducting life cycle analyses (LCA) it is possible to determine GHG emissions in the chain, and the avoided emission compared to fossil fuel alternative. LCA is generally considered to be an appropriate method to evaluate the GHG performance of bioenergy compared to that of fossil alternatives.

Taking the example of wood pellets shows the overall emission and energy flow in production of bioenergy using wood pellets. In figure 4, the pellet chain is divided into 5 stages:

1. Stage I represents the cultivation of energy crops. This section should be excluded for wood pellets produced from wood residues and by-products. A significant input in this section is fertilizer. Fertilizer is often required to maintain the soil fertility and crops

productivity. The GHG generated during the production of fertilizer should not be neglected from the emission balance equation. Besides that, diesels are also used in machineries for harvesting and collecting the woody biomass. For example, the harvesting of pine trees includes felling and skidding trees to land area, processing trees to logs, loading and transportation to the hauling points.

2. Stage II represents the first transportation step. In case of energy crops, harvested trees are transported to pellet mills or central wood chipping terminals that may be located some distance from the harvesting site. In case of wood residues or by-products, the first transport step is typically from a lumber mill to a wood pellet mill. Normally trucks are used for this purpose. Diesel is the major energy input in this stage. In some cases pellet mill can situate in same area with sawmill and transportation is carried pneumatically.
3. Stage III represents the processing of solid biomass. The major consumption of energy comes from grinding, drying, pelletization and cooling in the forms of electricity and heat. After cooling processes can include also packaging. Drying and pelletization of woody biomass creates a dense and clean-burning fuel which is easier to transport. It is possible to significantly reduce the GHG missions associated with this stage by using renewable energy instead of fossil fuel such as coal, oil or natural gas to power and heat the processing mill. For example, on-site incineration of low-value solid biomass (e.g. bark) can be carried out to generate heat and electricity for drying and pelletization. In this scenario, the dependence on fossil fuel is greatly reduced and this reduction positively contributes to the overall GHG emission balance.
4. In stage IV, wood pellets are distributed to the end user as bulk material or in sacks (small and big sacks). Besides wood pellets, woody biomass is typically also traded and transported in the forms of wood chips (and in some EU countries small amount of briquettes). In this stage, the expense of energy and hence GHG emission is proportionate to the distance between mills and end-users. Trailer, train and trucks are employed for land-transport. Small vessels such as river barges or coasters are used for transport on canals and short distances over sea (e.g. in the Baltic Sea), whereas large dry bulk carriers are used for ocean transport for imports from continents. The pellets have to be transported by trucks or trains from pellet plants to port or to end-user e.g. power plant, and loaded on vessels to be transported across the oceans.
5. Stage V represents the production of electricity and heat from wood pellets generated in co-firing power plants, boilers, stoves and fireplaces. Part of the primary energy is lost as waste heat due to process inefficiency. Wood ashes generated after combustion can be recycled as fertilizer to forests and energy crops plantation for nutrients replenishment – if at least the ash is not contaminated, and the forest is near enough. This may reduce emission and energy consumption during the production of fertilizers for stage I.

By comparing with typical fossil power generation, a meaningful comparison of GHG emission can be made. The GHG balance of bioenergy systems varied with feedstock, location (transport) and conversion technologies to produce heat, CHP or electricity. There are also carbon stock changes due to land use change when energy crops are cultivated on existing vegetations. By using the concept of emission and energy balance, the energy flow can be calculated to provide useful indicators to evaluate the sustainability of bioenergy. Indicators such as GHG emission per unit kWh electricity generated gives information on how much GHG savings are achieved by bioenergy referring to fossil fuel energy scenario. Energy input is parallel or proportionate to GHG emission savings, particularly when fossil fuel is used to supply energy to the system. The energy input such as electricity, heat and transportation fuel need to be deducted from the power generated. Similarly, GHG emitted from these input need to be added into the emission balance. To promote GHG savings, the use of fossil fuel should be minimized in the overall process. For example, using natural gas for drying saw dust should be avoided – rather use bark. Besides that, improving efficiency of electricity and heat generation using wood pellets can also significantly improve GHG savings. As the net energy production is increased, GHG saving is also improved since it is calculated per kWh electricity produced.

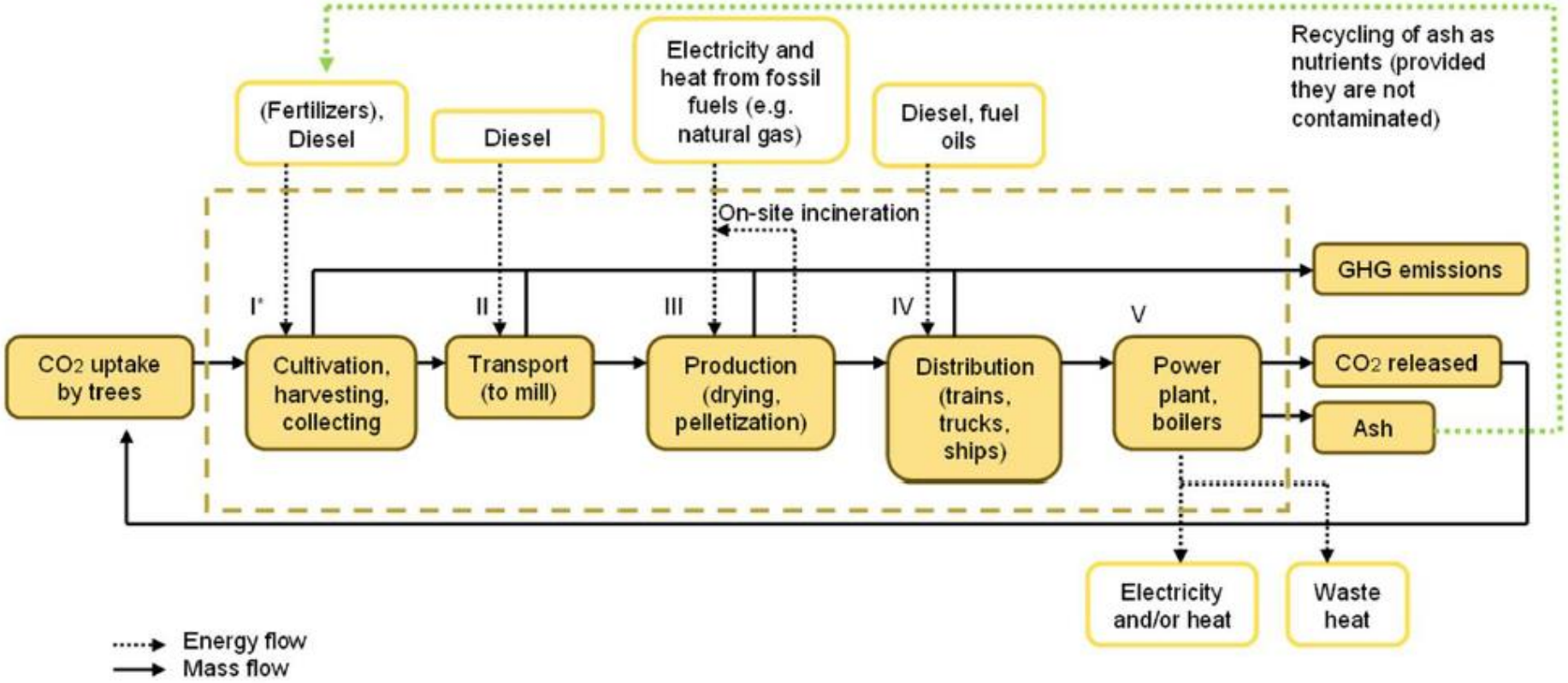

Figure 4 Emission and energy flow of a typical pellet chain and bioenergy power generation (* for energy crops only)

3. Criterion 2: Preservation of primary forest and other wooded areas

Criteria	Preservation of primary forest and other wooded land
RED Article	17.3 – Preservation of biodiversity
Requirement	Biomass shall not be made from raw material obtained from land that was wooded in or after January 2008, whether or not the land continues to have that status
Detailed description of requirement	• Primary forest and other wooded land, namely forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed. • This includes areas that: (i) are designated by law or by the relevant competent authority for nature protection purposes; or (ii) are designated for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or includes in lists drawn up by intergovernmental organization or the International Union for the Conservation of Nature, subject to their recognition in accordance with the procedure in Article 18, section 4, second paragraph of the RED. • Unless evidence is provided that the production of that raw material does not interfere with those nature protection purposes.

Fig. 5 shows the distribution of primary forests in Europe and Turkey. As examined in D5.1-2, FSC is the only SFM that fully covers the preservation of primary forests. Table 6 presents the area of primary forest and area of certified forests in European countries. Although Estonia has the largest percentage of primary forest per total forest area, it is moderately covered by FSC. However, the country with second largest proportion of primary forest per total forest, i.e. Russia, has negligible area of forest certified.

Table 6 Proportion of primary forest and certified forest (countries with less than 5% of primary forest / total forest area are not included) (Full data is available in the last section)

Countries	% Primary forests / total forests area	% FSC certified area / total forest area
Estonia	43.5	24.5
Russia	31.7	1.7
Sweden	9.3	25.7
Slovenia	8.7	12.8
Turkey	8.6	0.1

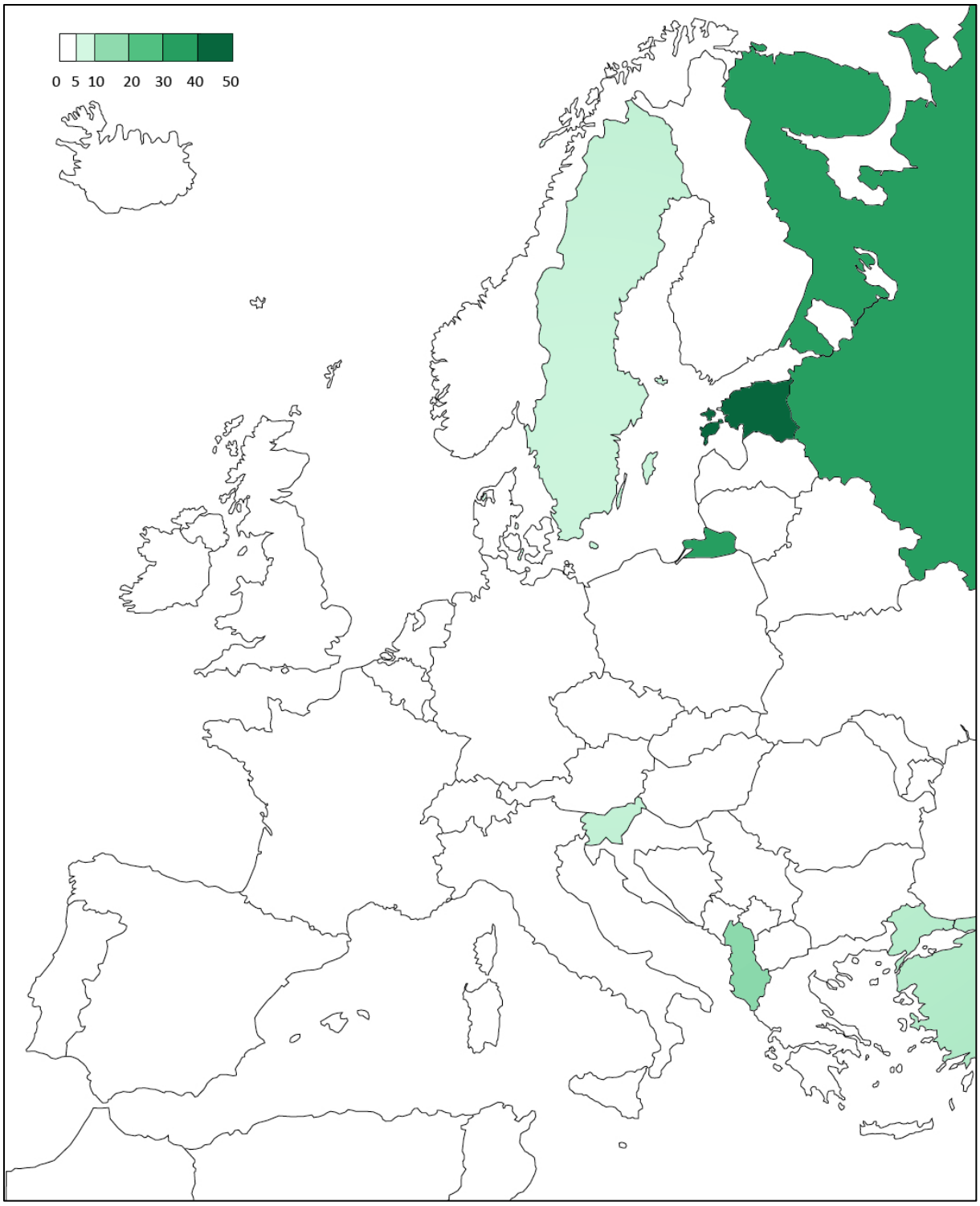

Fig. 5 Distribution of primary forests in Europe and Turkey (percentage of primary forest area per total forest area).
* North Africa, Cyprus and countries smaller than Luxembourg are not included
** The rest are natural regenerated forest and planted forests
(Source: FAO, 2010)

4. Criterion 3: Preservation of protected areas

Criteria	Preservation of protected areas
RED Article	17.3 - Preservation of biodiversity
Requirement	Biomass shall not be made from raw material obtained from land that was classed as a protected area in or after January 2008, whether or not the land continues to have that status.
Detailed description of requirement	• This includes areas that: (i) are designated by law or by the relevant competent authority for nature protection purposes; or (ii) are designated for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or includes in lists drawn up by intergovernmental organisation or the International Union for the Conservation of Nature, subject to their recognition in accordance with the procedure in Article 18, section 4, second paragraph of the RED. • Unless evidence is provided that the production of that raw material does not interfere with those nature protection purposes.

Fig. 6 depicts the distribution of protected forests in Europe. Table 8 presents the area of protected forest and area of certified forests in selected countries. FSC and PEFC are both considered to have fully addressed this criterion by The Dutch benchmark, but due to lack of reference dates, they are only considered partially addressed by the British benchmark. Italy, Moldova, Ukraine and Romania have relatively large percentage of protected forests but are not well covered by the schemes. Some protected forest areas in Europe are designated to conserve forest biological diversity without direct human intervention (MCPFE[1] class 1.1). These are often primary forests and wilderness areas in Eastern and Northern Europe, especially in Sweden, Slovakia and Bulgaria. Some protected forests designated for the conservation of forest biological diversity are managed allowing a minimum of human intervention (MCPFE class 1.2). These characteristics often apply to core zones of national parks. The largest areas of these protected forests are located in Northern as well as Eastern Europe. Most of the protected forest areas are actively managed to conserve biological diversity (MCPFE class 1.3), covering 79% of Europe's protected forests (MCPFE, 2011).

The forest protection for "landscape and specific natural elements" (MCPFE Class 2) principally aimed at achieving the goals of landscape diversity, cultural, aesthetic, spiritual and historical values and recreation. In general, commercial forestry is possible in these areas as long as it complies with the primary objective of landscape protection (MCPFE, 2011). Therefore it is not included in this work for such a consideration. However, it should be noted that many forests in Europe also exercise functions protected by law, for e.g. water protection and erosion control areas.

[1] Ministerial Conference on the Protection of Forests in Europe

Table 8 Proportion of protected forest and certified forest (only including countries with >20% protected forest / total forest areas) (Full data is available in the last section)

Countries	% Protected forests / total forests area	% FSC certified area / total forests area	% PEFC certified area / total forests area
Slovenia	58.0	20.3	0.0
Italy	56.0	0.5	7.0
Ukraine	54.0	14.9	0.0
Moldova	53.0	0.0	0.0
Belarus	50.0	40.5	90.3
Romania	50.0	10.6	0.0
Belgium	46.0	2.8	40.9
Austria	41.0	0.0	63.7
Hungary	36.0	15.3	0.0
Poland	36.0	74.7	54.1
Slovakia	34.0	7.6	63.1
Spain	34.0	0.6	5.4
Iceland	32.0	0.0	0.0
Norway	29.0	2.2	71.4
Germany	26.0	5.7	66.8
Netherlands	25.0	43.7	0.0
Turkey	25.0	0.4	0.0
Czech Republic	22.0	1.9	69.8
Lithuania	22.0	47.3	0.0
Ireland	22.0	57.0	0.0
Albania	21.0	0.0	0.0
Estonia	21.0	47.1	37.4
Latvia	21.0	22.9	46.8

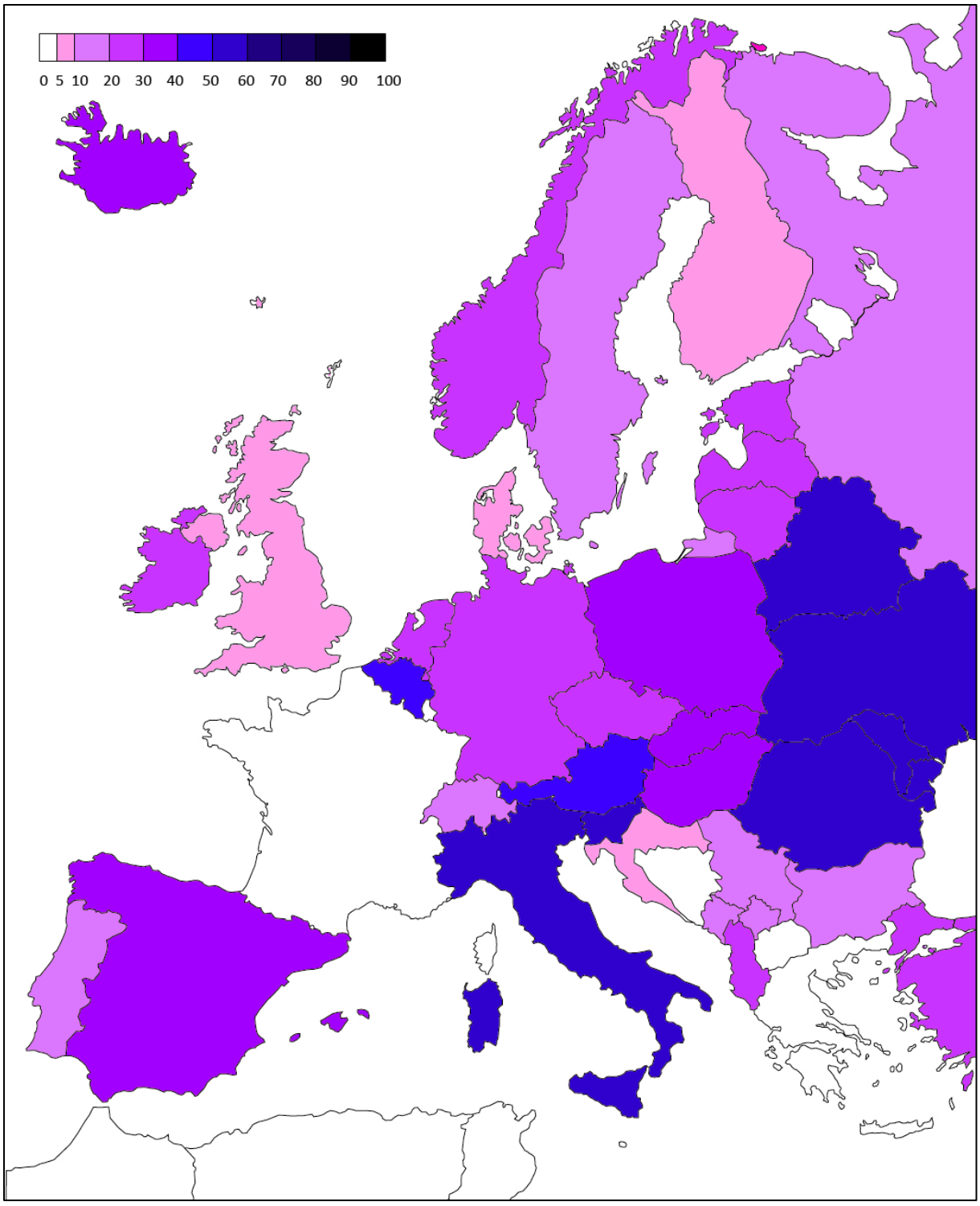

Fig. 6 Distribution of forest area designated for protection of soil and water, conservation of biodiversity, and social services in Europe and Turkey (percentage of protected forest area per total forest area)
(Source: FAO, 2010)
* North Africa, Cyprus and countries smaller than Luxembourg are not included

5. Criterion 4: Preservation of grassland with high biodiversity values

Criteria	Preservation of grassland with high biodiversity value
RED Article	17.3 - Preservation of biodiversity
Requirement	Biomass shall not be made from raw material obtained from land that was classed as grassland with a high biodiversity value in or after January 2008, whether or not the land continues to have that status.
Detailed description of requirement	Grassland with high biodiversity value is defined as: (i) natural grassland, namely grassland which, in the absence of human intervention, would remain grassland and which maintains the natural species composition and ecological characteristics and processes; or (ii) non-natural grassland, namely grassland which, in the absence of human intervention, would cease to be grassland and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status.

The RED criterion has the purpose to preclude the establishment of plantation forest on land that was previously grasslands with high biodiversity, and therefore it is not relevant to natural production forest. However, none of the forest management schemes assessed cover this criterion. Fig. 7 shows the distribution of grasslands (permanent and temporary) in Europe and Turkey. Table 10 listed the grasslands area by countries. Russia, Turkey, France, and the United Kingdom have large area of grasslands. In UK, as indicated in Renewables Obligation: Sustainability Criteria for Solid and Gaseous Biomass for Generators (greater than 50 kilowatts): “4.20. We are aware that the EC is working to establish criteria and geographic ranges of highly biodiverse grassland. Until such time as the EC have established criteria and geographic ranges of highly biodiverse grassland, and reflected it in future amendments to the Orders, we will not require operators of generating stations to report on the highly biodiverse grassland criterion.” (Ofgem, 2012b). However, currently the Common Agricultural Policy (CAP) reform proposals (in negotiation) will force farmers to retain the area of permanent pasture (land sown to grass for five years or more) and other unimproved land at the level indicated on their 2014 Single Payment Scheme form - within a tolerance of 5%. Most productive grassland can be ploughed up without the need for official approval. But farmers with parcels of grassland greater than 2ha that have not been cultivated for 15 years or more, or are defined as unimproved or semi-natural pasture, must seek approval from Natural England before ploughing or improving the land. Environmental Impact Assessment (EIA) may be required before any proceeds (Farmers weekly, 2012).

The Environmental Impact Assessment (Agriculture) (England) (No.2) Regulations

The EIA regulations seek to protect bio-diverse pasture like species-rich hay meadows, marshland, scrub, moorland and heath. But they also encompass all elements of the environmental impact of changing the farming practice, including its bearing on the landscape, erosion, flooding, flora and fauna. Importantly, land which is unimproved as a result of an environmental stewardship scheme does not fall within the EIA regulations, unless it has also been grassland for 15 years or more. It can, therefore, be cultivated or improved without official consent, following the end of the stewardship scheme.

Table 10 Grasslands distribution in Europe (Full data is available in the last section)

Countries	Grasslands area / total land area (%)	Grasslands area (million ha)
Russia	5.53	94.50
Turkey	17.4	13.6
France	23.2	12.7
United Kingdom	45.6	11.2
Spain	14.1	7.1
Ukraine	8.9	5.4
Germany	14.9	5.3
Romania	20.7	4.9
Italy	16.0	4.8
Ireland	56.1	3.9
Poland	12.4	3.9

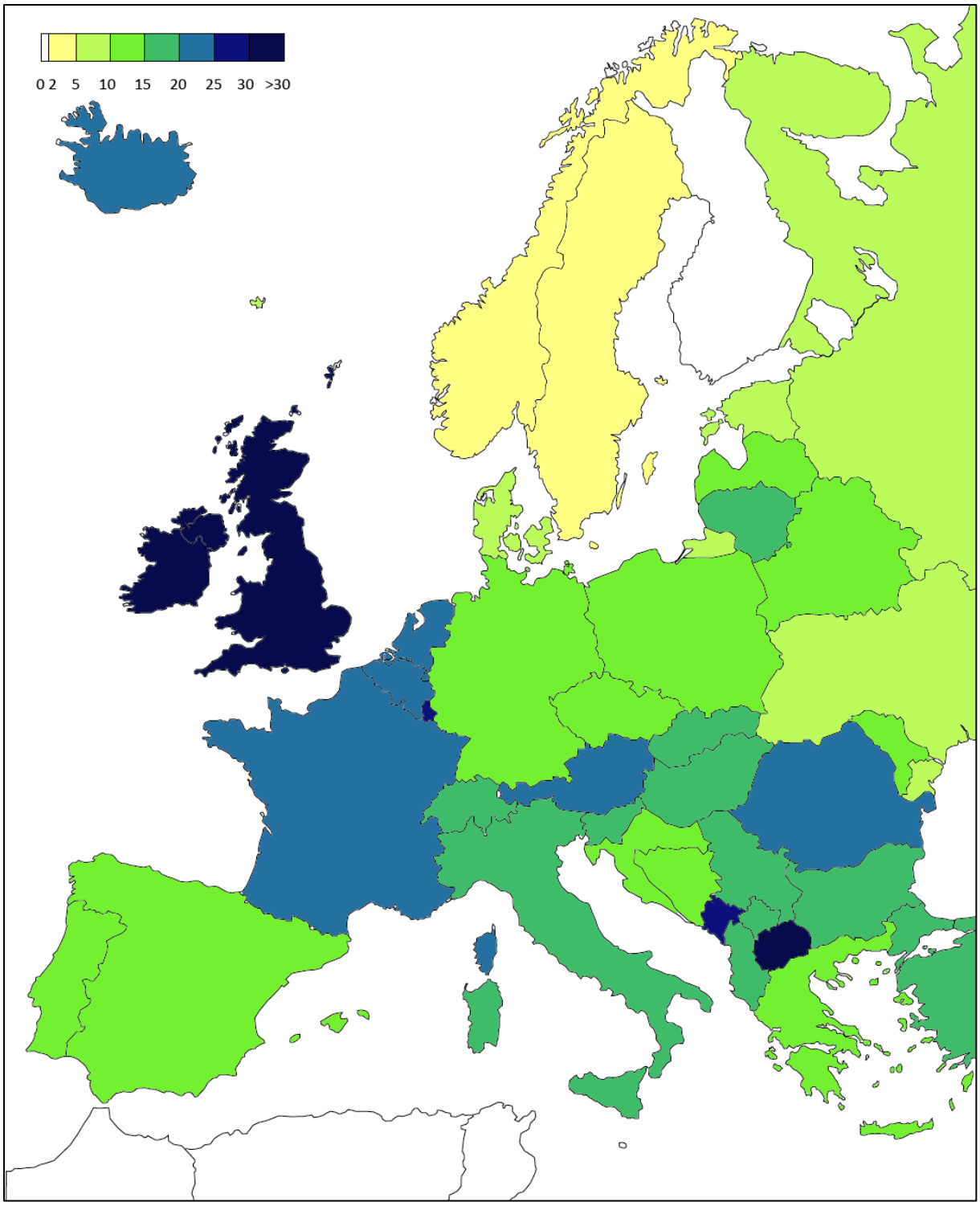

Fig. 7 Distribution of grasslands (permanent and temporary) in Europe and Turkey (percentage of total grassland per country land area)
(Source: Smit et al., 2008)
* North Africa, Cyprus and countries smaller than Luxembourg are not included

6. Criterion 5: Preservation of wetlands

Criteria	Preservation of wetlands
RED Article	17.4 - Preservation of carbon stock
Requirement	Biomass shall not be made from raw material obtained from land that was a wetland in January 2008 and no longer has that status.
Detailed description of requirement	Wetlands are defined as land that is covered with or saturated by water permanently, or for a significant part of the year. This stipulation shall not apply to land that at the time that the raw material was obtained had the same status as in January 2008.

What are wetlands? Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by shallow water. The Ramsar Convention takes a broad approach in determining the wetlands which come under its mandate. Under the text of the Convention (Article 1.1), wetlands are defined as: “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres“.

According European Environment Agency, 49% of the change in wetland areas between 2000 and 2006 was due to forest creation and management (in 25 European countries) (EEA, 2012). In Europe, large part of wetlands are forested – they are forested peatland Ramsar sites with boreal systems, mainly in Estonia, Finland and Sweden (Blumenfeld et al., 2009). At EU level, the Habitats Directive prohibits the disturbance of habitats of protected animals and plant species, which include wetlands. Fig. 8 shows the distribution of wetlands in Europe and Turkey. Table 12 shows the wetlands area in each country per total land area. Obviously countries around the Baltic Sea have large area of wetlands. Nevertheless, the coverage of PEFC (which is considered that it includes the wetlands conservation criteria) in this region is relatively low.

The Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)

The Habitats Directive (together with the Birds Directive) forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. All in all the directive protects over 1.000 animals and plant species and over 200 so called "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance. The Natura 2000 network comprises special areas of conservation designated by Member States under the current Directive.
http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

Table 12 Wetlands distribution in Europe and PEFC coverage (Full data is available in the last section)

Countries	Wetlands area (million ha)	Wetlands area per total land area (%)	PEFC certified forests (million ha)
Russia	218.7	12.8	0.6
Sweden	11.1	24.6	11.0
Finland	8.4	24.8	21.1
Norway	3.5	10.7	9.1
Ukraine	3.2	5.3	0
United Kingdom	3.0	12.3	1.3
Turkey	2.3	2.9	0
Germany	2.2	6.0	7.4
Poland	1.9	5.9	5.0
France	1.6	2.9	4.2
Estonia	1.5	33.6	0.9
Latvia	1.3	20.8	1.6
Belarus	1.3	6.3	8.3
Denmark	1.2	28.0	0.2
Romania	1.1	4.8	0
Iceland	1.1	10.8	0
Netherlands	1.0	23.5	0
Ireland	0.6	8.7	0

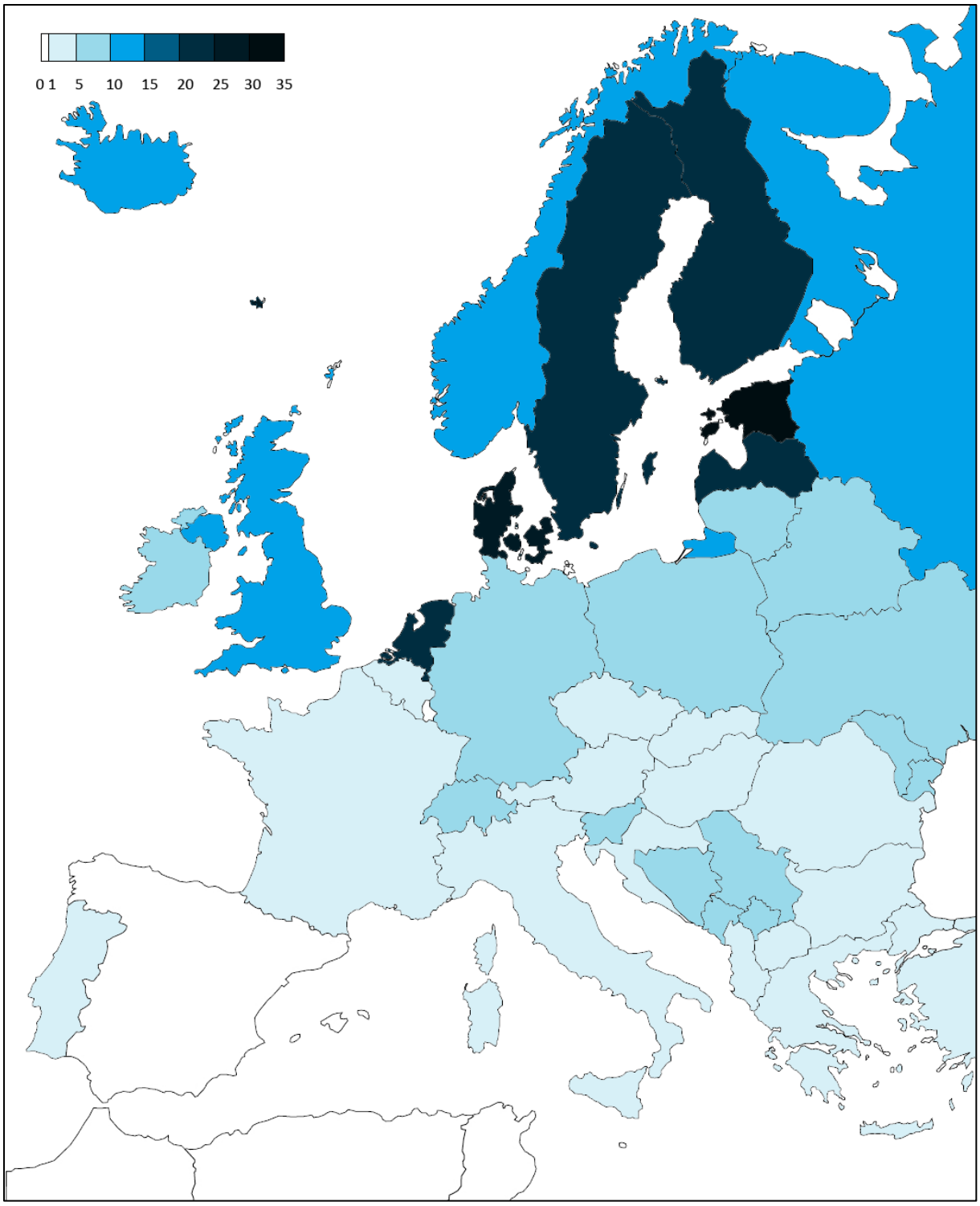

Fig. 8 Distribution of wetlands in Europe and Turkey (percentage of wetlands per country total land area)
(Source: Nivet & Frazier, 2004)
* North Africa, Cyprus and countries smaller than Luxembourg are not included

7. Criterion 6: Preservation of permanently wooded areas

Criteria	Preservation of permanently wooded areas
RED Article	17.4 – Preservation of carbon stock
Requirement	Biomass shall not be made from raw material obtained from land that was a permanently wooded area in January 2008 and no longer has that status.
Detailed description of requirement	• Permanently wooded areas are defined as areas spanning more than one hectare with trees higher than five metres and a canopy cover in excess of 30%, or trees able to reach those thresholds in situ. Land with a primarily agricultural or urban land use is not included in this definition. • Land used for agricultural purposes shall include the following in this context: tree stands in agricultural production systems, such as fruit orchards, palm oil plantings and woodland cultivation systems, in which crops are cultivated beneath trees. This definition shall not apply to land that at the time that the raw material was obtained had the same status as in January 2008.

As shown in Fig. 9 Sweden, Finland and Slovenia are the two countries with very high percentage of forests with density in excess of 25% per km^2 per total forest area. Data for lightly wooded area with 25 – 30% canopy cover are not available at the time of writing. Both FSC and PEFC are considered to have fully addressed this criterion. Table 14 compares the coverage of forests with density >25% per km^2 between the European countries and their SFMs coverage.

Table 14 Coverage of forests with density >25% per km^2 (Countries with coverage less than 2 million ha are not included) (Full data is available in the last section)

	Forests area with coverage >25% per km^2 (million ha)	Percentage / total forest area (%)	FSC certified area / total forest area (%)	PEFC certified area / total forest area (%)
Sweden	24.7	87.6	25.7	24.4
Finland	20.2	91.1	1.2	62.3
Spain	10.9	60.2	0.3	3.0
France	6.1	38.0	0.0	7.8
Italy	5.2	56.6	0.2	2.5
Romania	4.5	68.6	3.0	0.0
Germany	4.2	37.7	1.8	20.7
Poland	3.6	39.0	22.3	16.1
Norway	3.4	33.8	0.9	28.2
Austria	2.8	73.1	0.0	30.4
Bulgaria	2.7	68.8	2.0	0.0
Greece	2.5	65.3	0.0	0.0
Latvia	2.4	71.5	12.3	25.1

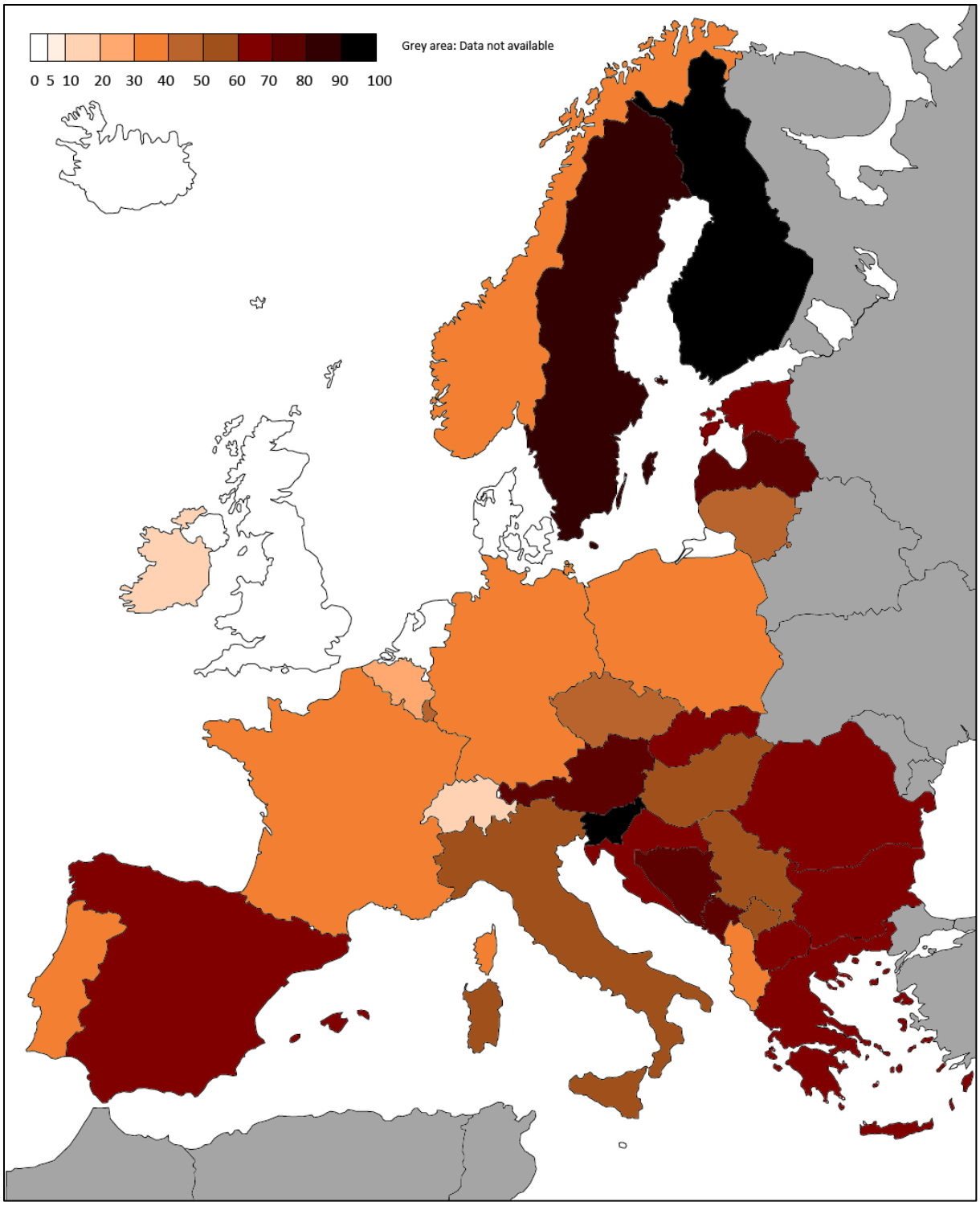

Fig. 9 Distribution of forests in Europe and Turkey excluding area with less than 25% forest coverage per km^2 (percentage of forest per total forest area)
* North Africa, Cyprus and countries smaller than Luxembourg are not included
(Source: Constructed based on Fig. 1 and Fig. 15)
Note: This figure is made only for indication and does not intend to give exact values

8. Criterion 7: Preservation of lightly wooded areas

Criteria	Preservation of lightly wooded areas
RED Article	17.4 - Preservation of carbon stock
Requirement	Biomass shall not be made from raw material obtained from land that was a lightly wooded area in January 2008 and no longer has that status.
Detailed description of requirement	Lightly wooded areas are defined as areas spanning more than one hectare with trees higher than 5 m and a canopy cover between 10% and 30%, or trees able to reach those thresholds in situ, unless evidence is provided that the carbon stock of the area before and after conversion is such that, when the methodology laid down in Annex V, part C of the RED is applied, the conditions laid down in criterion 1 would be fulfilled (minimum reduction in greenhouse gas emissions). This definition shall not apply to land that at the time that the raw material was obtained had the same status as in January 2008.

Fig. 10 shows the lightly wooded area with density of 10 - 25% forest (with 1 km^2 as a unit). Data for lightly wooded area with 25 – 30% canopy cover are not available at the time of writing. PEFC is considered to have fully addressed this criterion because it has explicitly defined “lightly wooded area”. It is obvious that UK, Netherlands, Denmark, Switzerland, Ireland and Iceland are countries with almost only lightly wooded forests. Table 16 shows the area of lightly wooded forests (10 - 25% density).

Table 16 Coverage of lightly wooded forests (10-25% per km^2) (Countries with that area less than 1 million ha are excluded) (Full data is available in the last section)

Countries	Area of lightly wooded forests (10-25% per km^2) (million ha)	Percentage of lightly wooded forests (10-25% per km^2) / total forest area	PEFC certified area / total forest area (%)
France	9.9	62.0	7.8
Spain	7.2	39.8	3.0
Germany	6.9	62.3	20.7
Norway	6.7	66.2	28.2
Poland	5.7	61.0	16.1
Italy	4.0	43.4	2.5
Sweden	3.5	12.4	24.4
United Kingdom	2.9	100.0	5.3
Portugal	2.1	60.8	2.3
Romania	2.1	31.4	0.0
Finland	2.0	8.9	62.3
Czech Republic	1.4	53.7	23.5
Greece	1.4	34.7	0.0
Lithuania	1.3	58.8	0.0
Bulgaria	1.2	31.2	0.0
Serbia	1.1	41.7	0.0
Austria	1.0	26.9	30.4
Switzerland	1.0	81.9	5.0

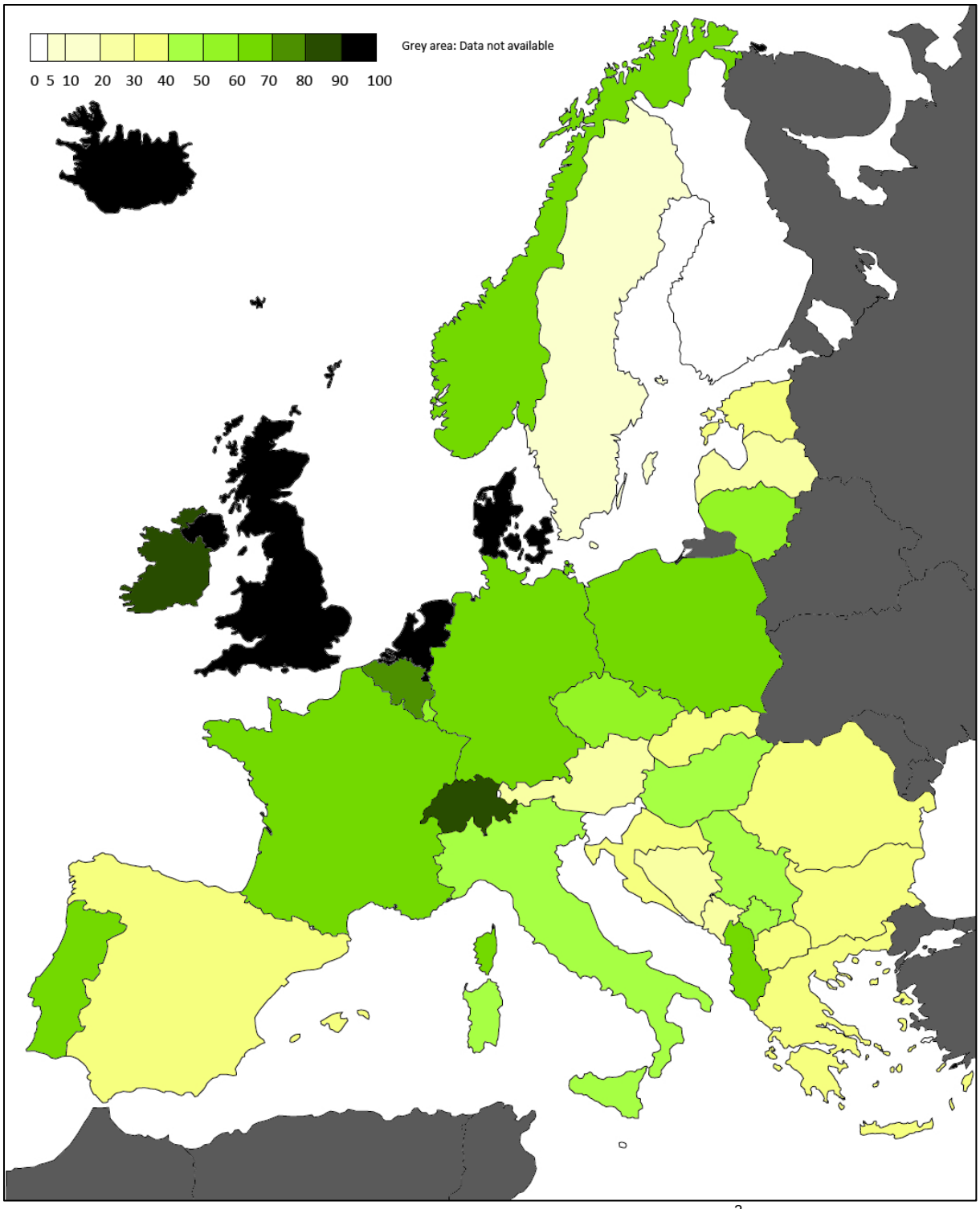

Fig. 10 Distribution of lightly wooded area (10 – 25% forest per 1 km^2) per total forest area. (Constructed based on data extracted from EEA (2009))
Note: This figure is made only for indication and does not intend to give exact values

9. Criterion 8: Preservation of peatlands

Criteria	Preservation of peatland
RED Article	17.5 - Preservation of peatland
Requirement	Biomass shall not be made from raw material obtained from land that was peatland in January 2008.
Detailed description of requirement	• An exception shall be made if evidence can be provided that: — the soil was completely drained in January 2008; or — the soil has not been drained since January 2008. In the case of peatland that was partially drained in January 2008, subsequent, deeper drainage of parts of the soil not yet fully drained constitutes a violation of the criterion. • Peat itself is not considered to be a biomass.

Fig. 11 demonstrates the distribution of peatlands in Europe. Peat is a heterogeneous mixture of more or less decomposed plant (humus) material that has accumulated in a water-saturated environment and in the absence of oxygen. A peatland is an area with or without vegetation with a naturally accumulated peat layer at the surface (IPS, 2012b). Therefore, the distribution of peatlands is closely related to that of wetlands. Countries surrounding the Baltic Sea are bestowed rich resources of peatlands. In fact, peats have been used as solid fuels over the years. Table 18 shows the areas of peatlands in different countries.

Table 18 Peatlands distribution in Europe (Full data is available in the last section)

Countries	Peatlands area / total land area (%)	Peatlands area (million ha)
Russia	5 - 10	85.38 - 170.75
Netherlands	5 - 10	0.21 - 0.42
Ireland	>10	> 0.70
Latvia	>10	> 0.64
Finland	26.3	8.9
Sweden	14.2	6.4
Belarus	11.6	2.4
Norway	7.4	2.4
United Kingdom	7.1	1.75
Germany	3.9	1.4
Poland	3.8	1.2
Iceland	9.7	1
Estonia	19.9	0.9

The most relevant EU Directives for the peat industry include:

(i) Environmental Impact Assessment (EIA) Directive - aims to ensure that before a decision is made about whether to allow peat extraction to proceed, the national authority making the decision has the maximum amount of information about the environmental effects of the project.

(ii) Habitats Directive – deals with the obligations of member states to list and designate sites to be included in a European network of Special Areas of Conservation to be known as Natura 2000. Some pristine peatlands are conserved as Special Areas of Conservation, as well as some peatlands which are restored after peat extraction.

(iii) Birds Directive - obliges member states to take requisite measures to establish a general system of protection for all species of naturally occurring wild birds in the EU. Some pristine peatlands are conserved as Special Protection Areas for birds, as well as some peatlands which are restored after peat extraction.

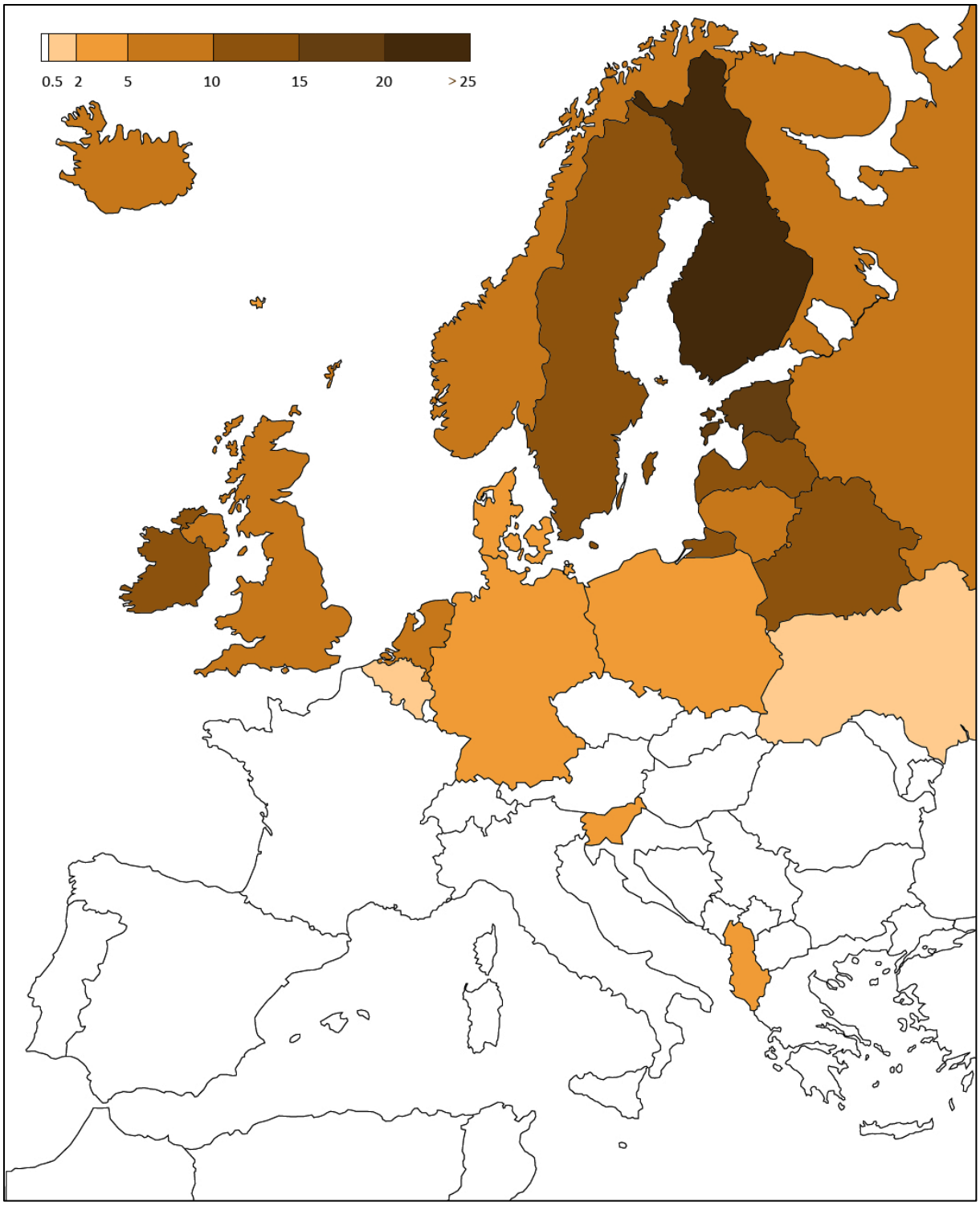

Fig. 11 Distribution of peatlands in Europe (percentage of peatlands per country total land area)
(Source: Parish et al., 2008; IPS, 2012a; cross-checked both references and the largest values taken)
* North Africa, Cyprus and countries smaller than Luxembourg are not included

10. Summary and background data

This report revealed that in Europe not every single criterion is relevant to every country. Table 19 shows the background data for all cartograms in this report.

Overall, Europe has only a very low percentage of primary forests. The only country with primary forests close to 50% of the total forest area is Estonia. Russia still possesses a large area of primary forests, about 32% of the country's total forest area. In most other countries less than 5% of the forest falls under the primary forest definition, with a few between 5-10%. Therefore, this criterion is most relevant to Estonia and Russia. However, coverage of SFM schemes in Estonia is considerably high, which depicts that protection of primary forests might be well addressed under these certification schemes.

Next, most of the European countries plot significant forest area as protected areas, except France, Greece, Macedonia and Bosnia and Herzegovina with almost no protected forests. Italy, Slovenia, Romania, Moldova and Ukraine possess more than 60% of protected forests per total forest area, but have relatively very low SFMs coverage. This criterion is therefore especially relevant to these countries.

Grassland is highly concentrated in the United Kingdom, Ireland, Luxembourg, Montenegro and Macedonia. However, in countries like France, Romania, Austria and Iceland also own about 20-25% of grasslands per total land area. None of the SFM systems have addressed the preservation of grasslands.

The next criterion addresses the preservation of wetlands. Scandinavian, Baltic states, Russia and the Netherlands have high percentage of wetlands per total land area. The United Kingdom and Ireland also have significant percentage of wetlands. Among the SFMs, only PEFC addresses this criterion. These countries were covered by considerable percentage of PEFC certified forest, except the Netherlands.

Although Europe has little primary forests, it has large area of regenerated forests. Finland and Slovenia count near to 100% of permanently forested area (excluding area with less than 25% forest coverage per km^2) per total forest area, followed by Sweden, Latvia, Austria, Bosnia and Herzegovina, and Spain with more than 70%. Most countries have more than 30% of dense forests per total forest area, except the United Kingdom, the Netherlands, Denmark and Iceland, which have less than 5% of high density forests. In contrast, these countries have large area of lightly wooded area (with less than 25% forest coverage per km^2). Similar to the case of preservation of wetlands, PEFC has addressed this criterion by explicitly defining lightly wooded area (with less than 30% canopy cover). The Netherlands has almost zero percentage of PEFC certified forests, and so this criterion seems very relevant to the country.

Finally, the distribution of peatlands is closely related to the distribution of wetlands. Similarly, countries around Baltic Sea and North Sea have relatively large amount of peatlands, especially Finland and Estonia. At the time of writing, no SFM systems have addressed the preservation of peatlands.

Table 19 Background data

	Types of lands (in million ha)												
Countries	Total land area[1]	Total forests area[1]	FSC certified area[2]	PEFC certified area[3]	Natural forests[1]	Planted forests[1]	Primary forests[1]	Protected forests[1]	Grass-lands[4]	Wet-lands[5]	Forests with density > 25% per km^2 [6]	Lightly wooded area with 10-25% density per km^2 [7]	Peatlands[8]
Albania	2.87	0.78	0.00	0	0.60	0.09	0.09	0.16	0.44	0.06	0.27	0.51	0.06 - 0.14
Austria	8.39	3.89	0.00	2.55	N/A	N/A	N/A	1.59	1.97	0.27	2.84	1.04	0.00
Belarus	20.76	8.63	3.70	8.26	6.37	1.86	0.40	4.31	2.98	1.31	N/A	N/A	2.4
Belgium	3.05	0.68	0.02	0.29	0.28	0.40	0.00	0.31	0.62	0.05	0.15	0.53	0.02 - 0.06
Bosnia and Herzegovina	5.11	2.19	1.00	0	1.18	1.00	0.00	0.02	0.69	0.40	1.62	0.56	0.00
Bulgaria	11.09	3.93	0.22	0	2.77	0.82	0.34	0.75	1.79	0.24	2.70	1.22	0.00
Croatia	5.65	1.92	2.03	0	1.84	0.07	0.00	0.17	0.78	0.12	1.25	0.67	0.00
Czech Republic	7.89	2.66	0.05	1.85	0.01	2.64	0.01	0.58	1.13	0.12	1.23	1.43	0.00
Denmark	4.31	0.54	0.20	0.25	0.11	0.41	0.03	0.04	0.42	1.21	0.00	1.06	0.1
Estonia	4.52	2.22	1.11	0.88	0.05	0.17	0.96	0.47	0.36	1.52	1.44	0.78	0.9
Finland	33.84	22.16	0.40	21.07	16.25	5.90	0.00	1.99	0.66	8.39	20.18	1.98	8.9
France	54.70	15.95	0.01	4.25	14.29	1.63	0.03	0.48	12.67	1.60	6.06	9.90	0.00
Germany	35.70	11.08	0.63	7.40	5.79	5.28	0.00	2.88	5.31	2.15	4.17	6.90	1.4
Greece	13.19	3.90	0.00	0	3.76	0.14	0.00	0.16	1.79	0.20	2.55	1.35	0.00
Hungary	9.30	2.03	0.31	0	0.42	1.61	0.00	0.73	1.49	0.19	1.04	0.99	0.00
Iceland	10.30	0.03	0.00	0	0.00	0.03	0.00	0.01	2.27	1.11	N/A	N/A	1
Italy	30.12	9.15	0.05	0.76	8.44	0.62	0.09	5.12	4.83	0.46	5.18	3.97	0.00
Latvia	6.46	3.35	0.80	1.62	2.71	0.63	0.02	0.70	0.75	1.34	2.40	0.96	> 0.64
Lithuania	6.52	2.15	1.06	0	1.61	0.52	0.03	0.47	1.01	0.59	0.89	1.26	0.00
Luxembourg	0.26	0.09	0.02	0.03	0.06	0.03	0.00	0.00	0.08	0.00	0.04	0.04	0.00
Moldova	3.38	0.39	0.00	0	0.38	0.00	0.00	0.20	0.38	0.25	N/A	N/A	0.00
Montenegro	1.38	0.54	0.00	0	N/A	N/A	N/A	0.08	0.45	0.09	0.41	0.13	0.00
Netherlands	4.15	0.37	0.16	0	0.00	0.37	0.00	0.09	1.00	0.97	0.00	0.37	0.21 - 0.42
Norway	32.38	10.07	0.28	9.12	8.37	1.48	0.22	2.92	1.12	3.47	3.40	6.66	2.4
Poland	31.27	9.34	6.98	5.05	0.39	8.89	0.05	3.36	3.88	1.86	3.64	5.69	1.2
Portugal	9.24	3.46	0.30	0.22	2.58	0.85	0.02	0.41	1.32	0.13	1.36	2.10	0.00
Republic of Ireland (Ireland)	7.03	0.74	0.45	0	0.08	0.66	0.00	0.16	3.94	0.61	0.10	0.64	> 0.70
Macedonia	2.57	1.00	0.00	0	0.89	0.11	0.00	0.00	0.69	0.05	0.70	0.30	0.00
Romania	23.84	6.57	0.72	0	4.83	1.45	0.30	3.29	4.93	1.15	4.51	2.06	0.00
Russia	1707.52	809.09	29.24	0.64	535.62	16.99	256.48	105.18	94.50	218.73	N/A	N/A	85.38 - 170.75
Serbia	8.84	2.71	1.04	0	2.53	0.18	0.00	0.33	1.55	0.59	1.58	1.13	0.00
Slovakia	4.88	1.93	0.15	1.22	0.95	0.96	0.02	0.66	0.80	0.20	1.34	0.59	0.04 - 0.10
Slovenia	2.03	1.25	0.26	0	1.11	0.03	0.11	0.73	0.32	0.12	1.18	0.08	0.00

Spain	50.58	18.17	0.15	1.50	15.49	2.68	0.00	6.18	7.12	0.37	10.94	7.24	0.00
Sweden	45.00	28.20	11.57	11.00	21.98	3.61	2.61	2.82	1.41	11.06	24.70	3.50	6.4
Switzerland	4.13	1.24	0.59	0.21	1.03	0.17	0.04	0.16	0.74	0.23	0.22	1.02	0.00
Turkey	78.36	11.33	0.09	0	6.94	3.42	0.97	2.83	13.62	2.27	N/A	N/A	0.00
Ukraine	60.37	9.71	1.45	0	4.80	4.85	0.06	5.24	5.37	3.20	N/A	N/A	1
United Kingdom	24.48	2.88	1.58	1.30	0.66	2.22	0.00	0.26	11.17	3.02	0.00	3.48	1.75

1. FAO (2010). Note: Protected forests include Protection of soil and water, conservation of biodiversity, social services)
2. FSC (2012)
3. PEFC (2012)
4. Smit et al. (2008)
5. Nivet and Frazier (2004)
6. Self-calculation
7. EEA (2009)
8. IPS (2012a); Parish et al. (2008)

---------- References are listed in D5.1-0 ----------

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