The Way Forward: Four Major Challenges to and Opportunities for Forest Sector Policy in Europe

Introduction

Parts I and II of the *State of Europe's Forests 2011* described the status and trends using the structure of the pan-European criteria and indicators of sustainable forest management (SFM). The first sections of Part III assessed progress towards SFM, focusing on the country group level and the balance among the criteria. However, there are some major cross sectoral challenges and opportunities for SFM in Europe, which cut across the structure of the indicators and which should be addressed in the light of the outlook for the sector as whole.

This chapter will review four major challenges for the sector: climate change, energy, biodiversity and the green economy. For each, it will outline the challenge, and then systematically present the information relevant to this challenge which has been supplied in the context of SoEF 2011, as a sound factual basis for policy making. It brings together relevant results from the quantitative and qualitative indicators, as well as analysis of other official studies, notably the forthcoming European Forest Sector Outlook Study (EFSOS) to build a picture of the major complex challenges facing the European forest sector. Finally, it will summarise the main challenges and opportunities for policy makers.

All four challenges are exceptionally complex and uncertain and involve actors and policy goals from outside the forest sector. All need analysis far more detailed than is possible in SoEF 2011 – and are indeed being analysed in many different fora. The objective of the present short chapter is to place these complex challenges in the context of broader information on the forest sector and to draw the attention of those responsible for forest sector policy to issues which do not fit well in the conventional policy framework.

The forest sector and climate change

The challenge of climate change

The forest is a major carbon store and sequesters carbon. Wood, which is carbon-neutral when sustainably produced, can replace non-renewable materials and energy, thus helping to mitigate climate change. However, the forest itself is vulnerable to climate change and will need to adapt to a changed climate in the future. The forest sector, therefore, has several potential roles for the mitigation of, and adaptation to, climate change. However, there are trade-offs among the various climate change-related functions, and between them and the many other functions of the forest. To take a very simple example, a single cubic metre of wood cannot be simultaneously a store of carbon and a source of renewable energy. The challenge for the forest sector as a whole is to make a major contribution to climate change mitigation and adaptation, without neglecting the other dimensions of SFM. The formulation of policy is complicated by uncertainty – about the mechanisms of climate change, about the future climate change regime, and about possible strategies for the forest sector.

Status and trends for the forest sector and climate change

From the quantitative and qualitative indicator data collected for this study it is possible to say the following (indicator reference in brackets):

- European forests are a significant carbon pool (1.4).
- This carbon pool has been increasing strongly as growing stock increases (1.2) because fellings are well below increment (3.1), and forest area has been expanding (1.1), although the latter has little

influence on growing stock for the early years of the rotation.

- There are a number of types of damage to the European forest (2.4) and defoliation occurs (2.3). Some of these types of damage (notably fires and storm, but also perhaps defoliation, and damage attributable to droughts) could be negatively affected by a changed climate, although at present knowledge on this is insufficient as a basis for adaptation strategies. The damage itself also results in carbon emissions to the atmosphere, as wood is burnt or decomposed.
- At present, there is significant revenue to forest owners, public and private, from marketed roundwood (3.2), non-wood goods (3.3) and forest services (3.4). In only a very few cases have countries reported revenue from carbon sequestration. If, under a future climate regime, there were significant payments for carbon sequestration by European forests, this would add an option for revenue flow to the present ones. The type of silviculture necessary to maximise carbon sequestration might, however, have a negative impact on other revenues. The changing price structure facing forest owners might influence their management decisions.
- Biodiversity (Criterion 4) is interlinked with climate change in many ways: plantations of single, often introduced, species (4.1, 4.3, 4.4) are said to be less resilient in the case of climate change, although they will probably form part of mitigation strategies as plantations are efficient means to sequester carbon and produce renewable materials and fuels. Adaptation strategies could well involve introducing species outside their natural range to forestall a changing climate. Climate change could raise the threat to species (4.8) and the ecosystems which justify the protection of forest for biodiversity (4.9).
- Climate change would threaten the ability of forest to perform their protective functions (Criterion 5).
- Europe consumes annually about 1 115 million m3 roundwood equivalent of forest products (6.7): to replace this by non-renewable materials would increase emissions of greenhouse gases and reduce climate change mitigation. Some of these lasting forest products serve as a carbon store ("harvested wood products" in the Kyoto Protocol terminology).
- As Europe is at present a net exporter of forest products (6.8), it is not at present exporting its "carbon footprint" to other regions, although the emerging results of EFSOS suggest that this could change if the high targets for wood energy are to be achieved. There is some uncertainty about the role of further processed wood products, such as furniture or joinery or paper products, as the carbon in these products is not included in the calculation.
- The use of wood as a renewable energy source makes an important contribution to climate change mitigation. At present wood provides about 3.7 percent of Europe's energy consumption, but much more in certain countries (6.9). Targets have been set, in the EU framework and elsewhere, to raise the share of renewables, as part of climate change policy, as well as for energy security. To achieve these targets would necessitate a significant mobilisation of wood from Europe's forests, trees outside the forest, industries and recovered wood products, as well as major efforts to develop other renewables and energy efficiency.
- There are in place important policies on carbon balance (B.2), which address both climate change mitigation and adaptation. Considerable emphasis is put on carbon sequestration by forests and wood products and the adaptation of forests to climate change impacts. The vital role of forests in reducing GHG emissions and in mitigating and adapting to climate change is not only put forward in national climate and energy policies, but partly also in National Forest Programmes and forest laws. SFM is often reported as a key concept contributing to climate change mitigation. Most countries established specialised entities responsible for implementing various regulations and programmes on climate change, renewable energy and energy efficiency. New national instruments are influenced by recent international climate change debates, agreements and targets.
- EFSOS is constructing a policy scenario outlining the silvicultural measures which would be necessary to maximise carbon stocks in Europe's forests, and the consequences of these assumptions for other parts of the sector.

Wood and energy

The challenge of wood and energy

The promotion of renewable energies, including wood, is a central part of energy and climate change policies all over the region. Evidence has accumulated in recent years that much more wood is being used for energy than previously thought, and that this volume has been increasing, under the influence of policy instruments and, above all, rising energy prices. Most countries, and the EU, have set ambitious targets for renewable energy. This is a positive development for forest owners who have welcomed the emergence of a "third market"[28], and higher revenue as global energy prices have in effect put a floor under the price for wood fibre, which can no longer fall below its energy value (at least long term, and in accessible regions). These developments have been less welcome to the traditional forest industries, which have to face increasing competition for their raw material.

The challenge to the sector as a whole is to expand strongly the supply of wood energy, from roundwood removals, but also from harvest residues, landscape care wood[29], industry residues and recovered wood, and to meet the ambitious targets for renewable energy without, however, undermining sustainability as regards wood supply and all other functions, in Europe and elsewhere. Furthermore, wood energy supply and use should be organised for maximum efficiency and minimum waste,

notably using wood as raw material, and recycling it if possible, before energy use (the "cascade" approach), and the energy should be generated efficiently in modern clean plants, with high combustion efficiency (notably thorough combined heat and power) and minimum release of micro-particles, which carry significant risks for human health.

Status and trends of wood energy for the forest sector and climate change

From the quantitative and qualitative indicator data collected for this study, it is possible to say the following (indicator reference in brackets):

- Wood energy contributes 3.7 percent of the final energy consumed in Europe excluding the Russian Federation and 2.5 percent of the total final energy consumption in the region of Forest Europe, but much more in some countries (6.9).
- Wood fibres from forest, other wooded land and trees outside forests remain the most important source for wood energy, followed by residues from wood processing industries, post-consumer recovered wood and processed wood based fuels (6.9).
- The value of marketed woodfuel roundwood (from the forest) in 2010 was nearly EUR 120 million, about a quarter of the value of marketed industrial roundwood (3.2). This does not include the value of other woodfuels, marketed or not.
- Fellings, which include fellings of wood for energy, alongside other assortments, are still well below increment, at the current rate of wood energy supply, in all countries except one (3.1).
- Although the amount of deadwood (considered favourable to biodiversity) varies widely between forest types, data suggest that the amount of deadwood per hectare has slightly increased in most regions over the past 20 years (4.5). Increased use of forest residues and more intensive harvesting for energy could reverse this trend, possibly with negative consequences for biodiversity.
- For the millions of small private forest owners (6.1), local energy markets represent one of the few outlets available for the wood they grow.
- At the policy level (B.4) two-thirds of reporting countries, and the EU, have targets to increase the use of wood for energy. In addition to the forest law, several countries refer to bio-energy, related regulations with regard to the production and use of wood. Furthermore, demand-side measures are mentioned, including renewable energy targets, as means for promoting use of wood.

An important question, to which SoEF 2011 does not provide an answer, is how much wood could realistically be supplied, on a sustainable basis, for energy in Europe. Would this be enough to meet the renewable energy targets and what would be the consequences of higher wood energy supply for the sector as whole? These questions have been addressed in the EUwood project (Mantau, 2010), of which UNECE/FAO was a partner. In summary, it will probably be possible to meet the wood part of the renewable energy targets in 2020 without harming the wood supply of the traditional industries, if a number of conditions are fulfilled: energy efficiency targets must be met, other renewable energies must grow faster than wood, and there must be an exceptional mobilisation strategy, with long-term commitment and investment, a comprehensive approach, numerous specific policy measures and favourable framework conditions (Prins, 2010). For 2030, even with the high mobilisation described above, it would be difficult to meet the energy targets without affecting wood supply to the industries or importing large volumes from outside Europe. Such high mobilisation would be quite different from today's forest management, especially in areas where at present forest management is not very intensive. High mobilisation of wood to meet ambitious energy targets would certainly have multiple consequences, on rural income, on silviculture and on biodiversity.

Conservation of forest biodiversity

The challenge for conservation of forest biodiversity

The Convention on Biological Diversity's objective is to achieve a significant reduction in the rate of biodiversity loss, while the EU's target is to halt biodiversity loss in the EU by 2020. Forest Europe ministers made commitments in the field of biodiversity in 1993 and 2003. Many countries have similar objectives. These targets are usually translated into strategies and plans, which naturally include forest biodiversity alongside other biodiversity. Over the past decades in Europe, large areas of forest have been protected for the conservation of biodiversity; regulations and guidelines have influenced forestry practice to make it more friendly to biodiversity. However, biodiversity is very difficult to measure directly, so it is not clear, despite intense efforts to monitor trends, whether the measures taken have achieved their objectives and whether they are sufficient to halt the loss of Europe's forest biodiversity. The challenge is not only to conserve biodiversity but to do it in an efficient and flexible way, using sophisticated policy instruments, including payment for ecosystem services, informational means, certification, etc., in addition to regulation and the creation of protected areas.

Status and trends for forest biodiversity

From the quantitative and qualitative indicator data collected for this study, it is possible to say the following (indicator reference in brackets):

- Over the last 10 years, the area of Europe's forests designated for biodiversity and landscape protection (4.9) has increased by half a million ha annually. About 10 percent of European forests is

[28] In addition to sawlogs and pulpwood.
[29] Wood arising from operations like urban forestry, road maintenance, orchard tending, etc.

protected with the main objective of conserving biodiversity and about 9 percent with the main objective of protecting landscape, which accounts for an area of 39 million ha. The strictness of protection for biodiversity varies considerably within Europe.

- About 87 percent of the European forests, excluding the Russian Federation, is classified as semi-natural (4.3). In the Russian Federation, 32 percent of the forest is "undisturbed by man".
- Nearly 70 percent of the total forest area in Europe, excluding the Russian Federation, is regenerated naturally or through natural expansion (4.2). Natural regeneration is expanding in Central European regions, while in other European regions planting and afforestation are the most used annual regeneration types.
- The area dominated by introduced tree species (4.4) increased slightly in absolute numbers from 2005 to 2010 in Europe (excluding the Russian Federation, which has a negligible area of introduced tree species) and covers around 9 million ha or 4 percent of the forest area. No noticeable changes have been observed over the last 10 years. A small proportion of the total forest area, one million ha, is occupied by tree species considered invasive, notably Robinia pseudoacacia in central Europe.
- About 70 percent of the forests in Europe is dominated by two or more tree species, and the remaining 30 percent is dominated by one tree species alone, mainly coniferous (4.1). The area of forest that consists of a single tree species has decreased annually during the last 15-year period by around 0.6 percent. In some areas such as the boreal forest, single species stands are often the natural norm, while elsewhere they indicate more intensive, production-oriented silviculture.
- Data suggest that the amount of deadwood (4.5), particularly standing deadwood, has been slightly increasing in most of Europe's regions over the past 20 years. However, the amount of deadwood per hectare varies considerably. The SoEF results indicate that the change in forest practices towards more nature-oriented management can be observed in forest characteristics.
- In 2010, a total of 446 000 ha and 7 700 ha of forests were managed for in situ and ex situ gene conservation, respectively, and 860 000 ha for seed production in Europe excluding the Russian Federation (4.6). The areas managed for ex situ conservation and seed production increased during the period 1990- 2010.
- Trends in forest connectivity in the landscape context (4.7) have been assessed and are reported by country for the first time. It is possible to identify regions with large forest connectivity loss caused by fire and transport infrastructure construction. Results indicate that expansion of forest area after natural succession or restoration in a given region does not necessarily increase the connectivity.
- More information than before was supplied on threatened forest species, but the information is not yet comparable and it is not yet possible to identify trends (4.8).
- It is important to monitor trends for the biodiversity of specific forest types as these trends can be masked by overall average developments over all forest types. Between 7 and 10 countries are able to report on a pilot basis on three biodiversity indicators by forest type.
- Trends in health and vitality of forests (Criterion 2) may influence forest biodiversity, when they move beyond the range of naturally occurring damage, for instance because of climate change or pollution.
- Marketed forest services (3.4) include biodiversity-related services, marketed either to governments or to environmental organisations. However, little is known about this aspect as yet.
- Most European forests are under a management plan or an equivalent (3.5), which typically includes management of the biodiversity of the forest in question.
- The large number of small private holdings in Europe (6.1) makes it difficult to manage forests for conservation of biodiversity, through lack of resources and knowledge and because the scale of management is too small to correspond to biodiversity needs. However, lightly managed or unmanaged forests, which are common on small holdings, are often positive for biodiversity.
- Although data on forest visits (6.10) are weak, it is clear that recreation of all types is the major function for many forests near urban areas or where tourism is important. High intensity of recreation use can threaten biodiversity (e.g. through trampling vegetation and disturbing wildlife) but also can encourage managers to maintain "attractive" forests, with characteristics which are often biodiversity-friendly (varied species, old stands, openings etc.). It is often possible to provide recreation and biodiversity functions simultaneously.
- With regard to policy on biodiversity (B.6), measures are being taken to encourage deadwood accumulation. Although several countries have quantified targets regarding forest protected areas, in most cases, the level of protection remained unclear. Several countries highlight integrated management, or the concept of SFM, as the overall approach to better contribute to forest biodiversity conservation and management. Countries with important forest sectors highlighted programmes to promote the conservation and use of forest genetic resources. While the institutional framework remains stable, the legal frameworks towards biodiversity have been subject to amendments in several countries and financial instruments seem to be of higher importance than before. In particular private forest owners ask for adequate incentives or compensation schemes to conserve biodiversity.

Sustainable forest management in a green economy

Challenges for the forest sector in a green economy

According to UNEP (UNEP, 2011), a green economy is one that "*results in 'improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities'. In its simplest expression, a green economy is low carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollutio n, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services.*" (UNEP, 2011) A green economy is considered one of several ways to achieve sustainable development, not the only way.

Many would consider that the European forest sector at present displays many of the characteristics of a green economy. The results of SoEF 2011 which are summarised below seem to confirm that the sector is indeed low carbon, resource efficient and, at least in part, socially inclusive. However, the European forest sector functions in an economy which is not "green"; economic incentives and mechanisms inside the sector, of necessity, follow the general rules, with many ecosystem services provided without explicit compensation and many distortions of price relationships. Agriculture, fossil fuels, and many non-renewable materials cause significant environmental, even social, damage, which are not reflected in their final cost, as they are borne by society as a whole. It is likely – although this still needs to be demonstrated – that the full life-cycle cost of sustainably produced wood products is less than that of competing materials and fuels.

The challenge for the European forest sector is to develop further those aspects which are part of the green economy, such as green jobs, sustainable consumption patterns, recycling and recovery, increased supply of renewable energy and ecosystem services. This will involve innovation as regards products, processes and services as well as business models, and much improved communication. In addition, it should promote these practices throughout the economy and society, both to share its experience and to work towards a more level playing field between the forest sector and its competitors for land capital and human resources.

Status and trends relevant to the forest sector in a green economy

From the available data for quantitative and qualitative indicators, it is possible to say in which ways the European forest sector has the characteristics of a green economy: carbon neutral, resource efficient and socially inclusive (references to indicators in brackets).

The European forest sector has the following characteristics which may be considered *carbon neutral* or tending in that direction:

- The carbon stock in forests has been increasing steadily (1.4).
- Fellings are below increment, so the European forest remains a carbon sink as growing stock increases (3.1, 1.2).
- Europe consumes large volumes of forest products (6.7). As these are mostly from renewable sources, if they were replaced by other materials, the emissions of greenhouse gases over the whole life-cycle would probably be much higher.
- As Europe is a net exporter of forest products (6.8), it does not export its carbon footprint for forest products to other regions.
- It produces and consumes large amounts of wood-based energy (6.9) which substitute for fossil fuels.
- At the policy level (B.2), considerable emphasis is put on mitigation of climate change, notably through carbon sequestration by forests and wood products, and on the adaptation of forests to climate change impacts. The vital role of forests in reducing greenhouse gas emissions and in mitigating and adapting to climate change is not only put forward in national climate and energy policies, but partly also in National Forest Programmes and forest laws. SFM is often reported as a key concept contributing to climate change mitigation.

The European forest sector has the following characteristics which may be considered *resource efficient*, in that all the wood is used, and there is practically no waste during processing or after consumption (most of the analysis is taken from the EUwood project):

- Most of the residues of the forest industries are used as raw material or source of energy (Saal, 2010; Steierer, 2010).
- Forest products (both paper and solid wood products) are recovered for use as raw material or energy (Leek, 2010). There is scope for expanding the collection of recovered wood products, which would otherwise enter the solid waste stream. Recovered paper is nearing the technical limits of recovery, although some improvement is considered possible.
- Large parts of the forest industries are energy self-sufficient or net energy suppliers through use of their own residues (black liquor, bark etc.) as sources of energy. Increasingly pulp mills work on a closed circuit principle, releasing minimum amounts of solid and liquid waste into the environment.
- Modern wood burning plants are very efficient, with high combustion efficiency and low release of pollutants. Older, smaller plants, however, are often less efficient and may release micro-particles which are harmful to health.

The European forest sector has the following characteristics which may be considered *socially inclusive*:

- There are many millions of private forest owners in Europe (6.1). About half the forests are publicly owned, sometimes by central government, but also by subnational and municipal governments. In this way, most of the European population is concerned, directly (as forest owners) or indirectly (as citizens),

with forest ownership and management and feel that the nation's forests are, in a real sense "their" forests.
- Nearly four million people work in the forest sector, although this number has been declining steadily (6.5).
- The forest sector contributes to the national income (about 1 percent on average, but much more in some countries) (6.2).
- Almost all forests are accessible for recreation (unlike most agricultural or urban areas) and some forests are intensive providers of recreation (6.10).
- Forest sites with cultural and spiritual values are increasingly being identified, listed and protected (6.11).
- At the policy level (B.9), employment in the forest and forest-based sector is an important indicator for the social benefits generated by forests, especially for sustainable rural development.
- At the policy level (B.10), raising the awareness of society about the multi-functional role of forests, particularly drawing attention to protection and socio-economic functions, and the contribution of forests to the quality of life in general is a widely declared target. Compared to 2007, more countries highlight public and multi stakeholder participation as a crucial tool in forest policy, management and decision making processes. In addition, a few countries specified the objective of ensuring and/or improving transparency as a principle of good forest governance.
- At the policy level (B.11), a common goal among Forest Europe signatories is to maintain and preserve the international and national heritage of cultural and historical sites and monuments. The integration of cultural and spiritual forest values into different land-uses such as forestry, recreation and tourism activities, as well as the enhancement of its contribution to rural development, is highlighted as a main policy objective by several countries.

A few examples are reported of mechanisms in the forest sector which may be considered to be characteristic of the green economy:

- Some forest ecosystem services are already marketed. The reported value of marketed forest services was nearly EUR 900 million: this includes biospheric services (e.g. for gene conservation or nature protection on a voluntary contractual basis or carbon sequestration-related afforestation projects). Even though data on marketed services are very limited, they represent at present a non-negligible income for forest owners and could probably be increased (3.4).
- Many European governments compensate forest owners for supplying ecosystem services, although often the link between the service provided and the payment (often a per hectare subsidy) is tenuous. 19 countries reported on government expenditure for forest services (6.4), which includes payment for biospheric or ecological services. However, the data are not very comparable and have not been fully analysed yet.

Conclusions and recommendations

The following conclusions and recommendations summarises policy challenges and opportunities on four thematic elements elaborated in more detail above.

Climate change

The forest sector has several potential roles for the mitigation of climate change, including carbon storage and sequestration, substitution of non-renewable materials and energy. The forest is also vulnerable to climate change and needs to adapt to a future changed climate. However, there are trade-offs among these climate change-related functions, and with the many other functions of the forest.

The main challenge is to map out, discuss, negotiate and then implement an agreed balance among the various forest functions in the context of a changing climate and thereby enable the forest sector to make the largest possible contribution to combating climate change, while maintaining the best possible combination of the other forest functions. This is made more challenging by the weakness of the knowledge base about forests and climate change, and low awareness of the main issues, so rational policy making is difficult. Topics on which research is urgently needed include development of strategies for climate change adaptation and proactive risk management, wood mobilisation, and the consequences of more intensive forest use for non-wood functions, life cycle analysis of all parts of the system (to compare wood to non-wood products, and to optimise the cascade approach to the sound use of wood).

However, the main challenge is institutional: to incorporate SFM issues into the climate change negotiations (which are already very complex) and to avoid legally-binding solutions which unduly favour one forest function (carbon sequestration) over all the others. Finding non-distorting price formation mechanisms for carbon, energy and forest ecosystem services should be an integral part of a rational and market-based solution. After these complex policy development challenges, it will be necessary to find effective and equitable ways of implementing the decisions.

Wood and energy

The report shows that wood energy plays a major role in the sector and in national energy supply, but that this role is expected to grow significantly in order to expand the share of renewable energies. The results from the EUwood project show that it will probably be possible to meet the wood part of the renewable energy targets in 2020 without harming the wood supply of the traditional industries, but only if a number of conditions are fulfilled, notably an exceptional mobilisation strategy. Such high mobilisation would be quite different from today's forest management, especially in areas where, at present, forest management is not very intensive. High mobilisation of wood to meet ambitious energy targets would certainly have multiple consequences, notably on rural income, on silviculture and on biodiversity.

If wood energy is to play a strong role in climate change mitigation and energy security, indeed in a broader sustainable development perspective, the supply of wood for energy must be brought to the centre of forest sector policy. This would enable a significantly higher mobilisation of wood supply than at present, from the forest (higher removals, more use of harvesting residues, possibly expansion of forest area and establishment of short rotation plantations), but also from industry residues, landscape care wood and recovered wood products. A higher energy price would facilitate this structural shift, but is not enough in itself. A series of policy measures and actions by all stakeholders have been identified (FOREST EUROPE Liaison Unit Oslo, DG Agriculture and Rural Development, UNECE/FAO, 2010; Prins, 2010) and would have to be implemented. Keyelements would be changing the behaviour of small forest owners, by modifying the institutional framework and by financial incentives, as well as significantly increasing the use of harvest residues, even, in some areas, stumps.

However, the single-minded pursuit of wood mobilisation for energy is not sufficient, and probably not truly sustainable, by itself. A major policy challenge, as with climate change, is to reconcile the objective of increased wood energy supply with the other dimensions of SFM. The positive effects of increased wood mobilisation on the carbon cycle, energy security and forest owners' income would have to be weighed against possible negative consequences for forest biodiversity and the wood supply for traditional forest industries, as well as the considerable economic and political cost of implementing the wood mobilisation measures. There are many specific and/or local win-win solutions, which must be identified and implemented. Nevertheless, some trade-offs are inevitable, especially if a high level of mobilisation is to be achieved. The challenge is to resolve these trade-offs while maintaining public support and thus help the forest sector to make a full contribution to sustainable development as a whole. This may require better ways of policy coordination, minimising conflict and competition between, for instance, energy policy and forest policy, or climate change policy and biodiversity policy.

Conservation of biodiversity

There is general agreement that biodiversity conservation is at the heart of SFM, and that it must be encouraged, within and outside protected forest areas. However there are problems with monitoring trends for biodiversity (as opposed to recording measures intended to promote biodiversity), and it is hard to say whether the objective of halting biodiversity loss is truly being achieved. It is also accepted that forest and biodiversity policy should be integrated. In this respect there has been progress: for instance, most national forest programmes refer to national biodiversity action plans. Nevertheless, the efficiency of these programmes is hard to measure, and while forest owners seek incentives to conserve biodiversity, public budgets are under intense pressure.

Setting aside temporarily the challenges of measuring progress in biodiversity conservation and of developing appropriate policy instruments, there remain major questions about long-term strategic objectives in the field of forest biodiversity:

- When biodiversity loss has been halted, should the status quo be maintained indefinitely, or should measures be taken to reverse the trend, for instance by increasing protected areas, creating transcontinental wild life corridors, reintroducing major predators, etc.? If so, there would be consequences for other parts of the forest sector.
- If the future is marked by more intensive silviculture, higher wood prices and higher harvests, notably for energy use, as foreseen in the previous section, would this halt, or even reverse, the improvement in the situation for biodiversity?

Both these questions require policy decisions which involve many actors outside the forest sector, and must weigh the importance of different policy objectives. They also require much better information than available at present on the long-term consequences of such policy decisions, as well as new policy instruments. There are many different approaches to explore further, including flexible incentives for biodiversity conservation, such as payment for ecosystem services, which deliver "more biodiversity for less public funds".

The European forest sector in a green economy

The European forest sector already displays many of the characteristics of a green economy. This study has shown that it is to a large extent low-carbon and resource efficient and, at least in part, socially inclusive. However, it must function in an economy which is not "green". For instance the negative externalities of sectors with which the forest sector must compete for land, capital and human resources, including agriculture and the supply of fossil fuels and non-renewable materials, are large and probably less included in their final cost than is the case for forest products and services.

The results mentioned above would seem to indicate that the European forest sector has the potential to play a major, even exemplary, role in the green economy, as it is fundamentally low carbon and resource efficient. To achieve this potential, its "green" features would need to be further developed by, for instance, promoting sustainable production and consumption patterns, green building, green jobs in the sector, and the supply of renewable energy. Payment for ecosystem services also should be developed, beyond the simple possibly inefficient systems in place at present. An Action Plan for the forest sector in the green economy is at present being developed by the UNECE Timber Committee and the FAO European Forestry Commission.

Finally the system of criteria and indicators for SFM, with regular monitoring, on which this report is based, is a good example of the type of monitoring system which will be necessary if a green economy is to be created. The experience from the forest sector in this respect should be shared with other sectors.

Annexed Tables for Part III

Table 85: Key parameters and thresholds for assessment of quantitative indicators

Ind.	Key parameter	Unit	Thresholds				
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1.1	Annual change in forest cover 1990-2010	% points	<-0.2	-0.2-0.0	0.0-0.1	0.1-0.2	>0.2
	Measure of change has been preferred to a measure of present status in order to avoid comparing very different histories and situations. Implicitly assumes that increase in forest area is positive.						
1.2	Annual change in growing stock/ha, 1990-2010	m³	<-1.0	-1.0 - 0	0-1.0 (or only one data point)	1.0-3.0	>3.0
	Growing stock per hectare may increase if cuttings are consistently below net increment. It may decrease if there is overcutting, but also (as is the case in several countries) when there is rapid expansion of forest onto non-forest land, which, when planted, has very low growing stock per hectare, bringing down the average.						
1.3	Percent of even-aged forest in age class 0-40 years	%	n.a.	<20 (gaps)	Balance	n.a.	n.a.
	An unbalanced age class structure (e.g. because of past overcutting or irregular planting activity) can perturb future wood supply. In practice, the age class structure reflects past silvicultural decisions and is a weak indicator of sustainability.						
1.4	Annual change in total living carbon stock on FOWL, 1990-2010	% p.a.	< -1.0	-1.0 – 0.0	0.0 – 1.0	1.0 – 2.0	> 2.0
	Build up of carbon in the forest ecosystem is a proof of success in carbon sequestration (and, as regards carbon in living trees, will be determined by trends for growing stock). Carbon in soil, deadwood and litter is ignored (despite the significance of these carbon stocks) as practically no data are available on change.						
2.1	Percentage of natural ecosystem area at risk of eutrophication for an emission scenario based on current legislation	%	>80	50-80	20-50	1-50	0
	Source: work under the ECE Convention on Transboundary Air Pollution (ICP Modelling and mapping). Derived from model data and based on principle of critical loads[1]. Applies to all land, not only forest land. Based on a grid of 25*25 km squares: if 5 percent of a square is over the critical limit for nitrogen deposition, which takes into account soil type as well as deposition, that square is considered "at risk". Cross checked against results of ICP Forest (as reported under indicator 2.1), which could not, however, be used at the country level because of small number of sample plots in many countries. The two methods are approximately in agreement.						
2.2	C/N index, median value for the country	Index	<1.0	1.0-1.2	1.2-1.3	1.3-1.5	>1.5
	From the Biosoil project. This index is the proportion of the ratio of carbon to nitrogen in the forest floor (C/N_{FF}) to the ratio of carbon to nitrogen in the mineral soil (C/N_{MIN}). It is a valuable indicator of the imbalance induced by excessive nitrogen input. If the index is below 1, the organic matter and nutrient cycling is probably disturbed, and forest health may be at risk. As this is a median value, it should be borne in mind that for each country, half the observations will be below the value shown, and half above, so that if the median value is near 1, it is likely that nearly half the individual observations are below 1, which is the warning level.						
2.3	Percent of sample trees in defoliation classes 2+3+4	%	>80	50-80	20-49	10-19	<9
	Result of annual crown condition survey under ICP Forests (in 2009, 7 193 plots in 30 countries), using standardised methodology. In some smaller countries the results may not be statistically representative of the national situation because of the insufficient number of sample plots.						
2.4	Percent of forest area damaged by biotic, abiotic and human-induced causes/ percent damaged by fire	%	>12/ >2	4-12/ 0.5-2.0	1-4/ 0.3-0.5	0.1-1/ <0.3	<0.1
	For most countries the total was taken of biotic (insects, pests, diseases), human-induced (harvesting) and abiotic (storm, wind and snow) damage, with non-reported damage and years ignored. Examination of the results shows that there are still some comparability problems. For countries in southern Europe, the percentage of damaged forest (biotic, abiotic, and human) was replaced by the percentage of forest damaged by fire (average of years reported).						
3.1	Ratio fellings/NAI, 2005	%	>100	95-100	n.a.	<95	n.a.
	Felling more than increment over a long period is clearly unsustainable although it may be necessary on a temporary basis either because of damage or to rejuvenate the resource. Every value of the ratio under 95 percent[2] is considered equally acceptable, as it is not appropriate to prefer one rate of resource use to another.						
3.2	Ratio value of marketed roundwood/ growing stock, 2005	EUR/ 1 000 m³	<255	255-390	390-870	870-930	>930
	Measures the intensity of use of the wood resource, in economic terms (preferred to EUR/ha as it takes account of stocking levels).						
3.3	Value per hectare of marketed non-wood goods	EUR/ ha of FOWL	n.a.	<5	5-30	30-65	>65
	Measures the intensity of use of the forest to supply non-wood goods. The data supplied are clearly not fully comparable among countries but are the best available.						

[1] Source: (Hettelingh, Jean-Paul 2008)
[2] 95 percent is chosen to take account of harvesting losses, etc. and as a measure of prudence.

Ind.	Key parameter	Unit	Thresholds				
3.4	Value of marketed services per hectare	EUR/ ha of FOWL	n.a.	n.a.	<6	>6	n.a.
	Measures the intensity of use of the forest to supply services. The data supplied are clearly not fully comparable among countries but are the best available. As many countries did not respond, there are only two classes.						
3.5	Percentage of FOWL under management plan or equivalent	%	0-20	21-40	41-60	61-80	81-100
	Objective and explicit long-term planning is clearly a part of sustainable forest management. However, the data are not fully comparable without reference to the footnotes as countries vary in the way they have interpreted the instructions on treatment of informal plans for small forest owners.						
4.1	Share of single species stands in FOWL, 2005	%, adjusted for trend[3]	>70	40-70	20-40	15-20	<15
	A proxy for loss of biodiversity, as often single species stands have less biodiversity. In many parts of Europe, single species stands are less natural and have poorer biodiversity. However, this is not the case in other areas, notably the boreal regions where natural forests are often monospecific.						
4.2	Share of natural regeneration in total regeneration, 2005	%, adjusted for trend[4]	<15	15-50	51-80	81-95	>95
	Measures the extent to which naturally occurring genetic diversity is preserved over rotations. Higher rates of natural regeneration are considered more favourable to the protection of genetic diversity.						
4.3	Share of plantations in FOWL	%	>75	21-75	6-20	1-5	<1
	Approximates lack of "naturalness" (there are too few "undisturbed" areas in Europe to construct a credible direct indicator of naturalness). A higher share of plantations indicates a "less natural" forest resource overall. Their benefits for wood production will be covered in other indicators, not in the biodiversity criterion.						
4.4	Share of introduced species in FOWL	%	>45	21-45	1.5-20	0.2-1.5	<0.2
	An indicator of change in species diversity and a frequent biodiversity indicator. The higher the percentage of introduced species, the greater disturbance to native biodiversity (even if the introduced species make a significant contribution to wood production).						
4.5	Volume of deadwood per hectare of FOWL	m^3/ha	n.a.	n.a.	<7	7-15	>15
	An indicator of conditions and silvicultural practice favouring biodiversity. Insufficient knowledge is available to estimate what are "desirable" deadwood levels in different circumstances, or to measure change, so it has been assumed that more deadwood is correlated with higher biodiversity.						
4.6	Share of forest land managed for conservation of genetic resources	%	n.a.	0-0.08	0.08-0.25	0.25-1.35	>1.35
	Includes area managed for *in situ* and *ex situ* gene conservation (but not for seed production), as a share of total forest. Does not address the question of whether this is "enough" or whether the genetic diversity of particular species is adequately protected, but seems an adequate proxy for now.						
4.7	Landscape pattern index	Index 1-5	<1.49	1.5-2.49	2.5-3.49	3.5-4.49	>4.49
	See report on indicator 4.7 for background and methods. The index combines scales for state and trend for two parameters, both expressed as country average, and rated by frequency distribution[5]: 1. Normalised connectivity per landscape unit. 2. Average proportion of forest classified as "core natural", expressed as the maximum difference in the proportion.						
4.8	Availability of data on threatened forest species	Scale 1 to 4	n.a.	Insufficient data	Data for most of the categories	Full or near full data for one year	Evidence of improved situation
	Data are available for many countries on threatened species, but often not on total forest-related species. Furthermore it is hard to interpret the raw data: a high number of threatened species might mean a danger to biodiversity, but could also reflect diligent data gathering or a country with many species at the edge of their ranges. For that reason the parameter chosen for SoEF 2011 addresses only the availability of information.						
4.9	Area protected as percent of FOWL	%	n.a.	<15	15-20	>20	n.a.
	The definitions of "protected" forest have been harmonised by MCPFE. The threshold chosen for 🌲🌲🌲 is around the agreed CBD target of 17 percent protected area (all ecosystems, not just forests). It is acknowledged that this is a simplification of the desirable percentage of protected forest which must be based on assessment of specific ecosystems.						
5.1	Protective function index: soil and water	Scale 2-4	n.a.	no data on area	data on area with protective functions	data on area designated	n.a.
	There is ambiguity in the responses about whether the data supplied refer to forests which have a protective function, sometimes measured by national forest inventory, or those which have a designated status (as intended by the enquiry). Many countries could not supply any information at all. Therefore an index was created, combining availability of information and status of designation.						
5.2	Protective function index: infrastructure etc.	Scale 2-4	n.a.	no data on area	data on area with protective functions	data on area designated	n.a.
	See 5.1. Often countries were unable to separate protective functions (soil and water) from protective functions (infrastructure). In this case, 5.2 was scored at 🌲🌲.						

[3] One class extra if clear downward trend, one class less if clear upward trend, over the whole period.
[4] One class extra if clear upward trend, one class less if clear downward trend, over the whole period.
[5] Rating as follows: Lowest ten percentiles, next 20 percentiles, middle 40 percentiles, next 20 percentiles, top 10 percentiles.

Ind.	Key parameter	Unit	Thresholds				
6.1	Availability of information on ownership and private holdings	Scale 3-4	n.a.	n.a.	Data on ownership only	Data on ownership and hold-ings	n.a.
	Ownership and holding structures are clearly central to forest policy. The official rationale for indicator 6.1 refers to the important contribution of private forest holders to the rural economy. The number of private forest holdings could be taken as a proxy[6] for the number of forest owners and compared to the total rural population, but this ignores the problem of fragmentation (many small holdings hamper management and increase costs) and the importance of public forests. For the time being, the key parameter only measures availability of information, although ownership/holding structure is mentioned in the comments The pattern of ownership and holdings is mentioned in the comments.						
6.2	Share of GDP taken by forest sector, 2010	%	n.a.	<0.7	0.7-1.5	1.5-3.0	>3.0
	Measures the relative importance of the forest sector in the national economy. Includes the forest industries (sawmills, panel, pulp and paper plants) as well as forest management.						
6.3	Net entrepreneurial revenue per hectare, average of years reported	EUR/ha	negative	0-35	35-80	80-175	>175
	Measures the contribution of forest ownership to revenue of forest owners.						
6.4	Government expenditure for forest services per ha of forest, average of years supplied	EUR/ha	n.a.	<10	10-20	>20	n.a.
	Indicator intended to measure income from non-marketed services, but in practice few, if any, respondents were able to supply this. However, information was provided on government subsidy schemes and incentive programmes, even if not directly connected to specific services, which provides useful indications of the extent to which government contributes to the forest sector. However, the approach varies, even among the countries which reported, so data comparability is very weak.						
6.5	Forest sector labour force as percent of population	%	<0.2	0.2-0.4	0.4-0.9	0.9-1.3	>1.3
	Measures the relative importance of the forest sector as a provider of jobs.						
6.6	Non-fatal accidents per 1000 workers, 2010	No.	n.a.	n.a.	>35	5-35	<5
	Measures the safety and health of the forest workforce. Non-fatal accidents were used as they are more numerous than fatal accidents and thereby less subject to arbitrary variation. This rate is influenced not only by working practices but also by natural conditions (slopes, windblow). There seem to be variations in the data set which are difficult to explain.						
6.7	Consumption of wood products (roundwood equivalent), per head, 2007-2009,	m3	<0.45	0.45-0.8	0.8-1.6	1.6-2.9	>2.9
	As wood is a renewable raw material, and sound use of wood is an objective of many policies, this parameter measures (indirectly) sustainable consumption patterns, to the extent that forest products are consumed instead of non-renewable, less sustainable materials.						
6.8	Net imports as percent of apparent consumption, 2007-9	%	>65	20-65	-20 to +20	-20 to -70	< -70
	Measures the degree to which countries are dependent on external sources of forest products or, conversely, contribute to the sustainable consumption of other countries.						
6.9	Share of energy from wood in national energy production	%	n.a.	<5	5-20	20-50	>50
	Measures the extent to which wood contributes to national energy supply. Includes all types of wood energy, not only "fuelwood" from forests.						
6.10	Annual visits per hectare of FOWL	No.	n.a.	<50	50-150	151-500	>500
	Should measure the intensity of recreation use, as in all countries, nearly all forests are "accessible for recreation". Unfortunately, relatively few countries have data on number of visits or even on areas where recreation is a major management objective.						
6.11	Index of data availability on number of cultural and spiritual sites	Scale 3-4	n.a.	n.a.	Partial data	Complete data	n.a.
	There is no possible comparability among the number of cultural and spiritual sites (archaeological remains, exceptional trees, historic sites, etc.), so the availability of data on the different categories is used as a (weak) proxy for effective national recognition and management of these sites.						

[6] Because of owners with multiple holdings and holdings with multiple owners, the correlation is not direct, and the number of private holdings is not the same as the number of private owners.

Table 86: Key aspects for assessment of qualitative indicators

Ind.	Title	Aspects assessed on the basis of national reports
A.1	National forest programmes or similar	Is there an NFP or similar? What is the level of the decision making body (ministry alone or with others, e.g. parliament, or other level)? Was the process participatory? Were other sectors consulted (formally or informally)? Is there reference to national development strategy and international commitments? Is monitoring periodic and pre-specified? Is there a recent policy document?
A.2	Institutional frameworks	Was full information supplied on: Institutional arrangements? Level of responsibility for policy decisions? Administrative staffing for forest sector?
A.3	Legal/regulatory frameworks and international commitments	Is the formal authority on main forest matters in parliament, in the constitution or at the administrative level? Is the latest amendment or enactment recent (after 2003)? Is there international reporting on forest matters (CBD, UNCCD, UNFF, UNFCCC)?
A.4	Financial instruments/ economic policy	Public expenditure per hectare on: Transfer payments Forest administration Management of public forests Research, education and training.
A.5	Informational means	Are the instruments of a forest-related informational strategy described? Is there a formal communication and outreach strategy?
B.1 to B.12	Policies, institutions and instruments by policy area	For each indicator: Are the objectives clearly described? Is there an institutional framework in place to achieve these objectives? Are there legal/regulatory instruments in place to achieve these objectives?

Data for Key Parameters by Country and Indicator

Table 87: Criterion 1. Forest Resources and Global Carbon Stock

Country	1.1 Annual change in forest cover 1990-2010 (percentage points)	1.2 Annual change in growing stock/ha, 1990-2010 (m³)	1.3 Percent of even aged forest in 0-40 age class	1.4 Annual change in total living carbon stock on forest, 1990-2010 (%)
Russian Federation	-0.01	0.09	24.5	0.00
North Europe				
Denmark	0.06	2.37	51.7	3.76
Estonia	0.00i	-0.24	41.1	0.90
Finland	0.05	0.57	34.8	0.77
Iceland	0.01	-0.54	93.7	6.92
Latvia	0.13	1.91	42.2	2.02
Lithuania	0.18	-0.54	31.9	0.80
Norway	0.06	1.60	44.9	2.13
Sweden	-0.01	1.51	44.0	0.33
Central-West Europe				
Austria	0.06	1.97	40.9	0.80
Belgium	0.01	2.81	44.4	1.39
France	0.09	1.06	22.8	1.26
Germany	0.05	2.50	27.7	2.16
Ireland	0.20	-1.58	94.6	2.15
Liechtenstein	0.13	-0.86	ND	0.31
Luxembourg	-0.01	3.08	43.1	1.37
Netherlands	0.03	2.02	39.1	1.76
Switzerland	0.13	0.24	27.6	0.67
United Kingdom	0.06	1.49	43.9	0.67
Central-East Europe				
Belarus	0.21	2.72	34.5	2.92
Czech Republic	0.02	3.91	31.3	1.19
Georgia	-0.03	0.95	ND	0.54
Hungary	0.13	-2.72	58.3	1.16
Poland	0.06	5.53	32.4	2.76
Republic of Moldova	0.16	0.41	ND	1.49
Romania	0.01	0.00	35.2	0.15
Slovakia	0.02	3.21	30.2	1.49
Ukraine	0.04	3.29	31.0	2.63
South-West Europe				
Andorra	0.00	ND	ND	ND
Holy See	0.00	ND	ND	ND
Italy	0.30	1.54	48.7	2.43
Malta	0.00	0.00	ND	0.00
Monaco	0.00	ND	ND	ND
Portugal	0.15	-0.59	79.2	0.12ii
Spain	0.19	0.48	ND	2.29

Country	1.1 Annual change in forest cover 1990-2010 (percentage points)	1.2 Annual change in growing stock/ha, 1990-2010 (m^3)	1.3 Percent of even aged forest in 0-40 age class	1.4 Annual change in total living carbon stock on forest, 1990-2010 (%)
South-East Europe				
Albania	-0.02	-0.18	ND	-0.04
Bosnia and Herzegovina	0.30	2.12	ND	1.15
Bulgaria	0.24	2.54	36.5	2.98
Croatia	0.31	2.31	36.7	1.67
Cyprus	0.17	0.41	ND	0.96
Greece	0.01	0.01	ND	0.90
Montenegro	0.00[i]	0.00	ND	ND
Serbia	0.16[i]	2.57	ND	4.83
Slovenia	0.11	5.09	ND	2.69
The former Yugoslav Republic of Macedonia	0.17	0.00	ND	0.02
Turkey	0.07	0.78	ND	0.99

(i) 2000-2010
(ii) 2005-2010 only

Table 88: Criterion 2. Health and Vitality

Country	2.1 Percentage of natural ecosystem area at risk of eutrophication for an emission scenario based on current legislation (CLE) (% area at risk)	2.2 C/N index, median value	2.3 Percent of sample trees in defoliation classes 2+3+4	2.4 Share of forest damaged (exc. Fire) (%)	2.4 Share of forest damaged by fire, selected countries, %
Russian Federation	24	ND	6.2i	0.51	0.13
North Europe					
Denmark	100	1.09	5.5	3.5	
Estonia	57	1.70	7.2	0.8	
Finland	41	1.31	9.1	0.08	
Iceland	ND	ND	ND	ND	
Latvia	99	1.02	13.8	0.2	
Lithuania	100	1.72	17.7	4.8	
Norway	14	ND	21	1.2	
Sweden	47	1.28	15.1	12.3	
Central-West Europe					
Austria	94	1.40	15.1[ii]	4.3	
Belgium	99	1.01	20.2	ND	
France	95	1.12	33.5	ND	0.11
Germany	67	1.12	26.5	2.7	
Ireland	81	1.18	12.5	0.04	
Liechtenstein	ND	ND	ND	ND	
Luxembourg	100	ND	ND	ND	
Netherlands	88	ND	17.9[ii]	ND	
Switzerland	96	ND	18.3	ND	
United Kingdom	19	1.26	22.2[ii]	0.4	
Central-East Europe					
Belarus	99	ND	8.4	2.6	
Czech Republic	100	1.14	56,8[iii]	3.3	
Georgia	ND	ND	ND	ND	
Hungary	100	1.42	18.4	12.5	
Poland	100	1.26	17.7	5.2	
Republic of Moldova	100	ND	25.2	ND	
Romania	20	ND	18.9	24.4	
Slovakia	100	1.49	32.1	1.5	
Ukraine	100	ND	6.8	0.13	
South-West Europe					
Andorra	ND	ND	6.8	ND	
Holy See	ND	ND	ND	ND	
Italy	61	1.62	35.8	22.4	0.42
Malta	ND	ND	ND	ND	
Monaco	ND	ND	ND	ND	
Portugal	83	1.61	17.1[ii]	24.5	3.0
Spain	93	1.70	17.7	ND	0.3

Country	2.1 Percentage of natural ecosystem area at risk of eutrophication for an emission scenario based on current legislation (CLE) (% area at risk)	2.2 C/N index, median value	2.3 Percent of sample trees in defoliation classes 2+3+4	2.4 Share of forest damaged (exc. Fire) (%)	2.4 Share of forest damaged by fire, selected countries, %
South-East Europe					
Albania	99	ND	ND	13.2	0.79
Bosnia and Herzegovina	81	ND	ND	0.0	
Bulgaria	91	ND	21.1	3.6	
Croatia	100	ND	26.3	3.4	
Cyprus	68	1.87	36.2	5.8	0.20
Greece	97	ND	24.3	ND	ND
Montenegro	95	ND	ND	ND	1.03
Serbia	95	ND	10.3	4.8	
Slovenia	92	1.31	35.5	0.2	
The former Yugoslav Republic of Macedonia	100	ND	ND	4.9	
Turkey	ND	ND	18.7	1.9	

(i) North-West Russia only
(ii) 2005
(iii) Some differences in the level of damage across national borders may at least partly be due to differences in standards used. This restriction does not influence the reliability of trends over time.

Table 89: Criterion 3. Productive Functions

Country	3.1 Ratio fellings/ NAI, 2005 (%)	3.2 Ratio value of marketed roundwood/growing stock, 2005 (€/1000m³)	3.3 Value per hectare of marketed non-wood goods (€/ ha of FOWL)	3.4 Value per hectare of marketed services (€/ha of FOWL)	3.5 Percentage of FOWL under management plan or equivalent (%)
Russian Federation	21.91	24	0.3	0.18	100
North Europe					
Denmark	44.57	695	299.0	ND	69.4[i]
Estonia	58.64	423	2.2[ii]	ND	69
Finland	71.84	915	4.3	ND	100
Iceland	ND	202	5.2	242.86	30.39
Latvia	71.81	ND	ND	ND	89
Lithuania	89.33	439	7.4	0.40	100
Norway	48.39	460	1.7	5.59	48
Sweden	93.34	909	ND	2.73	100
Central-West Europe					
Austria	93.54	840	24.6	28.41	100
Belgium	84.61	831	5.3	ND	74
France	57.84	639	8.1	3.37	60.6[vi]
Germany	61.75	706	66.3	5.52	68
Ireland	ND	1696	ND	ND	77
Liechtenstein	81.90[i]	ND	ND	ND	100
Luxembourg	ND	279	ND	42.21	60[vii]
Netherlands	69.32	473	37.9	ND	100
Switzerland	94.79	881	22.4	ND	71[vii]
United Kingdom	51.01	1008	31.5	13.36	57
Central-East Europe					
Belarus	61.86	ND	ND	ND	100
Czech Republic	80.61	993	50.2iii	ND	100
Georgia	42.30[i]	ND	ND	ND	87
Hungary	71.15	839	ND	ND	100
Poland	56.68	607	5.0	ND	91
Republic of Moldova	ND	ND	ND	ND	ND
Romania	60.27	ND	1.7	ND	94
Slovakia	70.81	765	6.9	118.93	100
Ukraine	30.94	ND	ND	ND	100
South-West Europe					
Andorra	ND	ND	ND	ND	ND
Holy See	ND	ND	ND	ND	ND
Italy	37.07	371	30.2	ND	89[vii]
Malta	ND	ND	ND	ND	100
Monaco	ND	ND	ND	ND	ND
Portugal	75.41	2025	98.2[iv]	ND	45[vii]
Spain	39.57	1006	23.9[v]	ND	12.1[viii]

Country	3.1 Ratio fellings/ NAI, 2005 (%)	3.2 Ratio value of marketed roundwood/growing stock, 2005 (€/1000m³)	3.3 Value per hectare of marketed non-wood goods (€/ ha of FOWL)	3.4 Value per hectare of marketed services (€/ha of FOWL)	3.5 Percentage of FOWL under management plan or equivalent (%)
South-East Europe					
Albania	550.32	ND	ND	ND	100[vii]
Bosnia and Herzegovina	75.10[i]	ND	ND	ND	ND
Bulgaria	40.85	451	0.8	ND	100
Croatia	51.01	885	0.7	7.71	100
Cyprus	26.00	151	0.6	0.34	40.82[ix]
Greece	48.31	ND	ND	ND	ND
Montenegro	39.67	ND	17.6	ND	47
Serbia	55.97	519	ND	ND	83
Slovenia	39.20	232	7.8	1.09	100
The former Yugoslav Republic of Macedonia	ND	402	10.3	ND	92
Turkey	ND	749	1.9	ND	100

(i) 2000
(ii) ncludes value of all game meat, not only of meat which is marketed.
(iii) Value of all non-wood goods, not only of those which are marketed (which are considered "minor"). This is therefore an overestimate.
(iv) Mostly cork
(v) Total value, not just what is marketed. However all cork and resin is marketed.
(vi) Forest only, not FOWL
(vii) 2005
(viii) Percentage with "management plan". No data on "equivalents" as these are managed by the autonomous regions.
(ix) About 60% for "forest", but much less for OWL

Table 90: Criterion 4. Biodiversity in Forest Ecosystems

	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.7	4.8	4.9
	Share of single species stands, 2005 (%)	Share of natural regeneration in total regeneration (%)	Share of plantations in FOWL (%)	Share of introduced species in FOWL (%)	Volume of deadwood on FOWL (m³/ha)	Share of forest land managed for conservation of genetic resources (in situ and ex situ only) (%)	Landscape pattern index (0-5)	Trend in country based average proportion of 'core natural' forest pattern 1990-2006	Availability of data on threatened forest species (scale 1-4)	Area protected (MCPFE classes 1,1, 1,2, 1,3 and 2) as % of FOWL
Russian Federation	60.00	98	1.9	0.00	21.2	0.003	ND	ND	3	1.9
North Europe										
Denmark	35.25	18	76.2	46.24	4.8	0.498	2.25	0.0058	1	15.7[vi]
Estonia	22.44	93	0.1	0.04	14.0	0.141	3.50	0.0024	3	22.2
Finland	41.47	72	0.1	0.15	5.5	0.034	4.00	0.0015	3	16.3
Iceland	87.37	10	28.4	19.85	ND	1.161	3.00	-0.0036	3	8.1
Latvia	16.83	81	0.1	0.04	17.7	0.162	3.00	0.0050	1	14.8[vi]
Lithuania	25.95	76	5.6	0.18	23.3	0.172	2.75	0.0056	2	17.3
Norway	36.47	86	2.8[iii]	1.93	6.8i	0.135	3.75	-0.0001	1	2.3
Sweden	25.39	62	2.0	1.76	7.9	0.002	4.00	-0.0043	3	6.7
Central-West Europe										
Austria	45.90	ND	7.0	1.50	20.3[vi]	0.240	2.75	-0.0307	4	16.5
Belgium	51.79	42	40.5	40.58	7.3[vi]	0.277	2.50	0.0023	3	6.2[vi]
France	24.33	77[ii]	9.3	6.99	7.0[vi]	0.072	2.00	-0.0076	2	24.1[iv]
Germany	ND	52	0.0	3.98	15.0	0.158	2.75	0.0001	3	83.6
Ireland	ND	11	88.8[iii]	69.60v	6.6[iv,vi]	0.097	2.75	0.0175	1	0.9
Liechtenstein	ND	96	4.1	0.00	ND	18.535	3.75	ND	1	27.6
Luxembourg	6.44	67	32.6	30.20v	11.6[iv,vi]	4.197	2.75	-0.0087	3	2.3i[v,x]
Netherlands	19.94	16	1.1	24.93	9.75	0.092	2.00	-0.0044	3	24.7
Switzerland	20.51	84	0.1	0.50iv	21.3[vi]	0.077	ND	ND	4	22.5[iv]
United Kingdom	55.78	23	76.5	48.64	3.9	0.621	ND	ND	1	15.7
Central-East Europe										
Belarus	21.37	79	21.1	0.01	1.2	0.093	ND	ND	3	13.9
Czech Republic	18.48	1	0.0	1.55	11.6	4.218	2.50	-0.0010	4	25.0
Georgia	ND	93	2.2[iii,iv]	0.00	ND	0.030	2.75	ND	1	19.7i
Hungary	35.58	21	6.4[iii]	34.94v	ND	0.002	2.00	-0.0090	3	21.9[vi]
Poland	49.90[i]	5	0.3	0.49	5.59[vi]	0.074	3.50	0.0100	3	17.3
Republic of Moldova	ND	99	0.5	ND	ND	0.579	1.50	ND	1	ND
Romania	ND	78	22.0	5.30iv,v	n.a.	0.173	1.50	-0.0039	1	8.4i[v,vi]
Slovakia	18.32	59	2.1	2.11	37.7	1.752	2.50	0.0349	4	42.5
Ukraine	36.76	50	4.1	4.12	27.0	0.266	ND	ND	3	11.7[iv]

	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.7	4.8	4.9
	Share of single species stands, 2005 (%)	Share of natural regeneration in total regeneration (%)	Share of plantations in FOWL (%)	Share of introduced species in FOWL (%)	Volume of deadwood on FOWL (m^3/ha)	Share of forest land managed for conservation of genetic resources (in situ and ex situ only) (%)	Landscape pattern index (0-5)	Trend in country based average proportion of 'core natural' forest pattern 1990-2006	Availability of data on threatened forest species (scale 1-4)	Area protected (MCPFE classes 1,1, 1,2, 1,3 and 2) as % of FOWL
South-West Europe										
Andorra	ND	ND	ND	ND	ND	ND	3.00	ND	1	ND
Holy See	ND	ND	ND	ND	ND	ND	3.00	ND	1	ND
Italy	25.73	93	6.5	3.96	9.1[vi]	0.656	ND	-0.0071	3	43.1
Malta	ND	0	100.0	ND	ND	ND	2.75	0.0000	1	ND
Monaco	ND	ND	ND	ND	ND	ND	3.50	ND	1	ND
Portugal	72.18	75	26.0	29.22	2.8[iv,vii]	0.003	3.75	-0.0210	3	44.1[iv]
Spain	18.72	ND	9.9	4.88	ND	0.027	2.00	-0.0068	4	18.5
South-East Europe										
Albania	68.09	88	9.0[iv]	0.80iv	0.5iv	ND	3.25	-0.0173	1	25.1[iv]
Bosnia and Herzegovina	ND	59	4.2	ND	ND	0.120	3.25	0.0095	2	ND
Bulgaria	41.38	79	20.8	5.27	ND	1.551	3.75	-0.0021	2	8.8
Croatia	20.53	96	4.0	3.35	14.0[vi]	0.066	ND	0.0160	4	11.3
Cyprus	97.98	82	17.6	0.81v	0.9[viii]	3.146	3.00	0.0009	3	6.8
Greece	ND	96	2.1	ND	ND	0.789	3.50	0.0052	1	4.2[vi,xi]
Montenegro	41.69	50	1.3	ND	ND	ND	3.50	-0.0017	2	ND
Serbia	ND	93	5.8	0.10[iv]	1.6[iv,ix]	0.013	3.75	-0.0044	3	14.6[iv]
Slovenia	4.90	98	0.0	2.84	18.9	0.091	2.50	0.0002	4	21.9
The former Yugoslav Republic of Macedonia	ND	89	ND	ND	ND	0.109	3.75	0.0080	1	ND
Turkey	ND	70	33.0	0.64[v]	ND	0.306	3.25	0.0002	2	4.0[vi]

(i) 2000
(ii) FAWS only
(iii) Plantations' share of forest, not of FOWL
(iv) 2005
(v) Introduced species' share of forest only, not of FOWL
(vi) Forest only
(vii) Standing deadwood only
(viii) Standing deadwood on forest only
(ix) Lying deadwood only
(x) No data on class 1.3
(xi) Class 1.1 (strictly protected) only

Table 91: Criterion 5. Protective Functions

Country	5.1 Protective function index: soil and water (scale1-4)	5.2 Protective function index: infrastructure etc. (scale1-4)
Russian Federation	4	4
North Europe		
Denmark	3	2
Estonia	4	2
Finland	3	2
Iceland	3	3
Latvia	3	2
Lithuania	3	3
Norway	3	2
Sweden	3	2
Central-West Europe		
Austria	4	4
Belgium	4	2
France	3	2
Germany	3	2
Ireland	2	2
Liechtenstein	2	3
Luxembourg	3	2
Netherlands	2	2
Switzerland	3	3
United Kingdom	2	2
Central-East Europe		
Belarus	4	4
Czech Republic	4	4
Georgia	3	2
Hungary	3	3
Poland	3	3
Republic of Moldova	2	2
Romania	3	3
Slovakia	3	3
Ukraine	3	2
South-West Europe		
Andorra	2	2
Holy See	2	2
Italy	3	2
Malta	2	2
Monaco	2	2
Portugal	3	3
Spain	4	3
South-East Europe		
Albania	3	2
Bosnia and Herzegovina	2	2
Bulgaria	3	3
Croatia	3	3
Cyprus	2	2
Greece	2	2
Montenegro	3	2
Serbia	4	4
Slovenia	3	3
The former Yugoslav Republic of Macedonia	2	2
Turkey	4	4

Index 1: Evidence of loss of ability to perform protective functions
Index 2: No data available on area of protective forest
Index 3: Data available on area of protective forest, but no formal designation
Index 4: Data available on area designated as protective forest in a formal way

Table 92: Criterion 6. Socio-Economic Functions

Country	6.1 Availability of information on ownership and private holdings (3-4)	6.2 Share of GDP taken by forest sector, 2010 (%)	6.3 Net entrepreneurial revenue per hectare, average of years reported (EUR)	6.4 Government expenditure for forest services per ha of forest, EUR, average of years supplied	6.5 Forest sector labour force as % of population	6.6 Non-fatal accidents per 1000 workers, 2010	6.7 Consumption per head, 2007-2009, m3 roundwood equivalent	6.8 Net imports as % of apparent consumption, 2007-9vii	6.9 Share of energy from wood in national energy production (%)	6.10 Annual visits per hectare of FOWL	6.11 Index of data availability on number of cultural and spiritual sites (scale 3-4)[xi]
Russian Federation	4	2.0	0.4[iii]	0.76	0.6	1.4i	0.7	-42.6	0.8	0.0[ix]	3
North Europe											
Denmark	4	0.9	318.8[iii]	35.00	0.4	6.0	3.6	79.6	3.7	125.9	3
Estonia	3	2.8	22.1	ND	1.8	2.7	3.3	-11.7	12.8	0.3	3
Finland	4	5.1	73.1	ND	1.3	34.8	4.8	-233.0	63.1	27.0	ND
Iceland	4	0.3[i]	ND	ND	0.3	ND	1.1	100.1	0.0	ND	3
Latvia	4	3.3	ND	ND	2.4	0.8	2.1	-66.9	85.3	ND	ND
Lithuania	4	2.0	37.3	0.29	1.4	ND	1.6	7.6	20.7	61.5	3
Norway	3	0.9	38.8	ND	0.6	6.4	2.4	-41.3	4.3	11.3	ND
Sweden	4	3.2	50.3	12.05	1.1	6.3	3.4	-217.8	26.1	ND	3
Central-West Europe											
Austria	4	2.0	203.4	1.79	0.9	185.8[vi]	3.0	-91.1	33.0	ND	ND
Belgium	4	0.8	125.9	ND	0.4	38.5	1.7	6.7	5.9	ND	3
France	4	0.7	105.3	10.85	0.3	8.5[i]	1.7	14.7	7.4	28.7	4
Germany	4	1.0	35.5	14.40	0.4	65.6	1.8	-5.0	11.0	135.4	4
Ireland	4	0.5	ND	1.67	0.3	3.3	1.0	21.0	0.6	24.2	3
Liechtenstein	4	ND	ND	ND	ND	ND	1.0	ND	31.1	ND	ND
Luxembourg	4	0.1[ii]	ND	ND	0.1	ND	2.6	5.6	ND	0.0	ND
Netherlands	4	0.5	-9.8	ND	0.3	ND	1.3	57.5	1.1	750.0	3
Switzerland	4	1.1	-9.0	54.69[iv]	0.7	126.0	1.6	16.2	0.0	420.6	ND
United Kingdom	4	0.5	-10.4	23.21	0.3	6.4	1.2	64.1	0.3	124.4	4
Central-East Europe											
Belarus	4	2.7[i,ii]	ND	ND	0.0	0.6	0.8	-24.2	31.0	ND	4
Czech Republic	4	1.9	ND	11.93	1.2	34.6	1.5	-14.8	5.4	81.6	ND
Georgia	3	ND	ND	ND	ND	ND	0.2	14.8	ND	ND	ND
Hungary	4	0.8	42.0	17.46	0.7	8.4	0.9	29.4	ND	ND	3
Poland	4	1.8	4.9	1.10v	0.6	67.0	1.1	15.1	4.5	0.0	ND
Republic of Moldova	3	ND	ND	ND	ND	ND	0.3	37.2	ND	ND	ND
Romania	3	1.8	ND	ND	0.9	2.1	0.7	-18.7	4.4	ND	ND
Slovakia	4	1.1	18.2	0.79	1.2	4.3	1.5	-24.8	3.0	0.0	4
Ukraine	4	ND	ND	ND	0.4	2.0	0.5	1.3	ND	0.3	ND

Country	6.1 Availability of information on ownership and private holdings (3-4)	6.2 Share of GDP taken by forest sector, 2010 (%)	6.3 Net entrepreneurial revenue per hectare, average of years reported (EUR)	6.4 Government expenditure for forest services per ha of forest, EUR, average of years supplied	6.5 Forest sector labour force as % of population	6.6 Non-fatal accidents per 1000 workers, 2010	6.7 Consumption per head, 2007-2009, m3 roundwood equivalent	6.8 Net imports as % of apparent consumption, 2007-9vii	6.9 Share of energy from wood in national energy production (%)	6.10 Annual visits per hectare of FOWL	6.11 Index of data availability on number of cultural and spiritual sites (scale 3-4)[xi]
South-West Europe											
Andorra	3	ND	ND	ND	ND	ND		ND	ND	ND	ND
Holy See	3	ND	ND	ND	ND	ND		ND	ND	ND	ND
Italy	3	0.9	41.6[iii]	33.96	0.5	53.6	1.2	45.6	14.1	16.8	3
Malta	3	0.2	ND	ND	0.1	ND	0.5	100.0	ND	ND	ND
Monaco	3	ND	ND	ND	ND	ND		ND	ND	ND	ND
Portugal	3	1.6	156.2	ND	0.9	ND	0.8	-71.8	62.8[viii]	ND	4
Spain	4	ND	35.2	72.35	0.4	133.0	1.1	18.4	ND	ND	3
South-East Europe											
Albania	3	ND	ND	ND	ND	ND	0.2	37.9	ND	ND	3
Bosnia and Herzegovina	3	ND	ND	ND	ND	ND	0.6	-46.0	ND	ND	ND
Bulgaria	4	0.8[i]	8.5	2.25	0.8	ND	1.0	3.1	5.9	ND	3
Croatia	4	1.1	ND	ND	0.8	33.0	1.1	5.4	7.7	0.8[x]	3
Cyprus	3	0.9[i]	ND	20.03	0.6	12.7	0.8	96.9	4.5	1.7	3
Greece	3	0.3	0.7	ND	0.4	ND	0.8	52.5	ND	ND	ND
Montenegro	3	0.2	ND	ND	0.1	ND	0.4	-26.4	16.5	ND	3
Serbia	4	ND	ND	ND	ND	ND	0.7	36.2	3.3	ND	ND
Slovenia	4	1.8	36.1	16.30	1.2	92.6	1.7	-57.1	10.9	ND	4
The former Yugoslav Republic of Macedonia	3	0.9	ND	ND	0.3	ND	0.6	56.4	10.4	ND	ND
Turkey	3	ND	ND	ND	0.3	ND	0.6	23.3	8.6	ND	ND

(i) 2005
(ii) Pulp and paper not included
(iii) Factor income, not net entrepreneurial revenue. The difference is wage costs, so this figure is overestimated by the amount of the wage costs per hectare.
(iv) Expenditure on ecological and biospheric services only. Expenditure by Confederation only, expenditure by cantonal governments not included.
(v) "Total government expenditure for forestry"
(vi) Exceptionally high because of work on windblown timber. Average 2000-2005 was 110.
(vii) Therefore net importers have positive figures and net exporters negative figures.
(viii) Data for total energy production seem very low, so share of wood comes out very high.
(ix) 0.01 visits/ha
(x) Data supplied for "visits" are in fact sales of tickets for national parks, so are a significant underestimate.
(xi) 3: partial data availability - 4: data available for each type of site

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