



DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT
ECONOMIC AND SCIENTIFIC POLICY **A**

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Sustainable Forestry in Finland: ENVI delegation in May 2016

Study for the ENVI Committee

DIRECTORATE GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Sustainable Forestry in Finland: ENVI Delegation in May 2016

STUDY

Abstract

As a densely forested country, relying on a legacy of sustainable forest management and advanced forest-based industry, Finland is in a special position facing the current sustainability challenges: climate change, biodiversity loss and stagnating economy. This report, commissioned by Policy Department A at the request of the Committee on the Environment, Public Health and Food Safety, presents the history of forest management and governance as well as recent developments in climate change, energy and biodiversity policy, circular economy and bioeconomy.

This document was requested by the European Parliament's Committee on Environment, Public Health and Food Safety.

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Manuscript completed in April 2016
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LIST OF ABBREVIATIONS

EEA	European Environment Agency
ETS	Emissions Trading Scheme
EU	European Union
LULUCF	Land Use, Land Use Change, and Forestry
MoU	Memorandum of Understanding
Mt	megatonne
NGO	non-governmental organisation
PEFC	Pan-European Forest Certification Scheme
PES	payment for environmental services
PJ	petajoule
RES	renewable energy sources

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EXECUTIVE SUMMARY

This in-depth analysis of the Finnish forest sector aims to provide background information for the ENVI Committee delegation to Finland from 17 to 19 May 2016.

Key facts and history

Finland is Europe's most densely forested country; its more than 20 million forest hectares make up 14 % of Europe's total forest area. The forest area per inhabitant in Finland is 4.1 hectares, which compares with the EU average of 0.3 hectares. Finland's forests have multiple functions; they produce timber, host much of Finland's biodiversity and, as the main land-use type, constitute a culturally and recreationally significant space.

Forests are also economically important in Finland. The forest sector employs 65,000 people (2.5% of the labour force, against an EU average of 1%). The forest sector accounted for 3.6% of added value in the Finnish economy in 2013. Finland accounts for 9% of global paper and paperboard exports, and forest industry products accounted for 20% of Finland's export income in 2013, with over 11 billion euro.

Finland has a rich and long history in developing and utilising its forest resources; forests have been a key component and still have an important role in the Finnish economy and society. The governance of forests reflects this legacy: sustainable forest management has been a key principle in Finland's forest policy. The aims of policy have broadened from securing sustainable yield to encompass a broad spectrum of ecosystem services. This creates challenges for judging the weight and priority placed on the different goals. While the legal basis and governance structure of forest management is broadly supported, limitations on the rights of forest-owners to use their forests or on the rights of citizens to enjoy Finland's forests, at the cost of timber production, have been questioned at times.

Climate change

Finnish forests are likely to change with climate change. The most significant adaptation challenges for forestry include pest and drought risk as well as harvesting difficulties generated by warm winters.

Finnish forests are a significant store of carbon. The annual carbon sink of forest trees and soil has represented 30 to 70 % of annual Finnish emissions over the two last decades. The idea of wood production sustainability is deeply engrained in Finnish forest policy; however, the narrow sustainability definition used does not acknowledge the carbon balance or biodiversity impacts of forestry for forest bioenergy production. Under the EU climate and energy targets for 2020, Finland's share of renewable energy must be at least 38 % of final energy consumption by 2020. About 80 % of the target is expected to be met by bioenergy, mainly forest bioenergy. Wood fuels accounted for almost 80 % of renewable energy and about 25 % of total energy use in 2014. While the production of forest bioenergy meets the sustainable forest management criteria that Finnish forestry applies, the fact that harvesting biomass for energy production decreases the carbon sink capacity of the forest is not accounted for. Further and more critical analysis of the sustainability of biomass use for energy production is needed.

Biodiversity

There is a clear biodiversity conservation gap in Finnish forests, particularly in the southern parts of the country, but budgetary constraints and challenges related to dealing with private ownership limit the establishment of new strictly protected areas. In addition to securing a public budget for conservation, biodiversity protection effort should focus on instruments that support mitigation through sustainable management, and new nature management and restoration schemes with private sector contributions.

Biodiversity conservation has at times been in conflict with forest management. Such conflicts should be managed with collaboration across administrative boundaries and with other relevant actors, including e.g., forest owners and forest industry, recreational users and tourism as well as different non-governmental intermediary actors.

Circular economy

The forest sector is one of the core sectors for advancing the circular economy in Finland. The high level of resource efficiency in the Finnish forest industry means that there has been little emphasis on improving the cascading use of wood material. The main opportunities for further improvement are related to the cascading of by-products. Improvements in resource efficiency could also be achieved through, e.g.: using wood process waste for material recovery rather than energy production; capturing and using excess energy (including heat) within processes; and using forest-based materials and chemicals to replace more harmful technical materials and chemicals.

Bioeconomy

The forest sector is at the centre of Finland's bioeconomy strategy, which focuses on sustainable business opportunities from new bio-based products and increased added value of these products. While this focus is warranted, the forest sector should also consider further developing the sustainability of the entire value chain, from sustainable management of the forest ecosystems to new product and service innovations. In particular, new high-tech bio-plastics, composites, chemicals and pharmaceuticals could be emphasised, as well as health and wellbeing industries which use but do not consume forest ecosystem services.

Recommendations in respect of current and emerging green economy opportunities and sustainability challenges

- Finland has deep experience in sustainable forestry, and is influential in many international processes. It could make a significant contribution by taking an active role in developing and implementing new product- and process-specific sustainability criteria.
- As an ambassador for bioenergy production in Europe, Finland should make every effort to ensure that climate change mitigation and renewable energy generation measures are implemented without compromising the sustainable management of natural resources. Successful mitigation policy would reduce the vulnerability of Finland's forest-based sectors and the ecosystems they rely on in the long term.
- The move towards a circular economy, and the emergence of new bioeconomy opportunities, will require a focus on the entire value chain, and new choices in product portfolios, production technologies and business models.

- Instead of focusing on biomass use volumes, Finland should always strive for added value. Cascading use of forest biomass (i.e. efficient use of residues and recycled materials to maximise total biomass availability) and diversification of forest-based businesses would generate growth opportunities further down the value chain. Business models which use forest ecosystems but do not consume them (e.g. health and wellbeing sectors) should be encouraged.
- Biodiversity conservation and sustainable management go hand in hand. Therefore, conservation efforts should be coherent and inclusive, supporting conservation at the landscape level and engaging the public and private sector actors.

1. INTRODUCTION

This in-depth study of the Finnish forest sector has been prepared for the Committee on the Environment, Public Health and Food Safety. It aims to provide background information for the ENVI Committee delegation to Finland from 17 to 19 May 2016.

The analysis covers experiences related to the policies and initiatives aimed at supporting the sustainability of the forestry sector in Finland, also in connection with climate change, conservation of forests and biodiversity. The analysis pays attention to the special characteristics of Finnish forests, forestry and forest-biomass-based industries. The analysis details the recent and ongoing policy processes and draws conclusions on the opportunities and challenges that Finnish forestry faces and might need to address.

Sustainable forestry, which is referred to many times in this report, can capture several slightly different notions. Sustainable timber production refers to growth (increment) exceeding cuttings (removals) and other drain of standing stock, e.g. through natural disturbances. Sustainable forest management is a broader concept, acknowledging ecological, social and economic aspects of sustainability, in the forest management context. Sustainable forest sector would broaden this approach to the value chains but it would perhaps be a general expression of goals, rather than accurate policy steering. Sustainability is evaluated with a range of different criteria; we attempt to always specify which criteria we refer to.

The analysis portrays the ecological, technological and institutional conditions that have led to Finland's experiences in supporting sustainable forest management, mass production of wood-based products and bioenergy. We report the recent policies and strategies in the areas of forest management, forest industry, bioenergy, circular economy, bioeconomy, climate change and biodiversity, and demonstrate the linkages between these policies.

Section 2 describes the history and facts of Finnish forestry. Sections 3 and 4 report and analyse Finnish forest policy in relation to climate change and biodiversity respectively. Recent advances in the forest sector in the area of circular economy are presented in section 5, while bioeconomy-related progress in this area is described in section 6 on bioeconomy. Section 7 provides a synthesis of the key challenges and opportunities for Finland.

2. HISTORY AND FACTS OF FINNISH FORESTRY

KEY FINDINGS

- Finland has extensive managed forests with multiple functions; they produce timber, host much of Finland's forest biodiversity and, as the main land-use type, constitute a culturally significant space.
- The North-Eastern location and large forest areas place Finland in a special position in Europe, with a key role in conservation and sustainable use.
- Finland has a rich and long history in developing and utilising its forest resources that have been a key component of the Finnish economy and remain so to date.
- The legacy of Finnish forest based technology, skills and economy constitutes a basis for new pathways in forest bio-economy, and generates high expectations.
- Because of the past success of centralised industrial conglomerates, industrial policy has a tendency to favour large investments.
- The aims of forest governance have broadened from securing sustainable yield to encompassing a broad spectrum of ecosystem services, which creates challenges for judging the weight and priority to be placed on the different goals.
- The legal basis and governance structure of forest management has enjoyed legitimacy. However, some limitations on the rights of forest-owners to use their forests and Finnish citizens to enjoy Finland's forests, at the cost of timber production, have been questioned at times.

2.1 Current role of forest sector

Finland is a sparsely populated country, with its 5.3 million people inhabiting the over 300 000 square kilometres (30 million hectares). Finland is Europe's most densely forested country (Map 1); the more than 20 million forest hectares make up 14 % of Europe's total forest area. The forest area per inhabitant in Finland is 4.1 hectares, which compares with the EU average of 0.3 hectares. The mean volume of growing stock (standing living trees) is 100 m³/ha, remarkably lower than the EU average, which is 154 m³/ha. (Finnish Forest Research Institute, 2014).

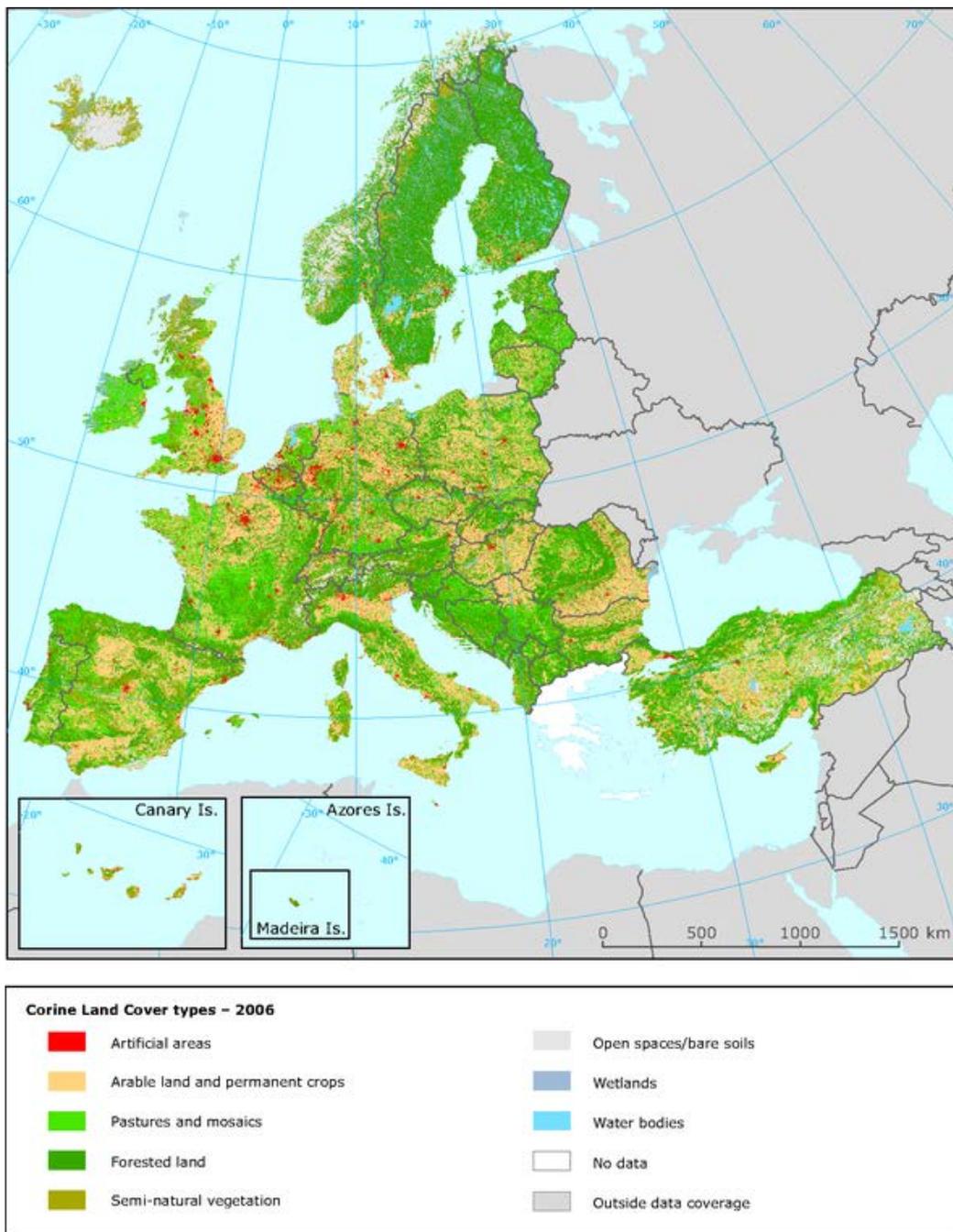
In addition to constituting the most important landscape feature and cultural heritage, forests are economically important. The forest sector employs 65 000 people, which is over 2.5 % of total labour force, while the EU average is 1 %. Out of the total 435 million cubic meters of timber cut in the EU in 2013, 13 % were cut in Finland.

Forestry and forest industry play an important role in Finnish economy, although their relative share of economy has been shrinking. In 2013, the forest sector accounted for 3.6 % of added value. Pulp and paper industry and forestry each produce close to 3 billion EUR, while wood products industries produce just over 1 billion. Also the entire EU is a globally important wood processor, despite its wood products account for less than 10 % of the global wood production. Almost a quarter of the global sawn wood and paper and board are produced in Europe.

Finland is a significant forest products exporter. Out of the world's paper and paperboard exports, Finland accounts for 9 %. The shares of sawn wood and pulp are smaller but they are still over 5 % of total global exports. Forest industry products accounted for 20% of Finland's export income in 2013, with over 11 billion EUR. Pulp and in particular paper products constitute clearly the largest share of forest sector export income. Out of the total of close to 9 billion EUR exports from pulp and paper, 70 % are to countries within the EU. The most important pulp and paper buyers within the EU are Germany and the

UK, and outside the EU the most important are the USA, Russia and China. Wood products exports generate over 2.3 billion EUR export income, out of which about half come from the EU. Japan is the most important wood products buyer, with 0.38 billion EUR in 2013. Roundwood exports are notably less significant than processed products. The value of roundwood and residues exports was 0.1 billion EUR in 2013, mostly to Sweden.

Map 1: European land-cover



Source: European Environment Agency (EEA 2013).

2.2 Ecological characteristics of Finnish forests

Eighty-six per cent of Finland's land area is classified as forest land, while the EU average is less than 40 % (Finnish Forest Research Institute, 2014). As the country extends far to

the north, and has also mires (peatlands) and rocks with low tree cover and little growth, the coverage of productive forest is 60 per cent of the land area.

Most of Finland's forests represent Boreal forest, Western Taiga. Two thirds of the different forest habitat types have deteriorated; only a very small proportion has remained in a natural or semi-natural state (Tonteri et al. 2008). Nine million forest hectares are mire (peatland), out of which half have been drained over the last century. Finland neighbours Russia, where large source habitats for many species are located. This makes Finland a gateway to Europe for many forest species, including mammals such as the Siberian flying squirrel and the wolf.

Of Finland's productive forests, 95 % are managed for timber production, with native tree species (dominantly Scots pine (*Pinus sylvestris*), Norwegian spruce (*Picea abies*) and birch (*Betula sp.*) and long 60-100 year rotation times (Äijälä et al., 2013). Management produces gradual, marginal changes in the forest ecosystem (Tonteri et al., 2008), the sustainability of which causes debate and requires attention (Rantala and Primmer, 2003; Siiskonen, 2007; Sarkki and Karjalainen, 2012).

2.3 Development of mass production: competence, technology and markets

Wood has always been an important resource in Finland, and its use has evolved in parallel with societal development. Building and heating were supplemented with tar production, which peaked during the World War II and has subsequently declined. Importantly, the gradual growth in industrial use for sawmills, which had begun in the 18th century, was supplemented with pulp and paper production, and total production was thus boosted after the war (Myllyntaus and Mattila 2002). Industrial development was coupled with technological advances with the use of residues and side products, in an industrial symbiosis involving production of energy and chemicals, and management of waste and sewage (Seppälä et al., 1998; Pakarinen et al., 2010).

Forest industry development spurred economic and social development in rural areas. The paper mill townships hosted vibrant communities. Schools, health care, churches and sports clubs were built by the paper companies. The companies grew into significant players in the pulp and paper world market, yet constituting an oligopsony in Finland (a few large companies as purchasers dominating the timber market). In this setting, public policy was sensitive to the needs of the forest sector (Siiskonen, 2007). For example, Finland's energy policy was not independent from the economically significant forest industry.

The value chains ranged from modernised silviculture and harvesting operations, to fine high quality printing and packaging products and services, generating rural jobs, in engineering and in international trade. The skills and competencies adapted to meet the needs of the markets (Primmer and Wolf, 2009; Hämäläinen et al., 2011). However, mechanisation and technological development eventually led to job losses in the sector: the number of forest based jobs has come down from over 100 000 in the 1980s to the current 20 000 (Finnish Forest Research Institute, 2014).

Forest products still accounted for over a third of export income at the start of the 1990s. Since then, the significance of forest industry has given way to electronics as the economic powerhouse. At the same time, the stagnating global demand for pulp and paper, and the growth of alternative fibre sources closer to end-users particularly in Asia (Toppinen and Kuuluvainen, 2010), have forced Finnish pulp and paper production to phase down. However, Finland is still the second largest paper producer in the EU (CEPI 2014).

The recent and ongoing investments in new bio-refineries by Metsä Group in Äänekoski in Central Finland and by UPM in Lappeenranta in South-Eastern Finland are expected to reverse the negative trend and generate new jobs, know-how and value added in a sector which otherwise faces profitability challenges due to low prices for its traditional products.

Despite its vast forest resources Finland has been a net importer of roundwood throughout the history of its forest industry. Imports have balanced supply fluctuations and prices. Since the end of 1990s the increase in roundwood use in Finnish forest industry has relied on imports, mainly from Russia. This trend was disrupted in 2008 when Russia implemented export duties on roundwood in order to support its own wood processing industry. This severely impacted Finnish forest industry, already facing an economic crisis. After Russia joined the WTO in 2012, the duties were lifted.

2.4 Institutional conditions, legislation and governance of sustainable forest management

2.4.1 Governance for the broadening understanding of sustainability

Industrial use was already generating wood shortages in the 19th century, leading to a need for regulation of wood extraction. The Forest Act was enacted in 1886, to control logging so that forest would not be “devastated” (Siiskonen, 2007). The subsequent forest laws detailed the silvicultural practices which were needed to secure the sustainability of timber production. A significant governance system with forest inventories, administration, planning and support was established. Sustainable timber production, maximising growth, remains the core goal of Finnish forest policy and legislation (Forest Act, 1996; 2013; National Forest Strategy, 2015).

Forest governance has adapted to tackle new challenges, as they have emerged (Primmer and Rantala, 2003; Primmer and Wolf, 2009, Primmer et al., 2013). The 1980s saw the rise of demand for diversification of forest use, which led to so called multiple use becoming a formal goal for forest policy, alongside timber production. Finland has open access to forests, and recreation has a strong institutional basis recognised in law and strategies (Mann et al., 2010). Most of the population uses open access to forests, through recreation, berry and mushroom picking and exercise (Sievänen et al., 2006; Pouta et al., 2006).

2.4.2 Modes of governance

Importantly, Finnish forest governance relies on strategies and programmes, which are prepared at the national and regional levels, at ten or five year intervals. The national programmes have traditionally been prepared in a collaborative fashion; the Forest Act states that “the necessary stakeholders” should be engaged. The number of stakeholder types has grown along with the broadening of the goals set for forestry, and public participation has been developed and applied (Primmer and Kyllönen, 2006; Saarikoski et al., 2012). The stakeholders involved in forest programme preparation include administration, research, industry, unions, land-owners, environmental and recreational NGOs and education.

National and regional forest programmes set targets for removals and the regional programmes function as frameworks for allocating funds. Yet, the programmes’ steering function is of a soft character, merely providing a framework for more operational actions and attracting commitment from the participating stakeholders. The latest Forest Strategy

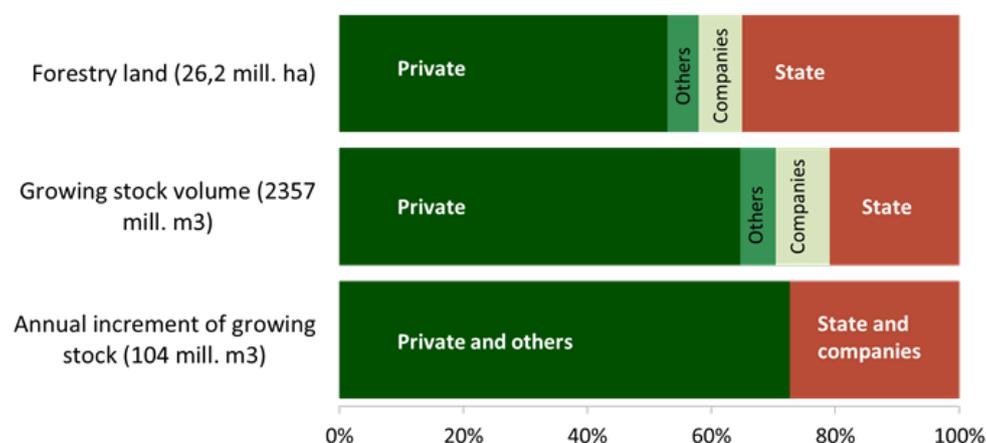
2025 (2015) places emphasis on forest-based business and the active and sustainable use of forests. The strategy is implemented through investment in knowledge management, education and infrastructure as well as through a streamlining of governance, and the development of markets for new products and forest ecosystem services, which are the “diverse benefits that forests produce to humans” (Forest Strategy 2025, 2015)¹.

2.4.3 Governing a large group of forest owners

Two thirds of Finland’s productive forests are owned by non-industrial private forest owners (Figure 1). The 600 000 forest holdings produce timber, carry the responsibility for sustainable management and biodiversity conservation, and supply Finns with recreational ecosystem services. The distributed nature of forest ownership is a major challenge, and explains the existence of an elaborate governance system where public administration, Local Forest Management Associations as well as private sector timber buyers and consultants each play a role (Primmer and Wolf, 2009).

The Forest Act mandates the silvicultural practices, which are detailed in best practice guidelines (Äijälä, 2013), and supported by planning and extension (Primmer and Wolf, 2009). This system maintains a uniform practice in a somewhat rigid fashion (Siiskonen, 2007) but mostly enjoys legitimacy among forest owners who rely on professional advice (Hujala et al., 2007; Paloniemi and Tikka, 2008). The law based control of silviculture regimes has raised some controversies, however. In particular the century-old ban on selectively removing large trees has been brought into question in some cases (Siiskonen, 2007; Harrinkari et al., 2016). The most recent amendment to the Forest Act (Forest Act 1085/2013) lifts this ban and introduces an uneven aged forest management regime, to supplement the traditional regime with thinnings and final fellings. This new silvicultural practice allows forest owners to avoid clear felling. The preparation of the Act demonstrated the divided expectations on forests, highlighting timber production on the one hand and ecological sustainability on the other (Harrinkari et al., 2016). The application of the new law in practice is only starting to emerge.

¹ Ecosystem services can be defined more accurately, as “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life” (Daily, 1997). Ecosystem services are often conceptualised as supporting, regulatory, provisioning and cultural services (Millennium Ecosystem Assessment, 2005).

Figure 1: Forestry land, growing stock and annual increment of growing stock by ownership category

Source: Finnish Forest Research Institute (Finnish Forest Research Institute 2014).

2.4.4 Governing state forests

State forests are concentrated in the northern parts of the country and are less productive than private forests (Map 2). They are managed by the state Forest and Park Service, Metsähallitus (Act on Metsähallitus, 2004; Act on Metsähallitus, 2016). Its duties have been divided into commercial forestry (which generates income for the state in the form of the Ministry of Agriculture and Forestry), and protected area management, which has been under the Ministry of the Environment. The same organisation has important public recreation service provision and employment duties, and it manages public watercourses. The legitimacy of the strong focus on timber production and state income generation has been questioned (Raitio and Sarkki, 2014).

The legal basis of the Metsähallitus has been in flux; a new law was passed on 30 March 2016 and it will come into force on 15 April 2016. The new law separates the forestry enterprise as a state-owned incorporated company from the other functions of the State forest service, with use rights to state lands and waters. The lands and water remain in state ownership and the Ministry of the Environment maintains the governance of the parks and protected areas. The sustainability of state forestry will be at the responsibility of different ministries and the Parliament, and operationally governed through regional natural resource plans. The law triggered debate and suspicion against a commercialisation of public land and waters, which materialised through a citizen petition against the law proposal signed by almost 130 000 people in March 2016. Also the rights of Finland's indigenous Sami people and their traditional reindeer herding were debated as a part of the process.

2.4.5 Forest policy in the European context

The EU Forest Strategy (EC, 2013) is a broad policy document outlining the multi-functional use of forests and the importance of sustainable management for ensuring long-term benefits. Balancing various forest functions, meeting demands, and delivering vital ecosystem services, are considered essential for providing a basis for forestry and the whole forest-based value chain, to be competitive and viable and to contribute to the bio-based economy. The Finnish Forest Strategy 2025 (2015) is not in conflict with the very broad EU strategy but it does place more emphasis on economic growth. The earlier

National Forest Programmes (e.g., Ministry of Agriculture and Forestry, 2008) have been somewhat broader. Finnish national and regional forest strategies and programmes state targets for forest use, including bioenergy production, which is distinct from the EU level policy.

Finland has played an active role in the European Forest Strategy process, and Finland is strong also in other European and international forest policy processes, including the pan-European sustainable forest management criteria and indicators processes, currently labelled Forest Europe and the industry driven Pan-European Forest Certification Scheme (PEFC). Finland hosts the European Forest Institute (EFI), which gives a window to communicating closely with the European processes. Also the intergovernmental forest processes, currently hosted by the UN Forum on Forests have benefited from Finnish contributions.

3. FINNISH FOREST POLICY AND CLIMATE CHANGE

KEY FINDINGS

- Forest carbon sinks are crucial for controlling the world's climate; the volume of forest carbon sinks matters.
- Climate benefits of wood products depend essentially on whether they substitute non-renewable products. Sequestering carbon in wood products is also beneficial for climate as such but this potential is rather small compared to sequestering carbon in forest trees or soil.
- Finnish forests are likely to change with climate change. The most significant adaptation challenges for forestry include pest and drought risk as well as harvesting difficulties generated by warm winters.
- The carbon sink of forest trees and soil have taken up 30 to 70 % of the Finnish emissions during the two last decades, the LULUCF² sector in total has taken up 20 to 60 %.
- Land use change from forest and other land uses is a source of greenhouse gases in Finland, despite of the large carbon sink on land remaining forest. This is because emissions from deforestation are larger than carbon sequestration at afforested or reforested sites.
- The idea of wood production sustainability is deeply engrained in Finnish forest policy, and also constitutes the backbone of climate and energy policies. The basic idea is that as long as forestry is sustainable, forests can be used for various purposes without setting further criteria or restrictions for specific products or uses.
- This narrow definition of wood production sustainability does not acknowledge carbon balance or gradual biodiversity impacts of forestry for fuelwood production. Therefore, the sector should critically and more broadly analyse sustainability of biomass use for energy production.

3.1 Climate regulation capacity of Boreal forests

As described in chapter 2, Finland's forests are significant carbon stocks and important for sequestering carbon, also in European terms. Forests play a crucial role in controlling the increase in the atmospheric carbon dioxide. Globally, the carbon sink of forests sequesters annually about a fourth of all anthropogenic carbon dioxide emissions. Boreal and temperate forests together represent about a half of the global forest carbon sink. Forests act as carbon sinks when carbon additions to the pools exceed removals. Favourable growth conditions and low levels of harvesting or natural mortality favour accumulation of carbon in trees. Large biomass reserves favour also accumulation of carbon in soil as a consequence of increased litter production. On the other hand, beneficial growth conditions may also accelerate microbial decomposition of soil organic matter and enhance soil carbon losses.

Forest management controls the carbon budget of boreal forests (Liski et al., 2000). Actions enhancing growth and tree biomass volume have a positive effect on the balance, whereas high levels of harvesting have a negative effect. Forest carbon sinks may increase in spite of increasing harvest levels if tree growth accelerates even more. Generally, old forests store more carbon than young ones but the rate of carbon accumulation is highest

² LULUCF refers to Land use, land-use change and forestry, and it covers human-induced exchange of greenhouse gases between terrestrial ecosystems and the atmosphere.

in quickly growing middle-aged forests. Excessive biomass levels or old age structures may make managed forests susceptible to pest and storm damage. These risks increase with climate change, following extreme weather events and short winters.

Carbon is also stored in wood products. The carbon pool and sink of these products is small compared to trees and soil but still significant. It is easier and more effective to accumulate carbon in trees and soil compared to wood products. There is a tradeoff between harvesting timber from forests and the storage of carbon in forest trees and soil. However, wood products are valuable in replacing more emissions-intensive products, and these substitution effects may have important positive climate impacts.

In Finland, trees and soil have been acting as substantial carbon sinks during the most of the past 100 years (Liski et al. 2006). This favourable development has been a side-product of forest policy maximizing growth and increasing the growing stock of trees.

3.2 Climate, energy and forest policies

Finland's climate and energy policy is closely linked to the international agreements on climate change, and to the climate and energy policy of the EU. In 2015, Finland adopted a national Climate Change Act that includes a mitigation target of reducing emissions by at least 80 % by 2050 from the 1990 levels (Climate Change Act, 609/2015). In addition, the National Energy and Climate Roadmap 2050 guides long-term climate and energy policies (Ministry of Employment and the Economy, 2014). In practice, national climate and energy policy is implemented via Energy and Climate Strategies (mainly in sectors subject to the Emissions Trading System) and National Climate Change Plans (non-ETS sectors).

Under the EU climate and energy targets for 2020, Finland's share of renewable energy must be at least 38 % of final energy consumption by 2020. About 80 % of the target is expected to be met from bioenergy³, mainly forest bioenergy (Ministry of Employment and the Economy, 2010). In addition, Finland has a national target of increasing the share of biofuels⁴ in transport to 20 % by 2020, whereas the EU-level target is 10 %. The current Government of Finland has stated that these obligations will be met ahead of time, by 2018. Also, the Government has stated that during the 2020s: (i) the share of renewable energy will increase to over 50 %, (ii) Finland will abandon coal use in energy production, (iii) the use of imported oil will be halved and (iv) the share of renewable fuels in transport will be at least 40 % (Ratkaisujen Suomi 2015).

In 2014, the share of renewable energy in total energy consumption was 33 %. Wood fuels accounted for almost 80 % of renewable energy and about 25 % of total energy use (Table 1). The total use of solid forest bioenergy in 2013 was 341 PJ (petajoules). It comprised of forest industry by-products (147 PJ), forest bioenergy use in heating and power plants (130 PJ) and small-scale combustion of wood in households (64 PJ) (Finnish Forest Research Institute 2014). Production of forest bioenergy meets the sustainable forest management criteria that Finnish forestry applies. However, the fact that harvesting biomass for energy production decreases the carbon sink capacity of the forest is not accounted for. These indirect land-use-related emissions per unit of energy produced are low for bioenergy produced from harvest residues and high for bioenergy produced from living trees.

³ Bioenergy: any energy produced from biomass.

⁴ Biofuel: fuel composed of, or produced from, biomass.

Table 1: Energy consumption in Finland in 2014 (TJ=Terajoule)

Energy source	2014 (TJ)	Share (%)
Wood fuels	339 290	25,2
Oil	310 032	23,0
Nuclear energy	247 047	18,3
Coal	126 170	9,4
Natural gas	95 373	7,1
Peat	59 265	4,4
Net imports of electricity	64 678	4,8
Hydro power	47 665	3,5
Wind power	3 986	0,3
Others	52 911	3,9
Total	1 346 418	100

Source: Statistics Finland, 2016

The use of forest chips in energy production was 8 million m³ in 2013. The main source of forest chips was small sized trees (3.5 mill. m³). Other sources were logging residues (2.8 mill. m³), stumps (1.2 mill. m³) and large-sized timber (0.5 mill. m³). Stump use has increased significantly - from nearly none in 2000 to 1.2 million m³ in 2013 (Finnish Forest Research Institute 2014). The stump bioenergy meets the current sustainable forest management criteria but the indirect land-use-related carbon emissions are quite high per unit of energy produced. In addition, removing the stumps reduces the amount of coarse woody debris, which is critical for many endangered forest species.

The increase in forest chips use has been fast, multiplying ten times in 15 years. Stump use has increased significantly - the 2013 figure was about 240 times higher than 2000 (Finnish Forest Research Institute 2014).

Finland has multiple subsidies for renewable energy (Lindstad et al. 2015, Motiva 2016, Metsäkeskus 2016), for example: subsidies for thinnings of young forests and small sized tree removal for energy; a feed-in tariff for renewable electricity production, including forest bioenergy, biogas and wind power; and an investment subsidy for renewable energy and energy saving, e.g. for investments in small forest bioenergy district heating plants, renewable electricity or biofuel production and demonstration of new technologies.

Biofuel use in transport is mainly supported by obligations placed on fuel distributors. All transport fuels must include a growing percentage of biofuels. The share of biofuel must be at least 6 % of the total energy content of petrol, diesel oil and biofuels delivered by the distributor for consumption in 2011–2014. After that, the distribution obligation rises steadily up to 20.0 per cent in 2020. The biofuels included in the distribution obligation must meet the sustainability criteria specified in the RES Directive (Ministry of Employment and the Economy 2016a). Forest bioenergy is expected to play a major role in the Finnish transportation fuel switch, as e.g. the forest industry companies have invested in biofuel production.

A new national Energy and Climate Strategy and the first National Climate Plan will be formulated during 2016, and the renewable energy subsidy scheme will be revised. The

form of the new renewable energy subsidy scheme is still open but it will highlight competitiveness and technology neutrality. The new policies will also likely include measures to increase biofuel use in transport (Ministry of Employment and the Economy 2016b).

Some concerns have arisen over the revision of the renewable energy subsidy scheme in Finland. First, the competitiveness and technology neutrality requirements can favour mature technologies (such as bioenergy) and hence not stimulate technology development. Since the supply of the most important forest chip source (i.e. small sized trees) is already subsidized, the competitiveness of other renewable energy technologies is weaker. However, with careful design, the subsidy scheme can drive cost-efficiency and new technologies. One option would be to separate the policies for bioenergy and other renewables.

3.3 Land-use, land-use change and forestry

The land-use, land-use-change and forestry (LULUCF) sector is a net sink of greenhouse gases in Finland⁵. The size of this sink has varied between 20 and 60 % compared to the emissions from the other sectors during 1990-2013. The largest contributor to the LULUCF sink is the increment of the growing stock of trees, which is a result of tree growth exceeding total carbon losses, i.e. the sum of harvesting and natural mortality of trees. In 2013, tree growth was 104 Mm³ and the total losses were 78 Mm³ (out of which over 65Mm³ were harvested). Both figures were the highest ever recorded.

The second largest contributor to the sink is the increasing carbon stock of dead organic matter in forest soil. The carbon sink of these two largest contributors, namely trees and forest soils, have varied between 30 to 70 % compared to the fossil carbon emissions in Finland between 1990 and 2013. The largest contribution to emissions in the LULUCF sector comes from carbon losses in organic soil (peat) in forests and agricultural land.

During the second commitment period of the Kyoto protocol (2013-2020), Finland reports emissions and sinks of greenhouse gases resulting from changes in forest area (Article 3.3) and those from forest management (Article 3.4). The emissions from deforestation are larger than the sink from afforestation and reforestation combined in Finland. This led to net emissions under Article 3.3 equal to 2.4 Mt CO₂ eq. in 2013. The carbon sink of forest management under Article 3.4 was equal to 46 Mt CO₂ eq. After accounting for the reference level and technical corrections, the net sink of LULUCF under Articles 3.3 and 3.4 was 13.4 Mt CO₂ eq.

In the international climate negotiations Finland has been in favour of a nationally defined carbon sink reference level, in line with most Western countries, which is the current arrangement agreed in Durban in 2011. Finland has been opposed to deforestation as the basis of forest carbon emissions agreed in Durban and requested the EU to compensate for the application of this criterion.

3.4 Prospects for forests in climate change policy

The availability of suitable wood for different needs will be a key question for forest and climate policy in Finland in the future. The demand for pulpwood and wood for energy is expected to increase significantly. According to scenario analyses by the national authority Natural Resource Institute, forest growth will increase substantially in Finland in the

⁵ The LULUCF sector has both sinks and sources of greenhouse gases. The net carbon sink means that the sinks are larger than the sources. In Finland, agriculture is a net source of greenhouse gases and forests are a major carbon sink.

coming decades and meet the growing demand. However, it is worth noting that these Natural Resource Institute scenarios assume that climate change will itself enhance growth rather significantly; and the sensitivity of the conclusions to this assumption has not been analysed thoroughly.

Finland has prepared a national climate change adaptation strategy (Ministry of Agriculture and Forestry, 2005) and a plan until 2022 (Ministry of Agriculture and Forestry, 2014) and several adaptation measures have been mapped. So far the adaptation policies have not led into concrete impacts in the forestry sector. Increases in disturbances resulting from extreme weather events and pest outburst should also be considered.

The complex discussion on the role of forests as a source of bioenergy in Finland can be summarised as follows:

- The size of the carbon sink of forests depends on the harvest levels. The higher the harvests, the smaller the sink. It is likely that the soil will start lose carbon if the harvest levels are high.
- According to the calculations by the Natural Resource Institute, tree biomass reserves will continue to expand in all future scenarios for Finnish forests, securing their function as a net carbon sink. However, the calculations do not take into consideration the risks imposed by e.g. climate change.
- It is likely that the soil will start to lose carbon in the scenarios of high harvest levels.
- The bioenergy targets of the national climate and energy strategies will be met by using residual forest biomass, namely harvest residues, stumps and small-sized wood from early thinnings. However, it is worth noting that these targets are already close to the economic-technical potential of the residues. Stump removals generate additional harmful ecosystem impacts.
- The use of the residual biomass fractions helps to reduce the greenhouse gas emissions of energy production even when the effects on the carbon balance of forests are accounted for.
- If living wood needs to be harvested and used primarily for energy production, the emissions per unit of energy are significantly higher than emissions from producing the same amount of energy using fossil fuels. These negative climate impacts result from very unfavourable effects on the carbon balance of forests.
- From a life cycle perspective wood energy may be seen as carbon-neutral, because all carbon in wood originates from the atmosphere and obviously burning wood cannot release more carbon to the atmosphere than it has once removed from there. However, in climate policy or efforts to mitigate climate change, such a perspective is insufficient because it does not account for the effects of harvesting on forest carbon sinks. These carbon sinks are crucial for the development of the atmospheric carbon dioxide.
- Double subsidies for bioenergy should be avoided. Non-biomass-based renewable energy sources have difficulties when competing with bioenergy, if bioenergy is subsidized in terms both of supply (subsidies for forest owners) and demand (subsidies for energy producers).

In the discussions about sustainability criteria for bioenergy in the EU, Finland is not in favour of developing product-specific criteria. Rather, Finland prefers reliance on the

overall sustainability of forest management and forestry and the existing governance arrangements, appealing to avoidance of additional bureaucratic burden. Some forest bioenergy may also have difficulties in meeting possible future emission reduction requirements in Finland and elsewhere in Europe (Repo et al. 2014).

4. FINNISH FOREST BIODIVERSITY CONSERVATION POLICY

KEY FINDINGS

- The biodiversity conservation gap in Finnish forests is obvious, particularly in the southern parts of the country, but budgetary constraints and challenges related to dealing with private ownership limit the establishment of new protected areas.
- Apart from securing a public budget for conservation, development efforts should be placed on instruments that support mitigation through sustainable management (for example retention trees), and new nature management and restoration schemes with private sector contributions (for example through compensation or offsetting instruments).
- Biodiversity conservation has at times been in conflict with forest management. Such conflicts should be managed with collaboration across administrative boundaries and with other relevant actors, including e.g., forest owners and forest industry, recreational users and tourism as well as different non-governmental intermediary actors.

4.1 Forest biodiversity conservation status

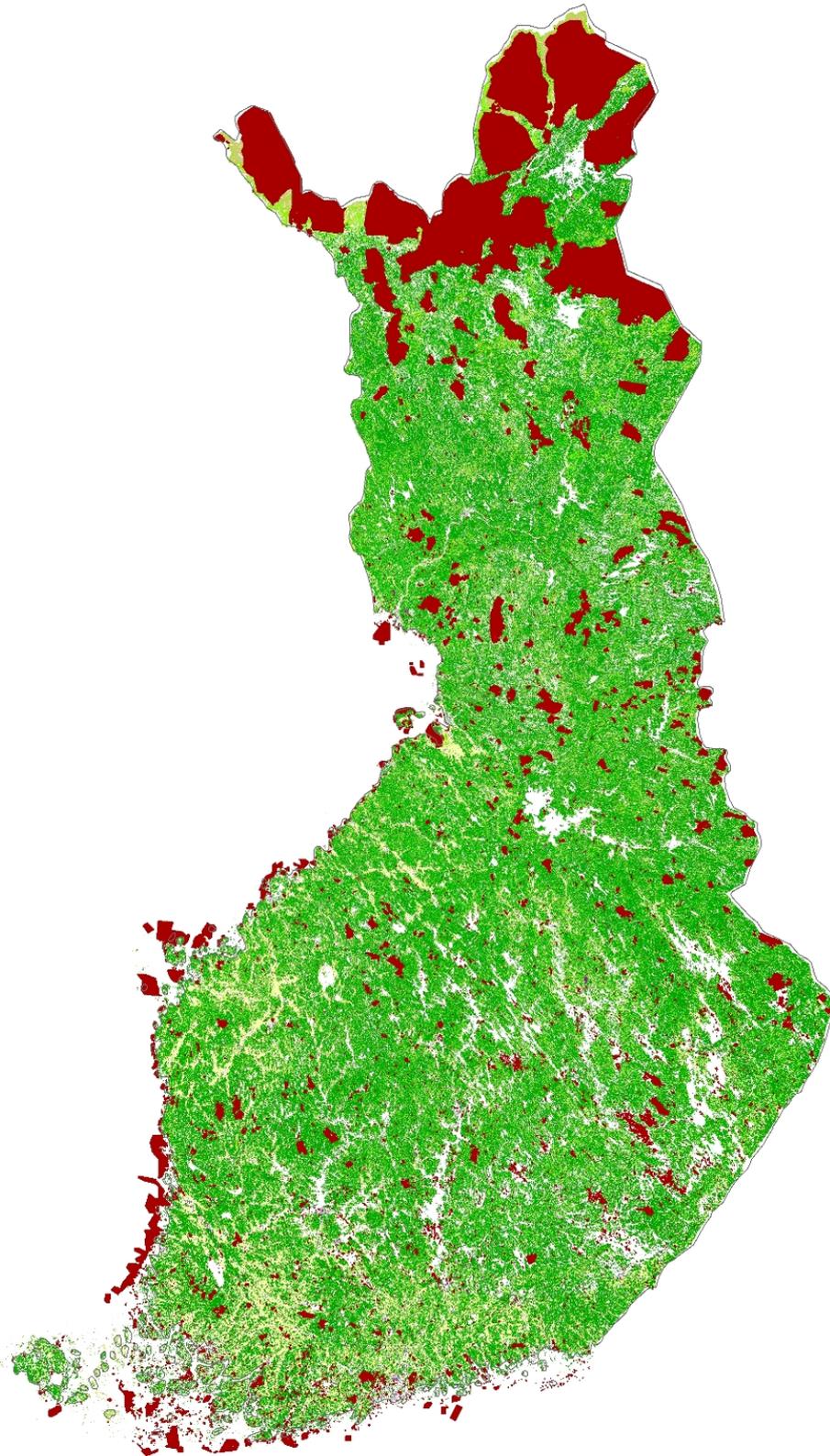
Finland is the North-Eastern refuge of the EU, with its large forest areas and a long shared boarder with Russia (Map 1). Given the large forest area, and with most of the productive forests being managed, forests and forestry have an important role in biodiversity conservation. Forests host half of Finland's species, and over a third of all endangered species are primarily forest species (Rassi et al. 2010). The proportion of the area of threatened forest habitats of the total area of all forest habitat types is 49 % in southern Finland and 27 % in northern Finland (Tonteri et al., 2008.)

The different protected area instruments are partly overlapping. The Natura 2000 Network covers 5 million hectares, altogether 1865 sites, which is 15 % of the total land area. Of this 75 % are terrestrial areas and the rest 25 % are water areas. Altogether 1721 Special Areas of Conservation (SAC) areas of the Habitats Directive cover altogether 4,8 million hectares which is 12.4 % of the total land area. The amount of Special Protection Areas (SPA) areas of the Birds Directive is 468 and their total land-area is 3.1 million hectares which is 8 % of the total land area.

At present, strictly protected areas cover over 9% of forest area; including softer restrictions, the protected area percentage is 13 (Finnish forest Research Institute 2014). Most of the protected areas are located in northern, less productive parts of the country, and the conservation void is clearly concentrated in the south (Map 2). Most of the ongoing conservation efforts are concentrated in southern Finland, as detailed in the following sections.

The main drivers for forest biodiversity loss are the decreasing amount of dead wood, shrinking area of old-growth forests and decreasing number of individual old trees (Rassi et al. 2010). In particular old growth forests should be protected with protected area instruments, however, coarse woody debris and old trees can also be produced in managed forests. The current amount of decaying wood in managed forests in Southern Finland averages only just 3 cubic metres per hectare, while in a natural old growth forest dead wood could amount to 100 cubic metres per hectare (Siitonen 2001).

Map 2: Protected areas in Finland [the red areas are protected].



Sources: Finnish Environment Institute, Metsähallitus.

In forest policy, the challenge with coarse woody debris is to balance the increased risk of pest outbreaks resulting from large amounts of fresh dead wood against the diverse flora and fauna which depend on this feature. The recent changes made in the Forest Act (2013) favour pest control, with new strict limits on dead wood per hectare and also with new interpretations on the size, and set aside status of valuable Forest Act habitats. Also the dominant forest Certification scheme, PEFC (PEFC Finland Standard, 2014), has looser criteria for leaving retention trees (standing trees on harvesting sites) than its predecessors. Certification is the only instrument specifying the number (amount) of retention trees. With the increasing demand for biofuel, dead wood will become even scarcer, as even stumps can be removed. Together, these developments will place increased pressure on endangered coarse-woody debris dependent forest species.

4.2 Forest biodiversity conservation instruments

Finnish biodiversity policy is a combination of traditional nature conservation and of an ecosystem service approach. The Finnish Biodiversity Strategy "Saving nature for people" emphasises mainstreaming of biodiversity policies into other policy sectors and sustainable use of natural resources (Ministry of the Environment, 2012). As for all Finnish strategies, it has been prepared in collaboration with a broad range of stakeholders. The strategy follows the EU biodiversity strategy (EC, 2011) but it draws more on the Biodiversity Convention's Aichi Principles developed in Nagoya in 2010 (CBD-COP10, 2010). The main goal of the Finnish Biodiversity Strategy is to halt biodiversity loss in Finland by 2020. In addition to the conservation of habitats and species, the strategy emphasis the economic and cultural values related to biodiversity conservation (e.g. recreation and tourism, health benefits, green business opportunities). These emphases mean that the conservation of biodiversity and ecosystem services should play an integral part in contemporary decision-making on the use of natural resources, including the use of forests.

Finnish nature conservation has traditionally been carried out through targeted conservation programmes based on inventories of particular habitat types. This has led to the establishment of protected areas, mostly through purchase by the state but also through the establishment of private protected areas. The largest programmes were adopted between late 1970s and mid-1990s on, for example, highly productive, fertile herb-rich forests and old-growth forests (Ministry of the Environment, 1989; 1993; 1995; 1996). The implementation of the national conservation programmes has partly overlapped and partly been followed by the implementation of the Natura 2000 network after Finland joined the European Union in 1995. The implementation of these programmes has generated resistance and been a source of conflict over the years, particularly between private forest owners and the environmental administration and NGOs (Hellström, 2001; Primmer et al., 2013). The recently tabled proposal for a supplementing Mire Protection programme (Alanen and Aapala, 2015) faced similar arguments but finally its abandonment was justified with budgetary reasons.

In general Finnish forest biodiversity conservation policy has evolved from a focus on establishing national parks and protected areas to considering ways of conserving the remnant valuable patches and biodiversity in managed forests (Primmer et al., 2013). The Forest Act (1093/1996) lists a set of valuable habitats whose characteristics must be preserved. The implementation of this instrument has made use of the professional extension services across the entire organisational field of forestry (Primmer and Wolf, 2009), and compliance has been at a high level (Similä et al., 2014). Breaking the trend of integrating biodiversity conservation further with forest management, the most recent amendment of the Forest Act (1085/2013) slightly changed the status of the valuable habitats by allowing removals of individual trees and by defining them as small-sized. As

the same amendment introduced also new habitats, there has been room for opposing interpretations of its overall environmental impacts (Harrinkari et al., 2016).

The Southern Finland Forest Biodiversity Programme (METSO, 2002) and its successors for the years 2008-2016 and 2014-2025 address particular ecological criteria and include a selection of instruments ranging from improving the network of protected areas and nature management in managed forests to improving the knowledge base and collaboration between forest and environmental organisations, extension and advice to forest owners, training of professional foresters, and related communications work (METSO 2008).

The METSO Programme (METSO 2002; 2008) has been developed as a response to criticisms by forest owners of the legitimacy of nature conservation; it places significant emphasis on collaboration across organisational boundaries and on attracting non-industrial private forest-owners to participate in conservation on a voluntary basis, through payment for environmental services (PES) like arrangements (Primmer et al., 2013; Primmer et al., 2014). The payments are largely based on income loss (opportunity cost, rather than output), due to domestic and European level institutional constraints (Primmer et al., 2013; Raitanen et al., 2013). Currently, private protected areas are established almost exclusively through positive payments attracting voluntary offers from forest owners, in a payments-for-ecosystem-services fashion. The cross-organizational collaboration has continued but the strong emphasis on integrating environmental and forestry administration practices in forest biodiversity conservation experienced at the start of the METSO Programme have faded out since the budgets of the two sector administrations have been separated (Primmer et al., 2013).

The objective for the METSO Programme is to establish new protection areas for 96 000 hectares on a voluntary basis. During 2008-2014, 54 400 hectares were protected as result of the Programme under the Nature Conservation Act. The current budget deficit has, however, have led to drastic budget cuts. In 2015 the total budget for the METSO Programme was 44 million EUR and by 2019 it will be cut to 11 million EUR (Finnish Government, 2015). Also mire (peatland) protection has been suggested to continue on a voluntary basis but there are no signals of this materialising without public funds. This will lead to increasing pressure to identify new opportunities for public-private collaboration and potential new ways to generate funding for conservation, e.g. through compensation or offsetting arrangements where enterprises causing biodiversity losses participate in conservation.

4.3 International biodiversity conservation collaboration

Finnish forest biodiversity is dependent on the biodiversity beyond the Russian border, where large natural forest areas still exist (Kobyakov & Jakovlev eds. 2011). Finland has had active scientific and political cooperation with Russia since 1970. Since 1986, the Finnish-Russian Committee on Nature Conservation has been the official body promoting cooperation on conservation for biodiversity. Several protected areas have been established on both sides of the border since the cooperation started, and there have been numerous projects funded by the two countries, and also by the EU. Despite the long cooperation, there are no legally binding commitments on biodiversity conservation between Finland and Russia. In 2010 a Memorandum of Understanding on the Green Belt and on developing the connectivity of the transboundary protected area network was signed by the Finnish, Russian and Norwegian environmental officials (MoU on the Green Belt 2010).

In more sector and market driven fora, Finland plays a key role in international forest collaboration and sustainable forest management. Finland has actively contributed to the UN hosted intergovernmental forest processes, currently hosted by the UN Forum on Forests and the pan-European criteria and indicators for sustainable forest management, under the Forest Europe process. Additionally, Finnish forestry has had a key role in developing the Pan-European Forest Certification Scheme (PEFC).

4.4 Prospects of Finnish forest biodiversity conservation policy

Protecting endangered species and habitats requires a combination of strict protection at the valuable sites and integrated conservation in managed areas. As a result of public budget constraints, Finnish forest biodiversity conservation policy must rely increasingly on managed forests. To encourage this, the economic and wellbeing benefits of conservation, such as links to health, recreation and tourism with related business opportunities, are increasingly highlighted to motivate conservation and sustainable management of these areas.

There are plenty of new opportunities for engaging businesses and infrastructure and land-use planning in new compensation and payment arrangements. For example, the recently started pilot project "Habitat Bank of Finland"⁶ is an example of a novel integrated instrument, which can build on the Metso payments-for-ecosystem-services experiences and go beyond in building public-private collaboration and generating new funds. Furthermore, there is an increasing interest in exploring how nature can help to address the health and social challenges in Europe (IEEP et al. 2016). Finnish stakeholders working with forest conservation, such as the Parks and Wildlife Finland, have already initiated several pioneering projects engaging with the health sector, including creating possible business opportunities at the local level.

However, this broadening of arguments for biodiversity conservation coincides with an emphasis on intensification in forest policy and the increasing use of biofuels. There is therefore a risk that the benefits associated with the ecological functions of forest ecosystems are considered of secondary importance, both as a policy priority and priority for public and private investment. However, these demands need not always be in conflict with one another. Sustainable and productive forests rely on healthy and functioning ecosystems which in turn deliver a range of benefits to society (See also Chapter 5). Balancing these benefits is a key challenge for policy, but one that is essential to get right.

⁶ http://www.syke.fi/fi-FI/Tutkimus_kehittaminen/Tutkimus_ja_kehittamishankkeet/Hankkeet/Habitaattipankki

5. CIRCULAR ECONOMY, ENERGY AND RESOURCE EFFICIENCY IN FORESTRY

KEY FINDINGS

- Developing higher value added from virgin biomass faces challenges. The bulk production of pulp and paper and bioenergy does not directly fit with the idea of the circular economy.
- Because of the high level of resource efficiency in Finnish forest industry, improving the cascading use of wood material has not yet played a big role in the Finnish debate. The opportunities for further improvement are related to the cascading of by-products.
- Improvement potentials of resource efficiency can be still found in the following areas:
 - Step up the use of side streams in drop-in products in other value chains or the development of new applications
 - Switch over wood-based process waste from energy production to material recovery
 - Increase the collection rate of paper closer to international best-practice levels
 - Improve the yield of recycled fibre
 - Capture excess energy within processes
- The most promising expectations are related to new products fitting to the circular economy principles in which forest-based materials and chemicals can be used for replacing more harmful technical materials and chemicals.

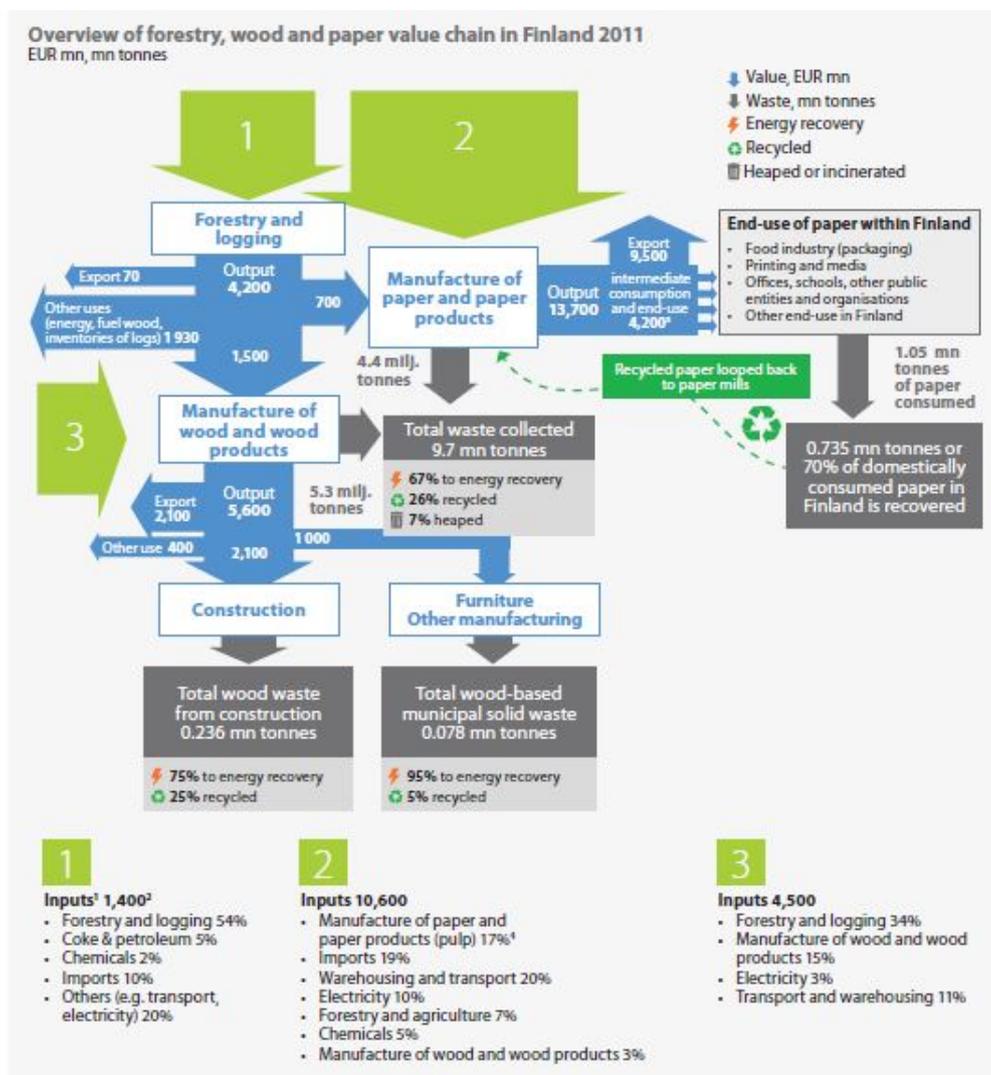
5.1 Resource and energy efficiency in the forest sector

Globally, the pulp and paper industry is the fourth largest industrial energy consumer (IEA, 2008) after iron and steel, chemicals, and non-metallic minerals. Production of pulp and paper requires energy input in the form of heat and electricity. On average, energy costs make up 16 % of production costs (CEPI, 2014), but can be as high as 30 % at specific sites.

At the European level more than half of the energy used by the pulp and paper industry originates from biomass, with most of the rest coming from natural gas. Utilising side streams from the production process, the pulp and paper sector is one of the largest producers of bioenergy and generates 20 % of the biomass used for energy in Europe, mostly for its own use (CEPI, 2012). In Finland, the share of biomass originating from the process in the energy production of the pulp and paper sector is very high (73 %).

Finland's forest industry has developed the processes over decades (even centuries), aiming for maximum efficiency (Pakarinen et al., 2010; Mattila et al., 2014). As Finnish pulp and paper manufactures have faced an increasingly competitive environment, they have been seeking ways to reduce production costs, including energy costs. The expected new requirements emerging from the EU Circular Economy package are therefore a natural continuation of the material and energy efficiency research and development efforts in the industry (Figure 2).

Figure 2: Output from forestry, wood and paper is mainly exported, waste is burned for energy or recycled



Source: Sitra 2015

5.2 New expectations from the circular economy

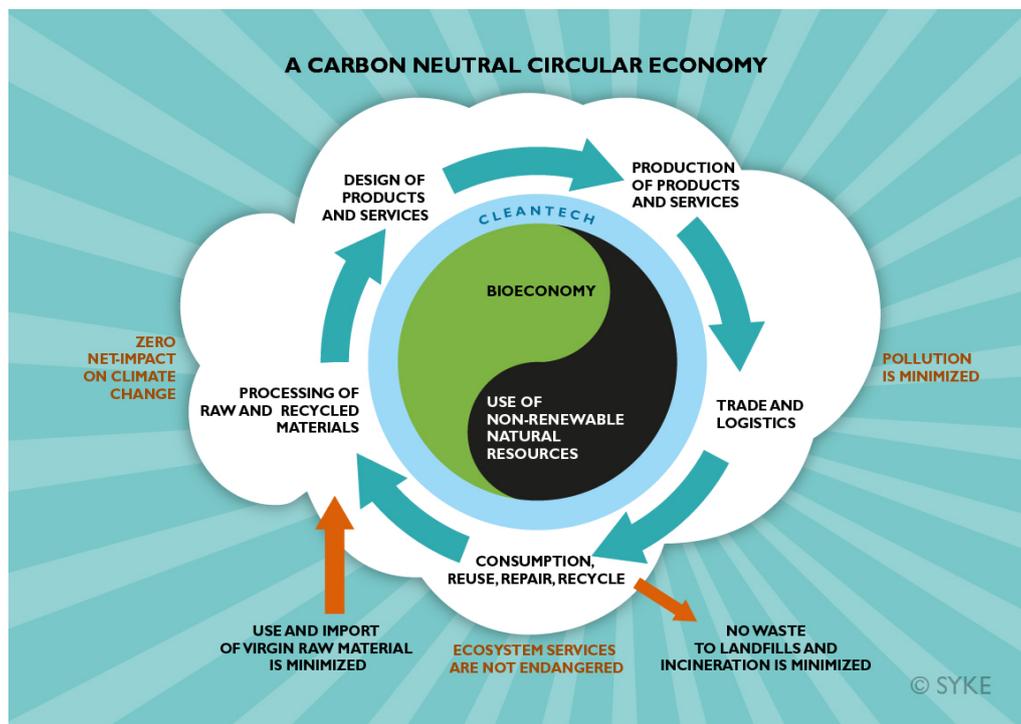
The EU has an objective to stimulate Europe's transition towards a circular economy that would in turn, boost the EU's global competitiveness, foster sustainable economic growth and generate new jobs. Biomass and bio-based products are one of the priority areas of EU's Circular Economy package (EC, 2016). The aim is to enhance the reuse and recycling of bio-based materials, such as wood.

The circular economy is being operationalised in the Finnish policy at a very general level, e.g. in the strategy of the Ministry of the Environment. Yet, the challenge has been recognised (Figure 3, Mickwitz et al., 2014), and there are several research projects supporting the operationalisation.

In Finland, wood is mainly used in construction or the manufacture of paper and paper products. Currently, the recovery of paper fibre for reuse accounts for a significant share of the total material flows. Most of wood waste from sawmills and construction is used as an energy source because energy production is the most profitable route for this waste. In some cases this will represent the most resource efficient use of waste wood. More resource efficient practices with waste wood and processing residues, such as material

cascading⁷, can further improve resource efficiency and balance energy and material needs. The EU paper sector is a well-developed example of such processes.

Figure 3: Finnish operationalization of the circular economy



Source: Micwitz et al., 2014

5.3 Prospects of Finnish forest sector in the circular economy

The forest sector (forestry, wood and paper) is one of the four focus sectors for advancing the circular economy in Finland. The sector has the potential to utilize renewable raw-materials very efficiently and it can generate and use renewable fuels in its own production. The sector can produce bio-based and biodegradable materials and chemicals.

The principles of the circular economy push for further improvement in the resource efficiency of the Finnish forest sector. Finnish forest industry can potentially develop and take part in business models that are suitable for the circular economy. Challenges lie in investing in new products and services to generate increasing value added in the longer term, or further down the value chain. In the short term, these investments might not appear attractive, as there is a tendency to maintain the existing product portfolios and processes.

One of the challenges faced in developing the circular economy, and to some extent the bioeconomy (see Chapter 6 below), lies in the linkages between who makes the investment to improve efficiency and develop circular activities, and who benefits from this investment. Whilst it is clear that the forest sector has a clear role to play in this process, so do the semi-finished/finished product sectors and consumers. Effectively linking the benefits of circular economy activities to those who are making the initial investments is a key challenge, particularly in a sector where the production of raw material (timber) can take a century.

⁷ The efficient utilisation of resources by using residues and recycled materials for material use to extend total biomass availability within a given system (Vis, Mantau, Allen (Eds) (2016))

6. FINNISH BIOECONOMY STRATEGY

KEY FINDINGS

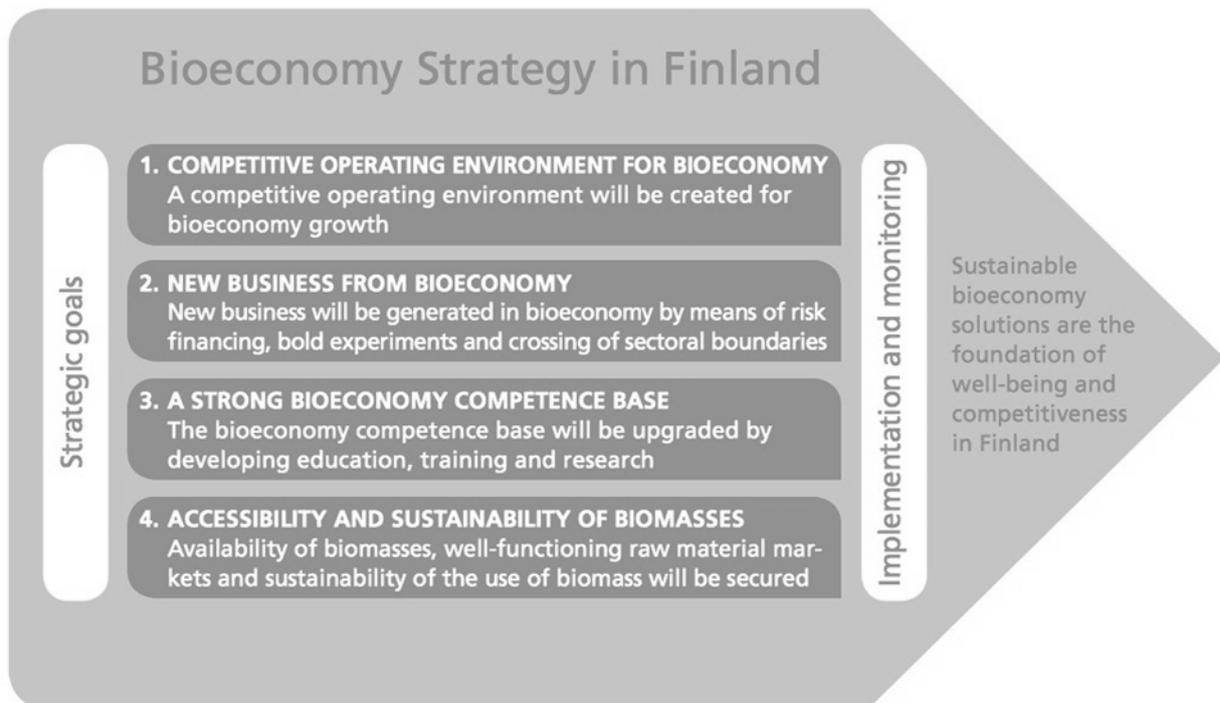
- The bioeconomy strategy of Finland focuses on the new sustainable business opportunities from new bio-based products and increased added value of these products. It also highlights opportunities related to non-consumptive uses and services.
- While the focus on resource-efficiency and increased added value of bio-based products is obvious and warranted, the forest sector should also focus on further developing the sustainability of the entire value chain, reaching from sustainable management of the forest ecosystems to new product and service innovations.
- In particular new high-tech bio-plastics, composites, chemicals and pharmaceuticals as well as non-consumptive health and wellness industries could make even tighter connections with the forest sector.

6.1 The underpinnings and goals of the bioeconomy strategy

In 2012 the European Commission published its bioeconomy strategy for Europe with its “cross-cutting nature offering a unique opportunity to comprehensively address inter-connected societal challenges such as food security, natural resource scarcity, fossil resource dependence and climate change, while achieving sustainable economic growth” (EC, 2012). As a natural resource dependent country and a leader in forest-based industry innovation, Finland has always aimed for efficient use and added value from bio-based products and related services. Yet, the recognition of new economic opportunities and the acknowledgement of resource scarcity together with the need for reducing fossil fuel dependence, has inspired the drafting of a Bioeconomy Strategy in 2014. The Strategy (Sustainable growth from bioeconomy, The Finnish Bioeconomy Strategy, 2014) was drafted in a project set up by the Ministry of Employment and the Economy. The forest sector is at the core of the strategy. There is an expectation of growth in new products and services and in generating value added.

The objective of the Bioeconomy Strategy is to generate new economic growth (up to EUR 100 billion by 2025) and to create 100,000 new jobs from an increase in the bioeconomy business and from high added value products and services, while securing the operating conditions for the nature’s ecosystems. The strategy builds strongly on the existing know-how and infrastructure, and aims to encourage the development of high added value products and services while securing the operating conditions for the nature’s ecosystems (Figure 4). With this strategy, Finland aims to set a course towards a low-carbon and resource-efficient society and a sustainable economy.

A key aspect of the EU strategy is the sustainable management of natural resources, whereas the Finnish bioeconomy strategy focuses more on the increased mobilisation of biomass to existing and new sectors in order to deliver economic benefits. The vision of the Finnish Bioeconomy Strategy is that Finnish well-being and competitiveness will be based on sustainable bioeconomy solutions. The lesser focus on sustainability in the Finnish strategy is explained by the core role that sustainability has played in forest management throughout the history of Finnish forest governance.

Figure 4: The goals of the bioeconomy strategy of Finland

Source: Sustainable growth from bioeconomy – Bioeconomy Strategy. 2014.

6.2 Streamlining regulation for bioeconomy

Partly motivated by the Bioeconomy Strategy, a substantial and procedural reform of several permit and administrative processes under various legislations is under way with the aim to achieve quicker and smoother permit processes. This regulation streamlining concerns at least the environmental permit, building permit, chemicals safety permit, environmental impact assessment procedure and nature conservation assessments. One element in this approach is the move towards a one-stop-shop electronic permit system. Although forestry operations do not require permits (they are administered through a notification procedure), this development influences the forest sector, through a general tendency to simplify administrative procedures.

The National Forest Strategy 2025 (2015) identifies streamlining needs in land-use planning in forested areas and improved geographically-based information services. The 2013 amendment of the Forest Act (1085/2013) was motivated by the need to adapt wood harvesting practices to versatile industrial production processes and energy production. The changes included more flexible tree stand rotation periods and a wider scope of alternative regeneration and harvesting methods.

Wood processing plants (mills and bioenergy plants) would benefit from more streamlined permit procedures. A number of substantial and procedural reforms are designed e.g. for the permit process under the Environmental Protection Act. These include enhanced advisory and negotiation services for permit applicants, streamlined public consultation and permit processing and cooperation with other relevant authorities, active and wide dissemination of information electronically by the operator and authorities and possibly merging of the state authorities responsible for permits and supervision. Many of the planned reforms are being piloted first in case studies such as the large-scale Äänekoski biorefinery project, which is portrayed as a showcase of forest-based bioeconomy.

6.3 Prospects of forest-based bioeconomy in Finland

The bioeconomy strategy of Finland aims for the goods made from biological materials to replace fossil fuel-based and other CO₂-intensive products. For example, the material substitution effects of durable wood products in Europe have been estimated to help to avoid some 2 % of EU greenhouse gas emissions (Nabuurs et al. 2015). The new forest-based products of biorefineries should aim for a range of new products. Their competitiveness compared to alternative products is anticipated to benefit from reduced costs and environmental impacts, resulting from the industry's operations being based on products manufactured from renewable and recyclable natural resources.

Forest industry already develops and manufactures new entirely bio-based products, which, according to the bioeconomy strategy, are expected to contribute to half of the sector's export income by 2030. The new products complement the growing necessity for packaging and hygiene products as well as wood construction. Furthermore, new successful sectors are gradually emerging from microfibrillated pulp, bio-plastics, composite materials, green chemicals and pharmaceutical industry raw materials as well as biofuels. These kinds of innovation are relevant for the forest sector.

These developments will need to go hand in hand with the understanding of resource efficiency in the forest-based sectors and whether aspirations in the bioeconomy need to be revised in relation to those of the Circular Economy as noted at the EU level in the Circular Economy Action Plan (EC 2015)⁸.

The growth potential of non-consumption uses (i.e. uses other than for material and energy purposes) of forest ecosystems, and business models relying on ecosystem services, play an integral part in the bioeconomy strategy. The benefits of nature, including ecosystem services that maintain the supply of natural resources, are recognised as vital for the bioeconomy, providing opportunities for many types of business and underpinning broader societal well-being, particularly in rural areas. For example, well-being services that are based on forests' natural values and that promote health are considered as a growing sector in the bioeconomy with both national and international customers. New business can also be built on the ecosystem services in water and landscape management with links to forests, especially in the urban and peri-urban context. The operationalization of this type of green growth opportunity still relies largely on examples, cases and pilots; and would require more dedicated focus and resources, to allow a more large-scale uptake in the future. In developing these examples it is important that initiatives and policies do not forget those who actually manage the forests (forest owners and forestry professionals) and their role in a bioeconomy that is evolving from the traditional material production process to a more diversified production of goods and services with a variety of different end users.

⁸ The Commission will examine the contribution of its 2012 a Bioeconomy Strategy to the circular economy and consider updating it if necessary.

7. CONCLUSIONS

KEY FINDINGS AND PROPOSALS

- Finland has deep experience in sustainable forestry, and is influential in many international processes. It could make a significant contribution by taking an active role in developing and implementing new product- and process-specific sustainability criteria.
- As an ambassador for bioenergy production in Europe, Finland should make every effort to ensure that climate change mitigation and renewable energy generation measures are implemented without compromising the sustainable management of natural resources. Successful mitigation policy would reduce the vulnerability of Finland's forest-based sectors and the ecosystems they rely on in the long term.
- The move towards a circular economy, and the emergence of new bioeconomy opportunities, will require a focus on the entire value chain, and new choices in product portfolios, production technologies and business models.
- Instead of focusing on biomass use volumes, Finland should always strive for added value. Cascading use of forest biomass (i.e. efficient use of residues and recycled materials to maximise total biomass availability) and diversification of forest-based businesses would generate growth opportunities further down the value chain. Business models which use forest ecosystems but do not consume them (e.g. health and wellbeing sectors) should be encouraged.
- Biodiversity conservation and sustainable management go hand in hand. Therefore, conservation efforts should be coherent and inclusive, supporting conservation at the landscape level and engaging the public and private sector actors.

POTENTIAL QUESTIONS

- Would Finland be willing to take a lead in developing Europe's sustainable forest management criteria, rather than relying on national criteria and governance systems?
- How will Finland develop, monitor and review the sustainability of its forest-based bioenergy, in particular as regards forest management and sustainable provision of ecosystem services?
- What mechanisms does Finland have in place, or plan to develop, for improving material and energy efficiency in forest based production chains, starting from the forest ecosystem, and reaching across the entire sector?
- How does Finland monitor the ecosystem sustainability and support the diversification of the use of forest biomass and forests, and in particular the non-consumption uses of forests?
- What new conservation initiatives or mechanisms does Finland have, to stop forest biodiversity loss and to engage different actors, including businesses, in this conservation effort?

Overall, the Finnish forest sector has the potential to constitute the basis for green economy and sustainable growth. Over time, Finnish forest management has been developed to meet sustainability criteria: both sustainable yield (growth exceeding removals) and the broader definitions of ecological, social and economic sustainability. Forest biomass-based products generally compare favourably to other means of producing the same or similar products, and Finnish forest management can be considered relatively sustainable in a global comparison – except for some important biodiversity conservation gaps. These include shortage of large connected protected areas in southern parts of the country and mire protection on endangered peatland habitats.

Finnish policies related to forests, such as forest policy, climate and energy policy as well as bioeconomy policy, rely on the overall sustainability of Finnish forest management defined and governed within the forest sector. The reliance on broad definitions is rather emphasised in Finnish forest policy; sustainability criteria are not questioned although their critical analysis might well be justified. Particularly, at the interface of different traditional and emerging uses of forest areas and wood resource, as well as at the interface of different policies steering these uses, there is a need to critically assess and adapt the ways in which sustainability is governed. Lately, new sustainability expectations in the market and in policy, in particular in the area of biofuels, have also triggered the need for developing sustainability criteria for individual forest products (notably for solid biofuels) or practices. This will challenge the reliance on existing understanding of overall sustainability of forest management.

The growing demand for wood has increased concerns about ecological sustainability. In particular biodiversity and ecological sustainability goals can be overlooked when the emphasis is on sustainable yield. Other goals also need attention to safeguard the functionality of ecosystems and meet the planetary boundaries. Biodiversity conservation is not confined to protected areas and endangered species; managed forest ecosystems play a key role providing habitat for diverse fauna and flora.

The different sectoral policies influencing the forest sector appear integrated from the outset. Each strategy and policy has been prepared as a collaborative effort between the relevant sectors and is broadly framed, covering ecological, social and economic aspects. This applies also to the Finnish Forest Strategy 2025 (2015). The integrated approach to policy development is by no means a guarantee for policy coherence in practice. Indeed, there can be critical trade-offs between different sectoral policy goals and their implementation. The conflicting goals and trade-offs should be identified and addressed. The policies emphasising increased biomass use, such as bioenergy policy and bioeconomy policy should be evaluated with a view to their biodiversity and carbon balance impacts (e.g. Makkonen et al., 2015). Similarly, the evaluation of biodiversity policy should include more detailed analysis of the benefits and costs associated with the policy implementation and how these are allocated within the society. The trade-offs between different uses of biomass and forest areas should be a target of analysis and open debate, so that the broad impacts of different uses are identified.

With significant forest resources and ambitious energy targets, Finland has significant potential to contribute to EU and global climate objectives. The current and proposed future deployment of bioenergy in Finland reflects these ambitions, yet at the same time raises concerns over their potential impacts on sustainability. The impacts on biodiversity and ecosystem services need to be balanced in this context.

Finnish forest industry has very high material and energy efficiency. The bioeconomy is seen as a new way to reduce coal dependence, and build new sustainable business. The new opportunities for bioeconomy are sought for in natural resource dependent sectors,

including forestry. A clear regulatory and governance framework is an important way to harness bioeconomy, in addition to targeted financial support. The legacy of Finnish forestry might, however, draw the attention to large scale investments, such as the new biorefineries in Finland. To be sustainable, the bioeconomy needs to develop in line with the circular economy, both to improve resource efficiency and to provide greater links between different policy areas influenced by the forest-based sectors.

Forest ecosystems and biodiversity need to be safeguarded to curb biodiversity loss, and to secure a sustainable future for Finland in the long term. This is in the interest of all Finns and forest sector actors. Resilience against extreme weather events, disturbances and other phenomena related to climate change relies on diverse and healthy ecosystems. Future generations of Finns deserve their culturally important ecosystems, and the European Union and the global community need well-functioning Boreal forests. The Finnish forest sector relies on its good reputation in managing forests sustainably.

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NOTES

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ISBN 978-92-823-9153-2 (paper)
ISBN 978-92-823-9152-5 (pdf)

doi:10.2861/62498 (paper)
doi:10.2861/16390 (pdf)

