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Measuring the Value of Forests in a Green Economy

Background paper for the expert workshop on 21 October 2016

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Disclaimer

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1. Introduction: how can the forest sector contribute to a green economy and why should we measure this contribution?

The green economy and associated concepts such as the bioeconomy or the circular economy are closely linked to sustainable development. The 2030 Agenda for Sustainable Development adopted in 2016 provided the UN system with a mandate to contribute to its implementation. Transitioning to a green economy is an ambitious and comprehensive goal which will affect all regions, all sectors of the economy and all parts of the society, each in a different way.

The forest sector, based on a renewable raw material, wood, processed in a way that causes little waste, and is frequently recovered and recycled after use, has an important role in the transition towards a green economy. Carbon is sequestered by growing forests and stored in forests and forest products, or used for energy instead of non-renewable fuels. In the ECE region[1], almost all national and international forest policies and strategies are based on the concept of sustainable forest management which requires integrating economic, social and environmental aspects, and has been well articulated in sets of criteria and indicators.

There are many ways to increase the forest sector's contribution to a green economy: they have been brought together in the Rovaniemi Action Plan for the Forest Sector in a Green Economy (ECE/FAO, 2014) which describes "how the forest sector in the ECE region could lead the way towards the emerging green, bio-based economy at the global level". The Rovaniemi Action Plan, which is voluntary, identifies an overall vision and principles, and proposes objectives and specific actions, as well as potential actors who might contribute to achieving the stated objectives.

It is essential for evidence-based policymaking to be able to measure progress towards policy goals. The Rovaniemi Action Plan aims to promote evidence-based policymaking, effective, efficient and equitable policy instruments and adequate monitoring in order to mainstream a green economy in forest sector policies (pillar E). In particular Action E.2.3 of the Rovaniemi Action Plan is to "develop the forest sector's contribution to broader green economy indicator sets". It includes:

- "Explore how "forest sector indicators can be used to report on a green economy;
- Discuss with other sectors how they want to report on their contribution to a green economy;
- Use the pan European and the Montreal Process criteria and indicators to assess sustainable forest management;
- Update indicators and develop new ones whenever appropriate;
- Ensure that forest sector indicators for green economy monitoring are consistent with other forest sector indicators, notably those for sustainable forest management".

[1] ECE Region includes 56 member States from Europe, Central Asia as well as United States and Canada: http://www.regionalcommissions.org/about/the-regional-commissions/economic-commission-for-europe-ece/

The UNECE/FAO Forestry and Timber Section initiated the implementation of the Action E.2.3 of the Rovaniemi Action Plan during a workshop on "Measuring and communicating the contribution of the forest sector to a green economy" organised during the Metsä2013 - Joint session of the ECE Committee on Forests and the Forest Industry and the FAO European Forestry Commission in Rovaniemi, Finland, in December 2013. The workshop provided an initial proposal as to how to measure the forest sector's progress towards and contribution to a green economy. The discussion on that topic continued during the seventy-second session of the ECE Committee on Forests and the Forest Industry, held in Kazan, Russia in November 2014.

The workshop in Geneva organised on 21 October 2016 is intended to discuss moving this process further with the participation of partners from outside the forest sector. For this purpose the UNECE/FAO Forestry and Timber Section invited to contribute to the workshop the Green Growth Knowledge Platform (GGKP), Organisation for Economic Cooperation and Development (OECD), The Economics of Ecosystems and Biodiversity (TEEB) Initiative, United Nations Environment Programme (UNEP) and the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Partnership of the World Bank. Also the Statistical Divisions at UNECE and FAO were consulted.

At t this stage the workshop does not address policy choices and the future outlook – which are, to a certain extent, implicit in the Rovaniemi Action Plan - but focuses on how to measure progress in this complex field.

The objective of this background paper for the workshop is to:

- Present green economy related definitions and concepts, and internationally developed assessment methods, notably natural capital accounting approaches, and in this way explore aligning forest sector approaches to those being used in wider contexts;
- Propose preliminary suggestions for discussion, based on the initial discussions in Rovaniemi and Kazan, on how the forest sector's contribution to a green economy could be measured;
- Articulate some questions for discussion by the workshop.

The paper, like the workshop, and the Rovaniemi Action Plan, takes an open approach, seeking to learn from, and communicate with, experts from other sectors, and to encourage cooperation between the many forest sector actors in the ECE region, at the national and international level, notably the Forest Europe and Montréal Process, who also participated in the review of this paper.

2. Green economy related definitions and concepts

Sustainable development has been the main policy objective pursued by the international community since the 1992 United Nations Conference on Environment and Development (UNCED). Various strategies have been elaborated by international organizations and national governments to achieve sustainable development, in addition to efforts by other stakeholders. In 2008, given the range of events taking place at the time in terms of financial markets, national economies, energy and commodity prices, the concept of green economy was given increased

and renewed attention as an alternative strategy to revive and reorient economic development and growth, with the additional aim of staying within the bounds of the planet's natural resources. The United Nations Environment Programme (UNEP) launched the Green Economy Initiative (GEI), which consisted of global research and country-level technical assistance. Subsequently, due to growing support and efforts from other agencies and stakeholders, "green economy in the context of sustainable development and poverty eradication" was placed on the 2012 Rio+20 agenda and was acknowledged as a tool for achieving sustainable development.[2]

UNEP defined a green economy as one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2011). In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive. Other definitions have been proposed by various stakeholders, including some governments and coalition groups, but they generally represent the same core idea (UN DESA 2012).

Green economy can be seen as a broad-ranging policy agenda that serves as a strategy for achieving sustainable development, with an emphasis on aligning economic with social and environmental policy. This agenda recognizes the potential of new environmentally sustainable technologies and green sectors to become the motor of a new economic development pathway. Thus, green economy promotes an economic transformation process, and this emphasis is also reflected in the development of indicators frameworks.

Since 2012, the concept of green economy has evolved in both international and national contexts. A large and growing number of countries have sought to elaborate green economy pathways, working with UN agencies and their initiatives, such as the Partnership for Action on Green Economy (PAGE), the Poverty-Environment Initiative (PEI), the Green Growth Knowledge Platform (GGKP), as well as other stakeholders, including the Global Green Growth Institute (GGGI) among others. Ownership and flexibility have featured prominently as national governments have developed their own interpretations and strategies for achieving a green economy, recognizing the need for these to be tailored to a country's circumstances and priorities.

Following Rio+20, the Green Economy Initiative has evolved to now be referred to as "Inclusive Green Economy", which recognizes the equal importance of equity and social cohesion relative to respecting environmental limits and critical ecological thresholds. An inclusive green economy is proposed as an alternative to today's dominant economic model, "to advance both sustainability and social equity as functions of a stable and prosperous financial system within the contours of a finite and fragile planet".[3] An inclusive green economy is presented as a pathway towards achieving the 2030 Agenda for Sustainable Development, eradicating poverty while safeguarding the ecological thresholds, which underpin human health, well-being and development (UNEP 2015a).

The emphasis on inclusiveness and the need to address social equity concerns distinguishes a green economy from other policy agendas. In addition, a green economy includes other sustainability dimensions, such as biodiversity, waste management, fisheries and forest resource management, in addition to climate change.

[2] Rio+20 refers to the United Nations Conference on Sustainable Development, held in Rio de Janeiro in 2012.
[3] http://web.unep.org/greeneconomy/what-inclusive-green-economy

A number of other policy agendas, which are closely related to a green economy, have emerged over the last decade. The closest is green growth, which emerged in parallel as a flagship initiative of the Organisation for Economic Co-operation and Development (OECD): green growth "is about fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities" (OECD 2011). The concepts of green growth and green economy are very closely aligned and indeed such a perspective has been recognized in the collaboration on the GGKP, by OECD and UNEP, together with the World Bank and the GGGI.

Both green economy and green growth can be seen as including the concept of low-carbon development and low-carbon growth, which focusses specifically on investments which reduce carbon emissions, or at least their growth rate. Green economy and green growth also include other aspects such as resource efficiency in general (not only energy), waste reduction and the contribution of natural capital, including nature and ecosystems, to economic development, well-being and inclusiveness.

Circular economy is a long-standing concept with various origins and definitions.[4] The concept focuses on the minimization of waste through resource-efficiency, reusing and recycling. At the core, it is the concept of closed-loop systems in which all raw materials are recaptured as a response to both growing resource scarcity and waste management challenges. In 2015, the European Commission adopted a "Circular Economy Package" as one its major policy initiatives.[5] A circular economy can be seen as a more specific strategy for the transformation and development of industry and infrastructure to contribute to sustainable consumption and production (SCP). UNEP (2015) has recognized a circular economy as one of the key components of an inclusive green economy.

Bioeconomy, another green economy-related concept, also responds to concerns about growing scarcity of resources, but in this case, biological resources, such as those from agriculture, forestry and fisheries. This policy agenda emphasizes a transition towards an optimal and sustainable use of renewable biological resources, as materials and bio-energy. The European Commission adopted a Bioeconomy Strategy in 2012 which focuses on innovation and technology development.[6] The pursuit of a sustainable bioeconomy can also be seen as contributing to SCP, and hence a green economy. Taking a simple perspective, bioeconomy can be seen as addressing the biomass-based sectors of a green economy, while circular economy is concerned with the more abiotic-based sectors of a green economy, such as industry and manufacturing.

3. Internationally developed assessment methods for a green economy

In view of the attention being placed on the finding of ways to operationalise the green economy and related concepts, so that countries can achieve sustainable development objectives, there was a need to develop methods to assess progress in this.

[4] https://www.ellenmacarthurfoundation.org/circular-economy
[5] http://ec.europa.eu/environment/circular-economy/index_en.htm
[6] http://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=strategy

This chapter provides an overview of international work which has been developed in the last few decades to assess the progress towards a green economy and the value of natural capital and ecosystem services. International assessment methods which include forest sector could be useful as a basis for measuring the implementation of activities of the Rovaniemi Action Plan for the Forest Sector in a Green Economy.

It is important to conduct an analysis of the complementarity of present approaches developed in the context of the green economy and the 2030 Agenda for Sustainable Development as well as the existing approaches for measuring the value of natural capital with forest sector valuation systems, because such analysis can contribute to the increase of synergies among the different assessment methodologies. Consequently it will provide better information for policy makers about the evident contribution of forest sector to a green economy and about the possible needs for policy adaptation necessary to enhance this contribution.

The workshop organised by the UNECE/FAO Forestry and Timber Section on 21 October 2016 is meant to provide the first step to such an analysis.

3.1. Overview of assessment methods

A key feature of the inclusive green economy agenda has been that there is no single, one-size-fits-all approach to policy design and implementation. For example, different countries will choose to prioritize different economic sectors for their green economy policy programme. Even for a given sector, different countries may select and design different policy instruments and investments to promote a green economy transition. Hence it follows that existing assessment methods for a green economy also allow for tailoring to a country's individual needs.

Internationally developed assessment methods for a green economy include a range of approaches and frameworks. These are summarized in Table 1 below.

Table 1: Overview of existing applications of measurement approaches to Inclusive Green Growth (adapted from GGKP 2016)

Approaches	Global-level Initiatives	National-Level Efforts
Dashboards	OECD Green Growth Indicators (OECD, 2011; 2014) Eurostat Sustainable Development Indicators (Eurostat, 2014)	Korea Green Growth Monitoring Strategy OECD framework indicators prepared by statistical offices in Denmark, Germany, Czech Republic, Netherlands, Slovak Republic, Slovenia (OECD, 2014) UNIDO/CAF/OECD green growth indicators applied as national instruments for monitoring in LAC drawing from the available methodologies to adjust the set of green growth indicators to the LAC regional context
Composite Indices	Green Economy Progress (GEP) Index (UNEP) Global Green Economy Index (Dual Citizen LCC, 2014) Yale Environmental Performance Index (Emerson et al., 2012) WEF Sustainability-adjusted Global Competitiveness Index Notre Dame Global Adaptation Index FEEM Sustainability Index	China Green Development Index China's Environmental Performance Index Malaysia's Environmental Performance Index Bhutan's Gross National Happiness Index

	SOPAC Environmental Vulnerability Index OECD Better Life Index Ocean Health Index Happy Planet Index Climate Change Performance Index Low-Carbon Competitiveness Index Earth Security Index	
Footprints	Global Ecological Footprint Carbon Footprint Global Resource Footprint Water Footprint	Switzerland's Environmental Impact Scotland's Ecological Footprint AFED Ecological Footprint for Arab Countries
Adjusted Economic Measures	Index of Sustainable Economic Welfare Genuine Progress Indicator (GPI) Adjusted net savings Total wealth including produced and natural capital (World Bank, 2006, 2011) Inclusive wealth (UNEP, 2012) Environmentally adjusted multifactor productivity (OECD, 2016a)	GPI in USA States of Maryland and Vermont Natural accounts developed, for example, by Australia, Austria, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Netherlands, New Zealand, Norway, Republic of Korea, Sweden, United Kingdom

Among these themes, environmental, economic and social information can be combined in ways broadly classified along four approaches, namely, a dashboard of indicators, composite indicators, environmental footprints, and "adjusted" economic measures (e.g. green GDP, adjusted net savings and extended wealth).

Recent applications of green economy assessment frameworks highlight several main features, according to a recent review published by the Green Growth Knowledge Platform (GGKP 2016):

- Dashboards seem to have been most widely used for measuring inclusive green growth (IGG) at the country-level, and frameworks and indicators have been developed by various developed countries.
- Composite indices measuring the progress towards a green economy are not yet fully developed, although a number of environmental indices exist and have been applied in various country contexts to measure aspects of relevance for a green economy.
- Footprints have rarely been applied at the national level but can be a useful ingredient of green economy measurement frameworks.[7]
- Adjusted economic measures that account for environmental information have advanced considerably (e.g. through natural capital accounting). Significant gaps, however, remain as existing approaches do not comprehensively cover natural resource depletion and environmental degradation.

In general, the different approaches serve different information needs. Dashboards of indicators and composite indices provide information that may characterize the progress towards a green economy. The main difference between dashboards and indices is that while dashboards simply present a selected group of indicators, indices entail a comparison and weighting of different indicators. Footprints are an assessment of the environmental impacts or resource requirements of economic activity. In a green economy transition, it would be expected that

[7] Switzerland is a noteworthy exception. The Swiss Statistical Office has included the Ecological Footprint as a sustainable development indicator.

such indicators could be reduced as part of the desired outcome. Adjusted economic measures also capture the desired outcome by combining some information on environmental impacts and resource requirements with conventional measures of economic output or welfare, such as GDP.

Some of these principal frameworks are discussed in the following sections, beginning with those developed internationally, and then highlighting some national efforts most relevant to the ECE region.

3.2. UNEP Green Economy Indicators

UNEP's framework has focused on indicators to support a policy process of assessing issues, setting targets and goals and monitoring progress (UNEP 2012a):

- Issue identification
- Policy Formulation
- Policy Implementation
- Policy Monitoring and Assessment

At the policy formulation and assessment stage, what makes the green economy approach, especially as articulated by UNEP, different from other approaches is its strong emphasis on the role of redirecting investment to address issues and concerns. The rationale for this approach is that misallocations of capital frequently lead to unsustainable development, where major financial resources are spent on, for example, the use of fossil fuels or unsustainable fishing, while too little is spent on improving public transport, renewable energy, ecosystem conservation and waste treatment (GGKP, 2013).

Green economy indicators are generally based on specific resource issues or economic sectors, providing a framework which adapts easily to specific sectoral initiatives and focus, such as the forest sector.

3.3. OECD Green Growth Indicators

The OECD's work on green growth measurement is part of a broader agenda on measuring well-being and sustainability. The OECD's selected indicators organize into the following four themes (see Figure which provides a list of topics covered by indicators in each of these themes):

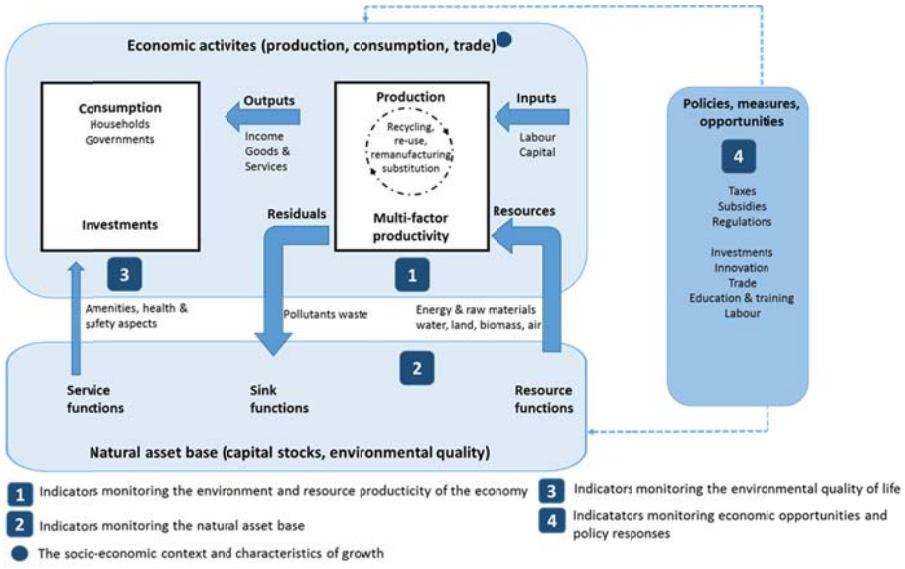
- environmental and resource productivity
- natural asset base
- environmental quality of life
- policies, measures, opportunities

The OECD Green Growth Indicators framework also includes a dashboard of six headline indicators to communicate the central elements of green growth in a balanced way (OECD 2014):

- carbon productivity
- material productivity
- environmentally adjusted multifactor productivity
- natural resource index
- changes in land use and cover
- population exposure to air pollution.

Recent analysis of indicators for green economy and green growth under the GGKP Inclusive Green Growth (GGKP 2016) has proposed extending the scope of the original OECD (2011) Towards Green Growth: Monitoring Progress framework from four to five main themes of relevance for measuring IGG: natural assets, resource efficiency and decoupling, resilience and risks, economic opportunities and efforts, and inclusiveness.

Figure: OECD Green Growth Indicators framework (OECD 2014)



1	**The environment and resource productivity of the economy**	• **Carbon and energy productivity** • **Resource productivity: materials, nutrients, water** • **Multi-factor productivity**
2	The natural asset base	• Renewable stocks: water, forest, fish resources • Non-renewable stock: mineral resources • Biodiversity and ecosystems
3	The environmental dimension of quality of life	• Environmental health and risks • Environmental services and amenities
4	Economic opportunities and policy responses	• Technology and innovation • Environmental goods & services • International financial flows • Prices and transfers • Skills and training • Regulations and management approaches
Socio-econmic interest and characteristics of growth		• Economic growth and structure • Productivity and trade • Labour marekts, education and incomce • Socio-demographic patterns

3.4. UNEP Green Economy Progress Index

UNEP is developing a Green Economy Progress (GEP) measurement framework to help countries evaluate their overall progress towards an inclusive green economy and to allow cross-country comparison of efforts (UNEP 2015b). This framework is complementary to UNEP's green economy indicators framework developed earlier, which focuses on using different types of indicators at different stages of a stylized policymaking cycle.

The GEP measurement framework being developed is to achieve four objectives, which are also similar for the OECD's Green Growth indicators framework. First, it is to compare efforts across

countries in key areas of the transition to an inclusive green economy. Second, it is to support the assessment of progress in achieving some of the Sustainable Development Goals (SDGs) within the Post-2015 Development Agenda. Third, it will help countries monitor progress against nationally set targets in priority areas. Finally, the framework is to bring more transparency to policymaking and inspire broader policy support for an inclusive green economy.

Currently the GEP measurement framework is composed of a Green Economy Progress index (GEP index) and a companion dashboard of green economy sustainability indicators. As can be seen in Table 2, the components of the index are not sector-specific, with the exception of indicators on energy use that are incorporated.

Table 2: Components of the GEP index (adapted from UNEP 2015b)

Indicator	Description	Multidimensionality			Country coverage
		Economy	Environment	Social	
Green Trade	Export of environmental goods (per cent of total export)	X	X	X	128
Green innovation	Patent publication in environmental technology by filing office (% of total patents	X	X	X	61
Renewable energy sources	Share of renewable energy supply	X	X		129
Energy use	Energy use (kg of oil equivalent) per $1,000 GDP	X	X		132
Inequality: Palma ratio	Ratio of the richest 10% of the population's share of income divided by the poorest 40%'s share)	X		X	121
Access to water	Access to improved water sources (% of total population)	X	X	X	197
Access to electricity	Access to electricity (% of total population)	X	X	X	211
Access to sanitation	Access to sanitation facilities (% of total population)	X	X	X	198
Air pollution	Particulate matter (PM2.5) pollution concentration	X	X	X	186
Material footprint per capita	Raw Material Consumption of used biotic and abiotic materials (tons/person)	X	X	X	175
Marine and terrestrial protected areas	Terrestrial protected areas (% of total land area) plus marine protected area (% of territorial waters	x	x	X	145 and 195 (respectively)

Progress is considered as being both multidimensional and long-term. In addition, progress – or change – in the indicators is incorporated into the proposed index, not simply the level or value. For example, the index incorporates the change in the share of renewable energy supply over the measured time period (ten years was chosen for sample calculations). Furthermore, the index can take into account progress made towards defined targets set by policy makers. The indicators are weighted according to the relationship between defined thresholds and initial values, thus representing some relative measure of how far a country must improve. The thresholds themselves are defined either based on scientific recommendations where these exist, or in a relative sense as the level defining the "top" quarter (25%) of best-performing countries.

The dashboard, which currently consists of an additional seven indicators, is intended to track the sustainability of a country's progress in situation relative to planetary boundaries and its stock of wealth. Importantly from a forestry perspective, this includes a land use indicator, measuring the percentage of land devoted to cropland agriculture, with a threshold value of 15%.

UNEP's GEP index is currently under development with consultative draft methodology and papers produced in 2015 and 2016. The index aims to capture progress towards achieving an inclusive green economy by tracking changes in flows that characterize inter-linkages between the social, economic and environmental dimensions of sustainable development.

3.5. National initiatives

Applications in the Czech Republic, Denmark, Germany, the Netherlands, Slovakia and Slovenia showed that most indicators proposed in the OECD framework can be met using nationally available statistics without additional data collection efforts or significant data gaps (OECD 2014). For some of the more sophisticated indicators, however, such as environmentally adjusted multifactor productivity, natural resource stocks index and soil resources, some data gaps remain. Work on developing the methodology is ongoing to fill these gaps (OECD, 2016). Moreover, not all indicators were considered relevant for each of the countries (OECD, 2016), and as in the latest edition of the Dutch Green Growth Indicators report, the OECD framework is adapted to be more suitable to the local context (Statistics Netherlands 2012, 2015).

Statistics Netherlands monitors the country's success in pursuing a green growth strategy, employing and tailoring the OECD's Green Growth Measurement Framework for this purpose. Reports have been published in 2011, 2012 and 2015. The first report described 20 indicators. This list was expanded in 2012 and then again in 2015 to cover 36 indicators under the six themes of the OECD framework. For each of the indicators, the 2015 report included an assessment of the trend over time, distinguishing between those indicators for which an improvement was seen from those which demonstrate deterioration, or those for which no change was detected (Statistics Netherlands 2015). For indicators of environmental and resource efficiency, Statistics Netherlands assessed whether the trend exhibits a pattern of absolute or partial decoupling.

The Czech Republic has undertaken two reviews of green growth in the country using the OECD's Green Growth Measurement Framework. The first was in 2011 and the second in 2013. The latest version measured 27 indicators under five themes (Czech Statistical Office, 2013).[8]

4. Natural Capital Assessment Methods

4.1. System of Environmental Economic Accounting

The System of Environmental-Economic Accounting (SEEA) is an international initiative, coordinated under the auspices of the United Nations Statistical Division. The SEEA provides a standardized framework for integrating data on natural and environmental resources into a set of tables and accounts that are satellite to the System of National Accounts (SNA). At UNCED in 1992, the member states of the UN agreed on a "programme to develop national systems of integrated environmental and economic accounting in all countries" to pursue the development of this standardized framework, building on existing initiatives in various countries.

The SEEA-Central Framework (CF) is a "multipurpose conceptual framework that describes the interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets" (United Nations 2012a). The SEEA-CF proposes accounts to cover physical resource flows, natural assets and their depletion (physical and monetary), and expenditure on environmental protection and resource management. The resource flow and asset accounts clearly comprise a form of natural capital accounting (NCA), according to a broader interpretation of this term. Thus, the SEEA is not itself a measurement framework. Rather it is an accounting system, related to national accounts, which could provide the statistical system for organizing and presenting data necessary for the calculation of various indicators suggested in the preceding sections.

The SEEA also includes specific attention for the agriculture, forestry and fisheries sector, referred to as SEEA-Agriculture, or SEEA-AFF (United Nations, 2016), just as there is specific guidance for other sectors or resources, such as energy and water. SEEA-Agriculture thus provides more detailed guidance on the application of the principles and framework of the SEEA-CF to the agriculture, forestry and fisheries sectors. The UN Committee of Experts on Environmental-Economic Accounting adopted the SEEA-Agriculture guidelines in 2016. The aim is to have the SEEA-Agriculture become a statistical standard, adopted by the UN Statistical Commission, as a subsystem of the SEEA-CF.

In addition to the Central Framework, there are also two other components of the SEEA. One is the Experimental Ecosystem Accounts (SEEA-EEA), which comprise "a coherent and integrated approach to the assessment of the environment through the measurement of ecosystems, and measurement of the flows of services from ecosystems into economic and other human activity" (United Nations 2012b). The scale on which the accounting may be conducted varies: the ecosystems measured may range from specific land cover type areas, such as forests, to larger integrated areas, such as river basins, and may include areas considered to be relatively natural and those that are heavily affected by human activity, such as agricultural areas." The ecosystem accounts are still for implementation at the national level. The difference with the Central

[8] The Czech report groups environmental and resource productivity/intensity under one theme, whereas the Statistics Netherlands report considered these as two themes, resulting in six themes in total in the latter approach.

Framework and standard national accounting is that the basic accounting units are defined according to ecosystem types and boundaries. Various pilot studies are underway as a means to promote the further development of the SEEA-EEA.[9]

The third component of the SEEA is the Extensions and Applications. This companion document to the SEEA Central Framework highlights the potential of data from the accounts of the SEEA Central Framework to be applied to a range of policy and research questions and to be extended to integrate with data in other domains. The focus in SEEA Applications and Extensions is on measurement and analysis at a broad, national level on topics such as sustainable resource use, environmental efficiency, environmental protection activity and the production of environmental goods and services, environmental assets and natural resources, and the household sector's behaviour with respect to the environment.

4.2. Wealth Accounting and the Valuation of Ecosystem Services (WAVES)

Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a partnership, led by the World Bank, which broadly promotes mainstreaming of natural resources in development planning and national economic accounts.[10] This is done through natural capital accounting (NCA) where there are internationally agreed standards, and also by developing approaches to ecosystem service accounts. The partnership, launched in 2010, includes a coalition of UN agencies, governments, international institutes, nongovernmental organizations and academics.

Natural capital accounts promoted under WAVES consist of resource accounts for natural resources like forests, water, and minerals, following the SEEA Central Framework, as well as experimental accounts for ecosystems like watersheds and mangroves. Eight developing countries have since embarked on programmes for NCA under the WAVES partnership, which provides technical guidance and expertise.

4.3. The Economics of Ecosystems and Biodiversity (TEEB)

The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on "making nature's values visible".[11] Its principal objective is to mainstream the values of biodiversity and ecosystem services into decision-making at all levels. It aims to achieve this goal by following a structured approach to valuation that helps decision-makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrate their values in economic terms and, where appropriate, suggest how to capture those values in decision-making.

TEEB has sponsored a number of studies at international and national level on the value of biodiversity and ecosystem services. In terms of indicators, it promotes the incorporation of the economic value of ecosystem services into relevant accounting and reporting frameworks. TEEB has not itself developed or endorsed specific indicator frameworks. Given the importance of forest ecosystems in the scope of TEEB's work, it is nonetheless helpful to provide this brief mention here.

[9] http://unstats.un.org/unsd/envaccounting/londongroup/meeting21.asp
[10] https://www.wavespartnership.org/
[11] http://www.teebweb.org/

5. Overview of assessment systems, including criteria and indicators developed by the forest sector which could be used to measure progress of the forest sector towards a green economy

Previous sections of this paper presented the methods being developed to assess the progress of forest sector towards a green economy, notably a wide range of dashboards, composite indices, footprints and adjusted economic measures, for use at the global/international or national levels, and addressing a green economy as a whole. The objective of this section is to explore the linkages and interactions between the forest sector (in a broad sense) and the green economy as whole, and on that basis to make a preliminary set of proposals for discussion on how the progress of the forest sector towards a green economy could be measured.

This section takes as its starting point the background paper presented to the workshop on "Measuring and communicating the contribution of the forest sector to a green economy" in Rovaniemi in 2013 (Prins, 2013).

Since the Rovaniemi workshop many approaches to monitoring the transition towards a green economy have been developed and are being tested, as shown in the previous parts of this paper. The pace of research, experimentation and discussion is accelerating. In the forest sector, there has been an increase in awareness of the issues and challenges, and several sustainable forest management (SFM) processes have discussed the issue (reports on this will be made at the workshop).

This section addresses some background issues and then suggests proposals for an approach to measure the progress of the forest sector towards a green economy.

5.1. Can present forest sector monitoring systems assess the sector's progress towards a green economy?

Most forest monitoring systems used at present have their origin in the need to manage timber production, combined with the need to monitor biodiversity and forest damage in the context of sustainable forest management. In most countries now, systems of criteria and indicators of sustainable forest management provide the framework for monitoring activities by governments or forest managers. Would these provide adequate information for managing the forest sector in a green economy, as described in previous parts of this paper? Table 1 compares systematically two sets of criteria and indicators of sustainable forest management (Forest Europe –FE- and Montréal Process - MP) with one of the general green economy indicator sets, the OECD green growth indicators – the one which is closest in its approach to that of the SFM criteria and indicator systems.

Table 3 Simplified comparison of OECD green growth indicators and two criteria and indicator sets for sustainable forest management
(for a more detailed comparison, see annex)

OECD indicator	Related SFM indicators	Comment
Environmental and resource productivity		
1. CO_2 productivity(GDP per unit of energy-related CO_2 emissions)	Carbon stocks and flows, increment to fellings ratio, wood products supply and consumption, value added in the forest sector.	Much of the relevant data is available, but not so far analysed in terms of "productivity". Essential to address recycling and residues in the context of CO_2 productivity and to define productivity: in the OECD system it refers to the ratio of CO2 emissions from fossil fuel burning to GDP. This would be feasible for the forest sector but would leave aside some features of the forest sector, notably the use of renewable energy and the carbon sequestration and storage in the sector
2. Energy productivity (energy input/output)	Wood energy supply and use (data available through JWEE[12])	SFM indicators focus on share of renewables, including biomass/wood in total energy, and energy vs. material uses for wood. The productivity aspect could be developed (ratio of renewable and non-renewable energy to output in the forest sector), and the situation for the forest sector compared to that for other sectors.
3. Material productivity (material input/output)	Consumption of wood, production of products, (roundwood equivalents)	While production and consumption data or estimates are available, there has been little analysis of the ratios between the two (material productivity) Use of Life Cycle Assessment tools could develop material productivity information
5. Environmentally adjusted multi-factor productivity	Forest land area, consumption of wood, employment	Data are available on some factors (land, labour, partly energy) as well as on output, but data on capital are not addressed in SFM systems. Nor do SFM indicators address how efficiently the various production factors are used or substitution between production factors.
Natural asset base		
7. Forest resources	Area, growing stock, health etc.	Data available on forest resource. The challenge is to present it in the format needed for the wider green economy systems.
10. Land resources	Trends in forest area	Trends in land use for forests should and can be integrated into broader land resource analysis

[12] Joint ECE/FAO/IEA Wood Energy Enquiry

OECD indicator	Related SFM indicators	Comment
11. Soil resources	Soil condition, soil degradation	Some data are available in SFM systems of soil condition and degradation. They need to be integrated into a broader approach, especially as forest soils are often the least damaged soils.
Economic opportunities and policy responses		
16. R&D of importance to Green Growth	Data are collected by UNFF and C&I processes on total spending on research, training and education in the forest sector	For the purposes of green economy analysis, it would be necessary to separate R&D "of importance to Green Growth" from other R&D. We are not aware of any effort to do this within the sector's analytical framework
18. Environment related innovation		The importance of innovation is accepted (especially in the forest industries), but we are not aware of monitoring of innovation in the forest sector. The OECD gathers information on development of environment-related technologies, but a breakdown is not available for the forest sector.
19. Production of environmental goods and services	Post-consumer recovery of paper and wood, production of renewable wood energy	"Environmental goods and services" are defined by OECD and Eurostat as those goods and services which have an **environmental protection** or **resource management** purpose as their prime objective (recovery of post-consumer paper and supply of renewable energy satisfy these conditions). Management of forests which are "not available for wood supply" or "not cultivated" is considered an environmental service. However, traditional SFM indicators do not distinguish these activities from other types of forest management
20. International financial flows of importance to Green Growth	C&I systems address financial flows for SFM, but not international flows, and do not separate those which concern "green growth".	International financial flows are addressed by the fourth Global Objective on Forests which aims to "reverse the decline in official development assistance for sustainable forest management."[13]
21. Environmentally related taxation	C&I systems for SFM consider policies and institutions to promote sustainable forest management, which would include specific taxation measures	It is not clear if tax systems for sustainable forest management are also considered in a green economy context as "environmentally related taxation"
22. Energy pricing	C&I systems address the use of wood for energy	SFM analysis tends to focus on volumes of wood biomass used for energy, but not on pricing issues, which should be seen in a much wider (all-energy) context.

[13] Data were presented and analyzed in (UNECE/FAO, 2015)

Several preliminary conclusions may be drawn from table 3:

- There are many areas of complementarity between sustainable forest management indicators and green growth indicators, confirming the impression that the forest sector can make a major input to a green economy.
- It also appears that there are sufficient data sources in place to make possible a satisfactory tracking of the forest sector's progress towards a green economy.
- However, the focus of the two approaches (SFM and green economy) is quite different, and it is not satisfactory simply to transfer SFM indicators to address green economy issues.
- Areas which are important for green economy monitoring, but not directly addressed in present systems to monitor sustainable forest management include:
    - Factor productivity/efficiency of resource use. Forest-centred systems concentrate on volumes and flows, not on efficiency of use, whether of land, capital, labour or wood.
    - Accounting approaches and valuation of the elements of the forest sector. Traditional national accounts (SNA) are exclusively in monetary units. Economic-environmental accounts (SEEA) combine physical measures (ha of forest, m^3 of wood in the case of the forest sector) with monetary units, which can create valuation issues.
    - R&D, patents and innovation have received little attention in discussion of SFM. Little information is available on patents and innovation in the forest sector, although the potential importance of these is clear.

5.2. The role of green national accounting in the work on measuring progress of the forest sector towards a green economy

Conventional macro-economic analysis and policy is highly dependent on the availability of reliable, recent and comparable information on national accounts, presented according to methods which have been codified and standardised over many years, notably through the System of National Accounts (SNA). The shortcomings of conventional national accounts (i.e. the SNA) such as: failure to include natural capital, distortion through omission of externalities, failure to include human wellbeing etc. have led to a major international effort to design and implement systems for economic and environmental accounting, also known as "green accounting". In particular the System of Environmental-Economic Accounting (SEEA) prepared under the aegis of the UN Statistical Commission[14] provides the necessary framework as well as detailed guidance for sectors, including agriculture and forestry. At the national level, it will not be possible to achieve truly evidence-based policy making for the green economy without a functional green national accounts system, based on sound theory and generating reliable and comprehensive data.

[14] The System of Environmental-Economic Accounting (SEEA) contains the internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics on the environment and its relationship with the economy. The SEEA framework follows a similar accounting structure as the System of National Accounts (SNA) and uses concepts, definitions and classifications consistent with the SNA in order to facilitate the integration of environmental and economic statistics. See section 4 for discussion of the SEEA

The forest sector is a major challenge for those who are developing green national accounts systems, for a number of reasons, including the following:

- The importance of the "natural capital" contained in forests, and the difficulty measuring and valuing it, especially on an annual time scale;;
- The multi-functional nature of forestry, leading to many "non-market benefits" and other externalities, which are difficult to quantify in physical terms, and even more difficult to express in monetary terms;
- The long term nature of forestry, leading to complex issues of discount rates and assumptions as regards the future (risks over the rotation, possible changes in management objectives, future market conditions and prices etc.).

Experts, including the designers of criteria and indicator systems for sustainable forest management, have resisted the idea of systematically expressing all forest sector indicators in monetary terms, because of the above-mentioned conceptual problems, and because such a methodology seems to imply that all values, including environmental, social and cultural values, should be subordinated to economic values.

However, the concept of green national accounts has been developed in order to incorporate environmental, social and cultural values into evidence-based policy making, and analyse physical measures alongside monetary measures. Combining environmental and social values with traditional economic units should – if correctly implemented – be an effective way of promoting rational discussion and evidence based decision making, without unduly favouring economic values over other value systems.

Green national accounts systems are being developed and will be implemented, whatever the difficulties encountered. The conclusion to be drawn is that the forest sector, and especially researchers, could devote further efforts to generating forest sector related information in a form which can be used by the emerging green national accounts systems, both physical data and, where appropriate, monetary data, bearing in mind that valuation of non-market benefits of forests has, up till now, remained at the theoretical, rather than the policy level in most cases. The emergence of the green economy will probably give extra impetus and importance to these efforts.

An example of natural capital accounts for forests

A recent study of natural capital accounts of the Forest Enterprise England (Forest Enterprise England, 2016), although still exploratory and subject to revision, demonstrated that it is already possible to use a natural capital account approach to produce policy relevant information. Table 5 summarises the main output of this study.

***Table 5 Extracts from natural capital account of Forest Enterprise England** (report year (2015/2016), in £ million)*

	Private value	*External value*	*Total value*
Timber	*207*	*-*	*207*
Carbon	*-*	*7595*	*7595*
Recreation and public access	*(283)*	*4880*	*4597*
Government PES funding	*575*	*(575)*	*-*
Total gross asset value	*503*	*11922*	*12425*
Maintenance costs	*(484)*	*(31)*	*(515)*
Total net natural capital assets	*19*	*11891*	*11910*

Note: For concepts and definitions see study (Forest Enterprise England, 2016). A number of headings have been omitted, as well as data for the baseline year and the change between the baseline and report year.

Whatever the shortcomings of the methodology and data (acknowledged by the authors), it is clear from this study that in England, the value of what is, at present, the core of most forest management and budgeting– timber sales and management costs – is much smaller than the external value provided in the form of carbon and recreation services by Forest Enterprise England. When this type of accounting is fully developed and accepted as a tool for management and policy formulation, in England and elsewhere, it is highly likely that priorities will change, as well as financial flows. In this regard, it is interesting to note that the UK National Ecosystem Assessment (2011) undertook scenario analysis of possible future trends concerning land use, population and income. The analysis concluded that in many cases, increases in monetary, marketed values of ecosystem services, such as agricultural crops or timber, could only be achieved with declines in various non-marketed ecosystem services, such as carbon sequestration. The development of improved and extended accounting systems would support even more refined and robust assessments of this type.

5.3. What is needed to put in place an effective system to measure the progress of the forest sector towards a green economy?

A system which is able to measure progress of the forest sector towards a green economy, in an objective, comparable and understandable way, will need significant investment, of time, political will and resources, as well as flexibility and open minds from all. The possible stages could be:

- Consensus forming, at the pan-European or global level, on what should be measured, as well as concepts, definitions, feasibility etc. (This paper is intended as a contribution to this initial discussion).
- Identification or creation of a framework for the development of the measurement system.
- Analysis of the sector's ability to generate the missing data and identification of the potential external systems/partners that had to be engaged.
- Widespread consultation and briefing with national correspondents and other information providers, as well as distribution of labour between partners, along the lines already developed for SFM by the team of specialists on monitoring SFM.
- Data collection, analysis and reporting.

However in some areas, deeper research and discussion will be needed before there is a realistic prospect of obtaining reliable and comparable data. These areas are briefly described below.

Integration of monetary measures into forest sector monitoring systems. Integration of ecological processes into accounting systems is at the heart of the green economy. Obstacles to do this include the lack of some of the key biophysical data (in a format, and with a frequency compatible with national accounts), as well as the difficulties of expressing these physical flows in monetary terms. Therefore forest sector systems must make a major effort to bring together parameters of the sector not only in terms of m^3 or ha, but also in monetary terms as required by the SEEA framework. This is essential not only for analysis of progress towards a green economy, but also for communication with other sectors. This implies basic information collection on matters like prices, costs, salaries, revenues, and profitability, as well as new methods to put monetary values on aspects which have been measured up till now in physical units. These data should be used and monitored regularly and become a core, normal part of sector analysis, as they are for e.g. agriculture. They should be developed in accordance with existing guidelines notably SEEA and the SEEA Agriculture (includes also forestry) at present under consultation. Many of these data may be being collected already outside the forest sector, notably in the context of national accounts systems, so efforts to acquire this information should be carried out in cooperation with appropriate expert bodies, and harmonised with standard practice for national accounts.

Definition and measurement of natural capital in forests. There is a need to estimate the value, not only of growing stock at today's wood price, but also of net present value of future crops (discount rate, demand projections), as well as of forest land, adjusted by valuation of ecosystem services/externalities. This will necessitate major consultation and research on both concepts and data.

Wood flows Efficiency of resource use and multi-factor productivity are also at the heart of the green economy concept. To estimate this, it is necessary to have a much more precise picture of flows of material and energy, something which is well understood at the level of individual plants, but much less well understood at the national level. The basis for this is available, for instance in the Wood Resource Balance, used in the second edition of the UNECE/FAO European Forest Sector Outlook Study (EFSOS II) (ECE/FAO, 2011), but there are still many gaps. This is not just a research topic but needs annual collection and publication of data. It is necessary to work with industry, who is the only ones able to collect this data. Volumes of recovered wood products should be addressed in the same effort, following successful experience in a few countries (e.g. Germany and the Netherlands, both of which are now in a position to monitor the volumes of wood products recovered for recycling after consumption).

5.4. An approach to measuring progress of the forest sector towards a green economy

On the basis of the comparison above, and the discussion in the paper for Rovaniemi, a possible approach has been developed which might be used as subject for discussion for an appropriate debate, review and modification, as a framework to measure the progress of the forest sector towards a green economy. These very preliminary proposals, summarised below, could be used as one of the direction in which the discussion could develop after the workshop on 21 October 2016.

What questions should a measurement system try to answer?

The measurement system, when in place, should aim to answer the following questions:

- How much, and in what way, is the forest sector contributing to a green economy?
- How to define the "greenness" of the forest sector? How specific is the forest sector's contribution? To which extent the "greenness" of the sector can be measured with the use of general tools (described in the first sections of this paper)? Which additional tools, specific for the forest sector should be developed?
- How "green" is the forest sector? Is the forest sector becoming more "green"? Which parts of the sector (by country and activity) are more "green" and which less "green"?
- In which countries is the forest sector better integrated in (making the most contribution to) a green economy?
- How "green" is the forest sector compared to other sectors?

Structure

The Rovaniemi Action Plan for the Forest Sector in a Green Economy (ECE/FAO, 2014) has eight "principles" in the preamble and five "pillars". Combining them[15] leads to the following five headings which are proposed to structure the measurement of the progress of the forest sector towards a green economy:

- Sustainable and efficient use of natural resources;
- Low carbon forest sector (e.g. contribution to mitigation of, and adaptation to, climate change);
- Sustainability of the work force;

[15] The process of analyzing the Action Plan and other aspects is described in detail in the 2013 paper (Prins, 2013), and not repeated here

- Integration of externalities and payment for ecosystem services;
- Good governance and evidence based decision making.

Six main areas of measurement

It is proposed that the measurement system be structured around six main areas, which are summarised below, with some explanatory justification.

1. ***Conservation of forest natural capital***. The conservation over time of the forest capital has always been at the heart of the concept of sustainable forest management, and is monitored by existing systems of criteria and indicators of sustainable forest management. This aspect will not lose importance in a green economy, and must continue to be measured. However, in an emerging green economy, this centuries old forestry concept will need to be expressed in terms which are understood by and compatible with emerging green accounting systems (see next section). The expression of the value of the forest natural capital should include not only wood stocks and flows but also the value of the non-market functions, and any increase or reduction in the forest's capacity to supply them. This is well known to be a very challenging exercise.

2. ***Multi factor productivity and efficient use of resources***. It is known that there is little waste in the forest industries, as residues are used for other products or for energy; recycling of paper and, increasingly, wood products, is widespread. However traditional analysis of the sector has focused on whether "enough" material is available, and less on how efficiently it is used. In a green economy, it will also be necessary to increase efficiency in the use of all resources, notably wood, but also energy, labour and carbon, and monitor these trends.

3. ***Contribution to climate change mitigation***. A green economy gives high priority to climate change mitigation, an area where forests and forest products play an important and complex role, notably through carbon sequestration and storage, as well as substitution, for non-renewable materials and energy sources. A "cascade" approach (using wood first as raw material, and only afterwards as energy source) is often advocated. However, at the national level, the forest sector contribution to climate change mitigation varies widely according to circumstances: extent of forests, increment/harvest balance, size and efficiency of wood processing industries, importance of renewable energy, consumption and recycling patterns etc. Furthermore this contribution can change over time, sometimes rapidly, for instance because of forest damage, market conditions or increased use of wood energy. The profile of each national contribution in this area should be described and any significant changes monitored.

4. ***Integration of externalities and payment for forest ecosystem services***. Integration of externalities, and their correction through adapted market mechanisms, is essential parts of a green economy. There are many externalities in the forest sector, notably as regards the ecosystem services provided by forests, usually without any monetary compensation. However, systems are being developed and put in place for payment for forest ecosystem services. Quantification of these services and monitoring of efforts to correct them are essential to measure the forest sector's contribution to a green economy.

5. ***Sustainability of the forest sector work force***. The development of "decent green jobs" and reduction of social exclusion are part of all green economy strategies. The protection of the work force against occupational injuries and disease are part of this, as is appropriate education and training, enabling the work force to contribute to a green economy and address the new challenges which will emerge. High accident/injury rates and inadequate education and training would significantly hinder progress towards a green economy. Finally the creation or maintenance of "decent green jobs" (as defined by ILO and mentioned in the Action Plan) is an essential part of a green economy, and thus of the forest sector in a green economy.

6. ***Good governance and evidence based decision making***. Good governance is an important part of a green economy. Although governance in the forest sector is already monitored in criteria and indicators of sustainable forest management, the profound changes necessary in methods and attitudes to move towards a green economy make it necessary to monitor how the sector is responding to the emerging governance challenges. In a very real sense, a green economy is based on changes in governance and decision making, using modified information input (e.g. corrected for externalities). Therefore the quality of governance should also be measured as part of the transition to a green economy.

Some indicators which might be used to measure progress of the forest sector towards a green economy

The list below is an initial set of ideas, structured according to the six areas outlined above. It is not a formal proposal, but an illustration of the type of indicators which might be useful.

Table 4 Some indicators which might be used to measure progress of the forest sector, at the national level, towards a green economy (as proposed to roundtable at Metsä 2013, Rovaniemi))

	Indicator	Direction of "progress"[16]
1	***Conservation of forest natural capital***	
1.1	Change in forest natural capital: physical parameters and monetary value of land and trees, adjusted for externalities and ecosystem services	Stability or increase
2	***Multi-factor productivity and efficient use of resources***	
2.1	Material productivity in the forest sector	Increase
2.2	Energy productivity in the forest sector[17]	Increase
2.3	Recovery rates for paper and wood products	Increase
3	***Contribution to climate change mitigation***	

[16] Change in the direction indicated would constitute progress towards a green economy and change in the other direction would be movement away from a green economy. In many cases, there will be some maximum achievable level which should be defined, so "increase" would not be infinitely possible.

[17] A distinction should be made between inputs of fossil energy and of renewable energy.

	Indicator	Direction of "progress"[18]
3.1	Carbon stocks and flows in forest ecosystems and harvested wood products	Increase in stocks and decrease in net emissions
3.2	Share of wood energy in total primary energy supply	Increase[19]
3.3	A measure of substitution or cascaded use in the forest sector	Progress would be a relatively high share of use as raw material compared to use for energy, provided wastage was kept low
4	***Integration of externalities and payment for forest ecosystem services***	
4.1	Value of ecosystem services provided by forests	Increase
4.2	Systems in place for payment of ecosystem services: number of systems and total value of transactions	Increase
4.3	Value of forest related carbon markets	Increase
5	***Sustainability of the forest sector work force***	
5.1	Occupational safety and health of the forestry work force	Increase
5.2	Investment in education and training	Increase
5.3	Number of "decent green jobs" in the forest sector (or share of decent green jobs in total employment by the forest sector)	Increase
6	***Good governance and evidence based decision making***	
6.1	National forest programme integrated into broader national policies and programmes for a green economy	Existence of an NFP which complies with agreed guidelines[20]
6.2	Monitoring systems capable of supplying green economy indicators and data required for national green accounting systems	Existence of systems

[18] Change in the direction indicated would constitute progress towards a green economy and change in the other direction would be movement away from a green economy. In many cases, there will be some maximum achievable level which should be defined, so "increase" would not be infinitely possible.

[19] This requires further discussion and putting in context. However, it is clear that the use of wood for energy is important and should be monitored, and compared to stated objectives.

[20] For instance, those defined by Vienna Resolution V1 and the MCPFE Approach to National Forest Programmes in Europe.

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Annex

OECD green growth indicators and SFM indicators (comprehensive approach, as opposed to the selection in table X)

OECD indicator	Related SFM indicators	FE	MP	Comment
Socio-economic context and characteristics of growth				Broad socio-economic context indicators, not applicable to an individual sector
Economic growth and structure	NA			
Productivity and trade	NA			
Inflation and commodity prices	NA			
Labour markets	NA			
Socio-demographic patterns	NA			
Income and education	NA			
Environmental and resource productivity				
1. CO_2 productivity	Carbon stocks and flows, increment to fellings ratio, wood products supply and consumption	1.4, 3.1	2.b, 2.d, 5.a, 5.b, 5.c, 6.1.a, 6.1.i	CO_2 productivity in forest ecosystems and in forest products industry and consumption represent fundamentally different issues (carbon sink, life cycle assessment). Much of the data is available, but not so far analysed in terms of "productivity". Essential to address recycling and residues
2. Energy productivity	Wood energy supply and use	6.9	5.c	SFM indicators focus on share of renewables in energy, and energy vs. material uses for wood. Productivity aspect could be developed (energy input – with breakdown renewable/non-renewable – compared to product output), and situation for wood compared with other materials.
3. Material productivity	Consumption of wood, production of products, (roundwood equivalents)	6.7	6.1.d	Use of Life Cycle Assessment tools could develop material productivity information
4. Water productivity	NA			Some forest industries (pulp, paper, fibreboard) are major water consumers, but this is not addressed in SFM analysis

OECD indicator	Related SFM indicators	FE	MP	Comment
5. Multi-factor productivity	Forest land area, consumption of wood, employment	6.5, 6.7	6.1.d, 6.3.a	Data are available on some factors (land, labour, partly energy) as well as on output, but data on capital not addressed in SFM system. Nor do SFM indicators address how efficiently the various production factors are used or substitution between factors.
Natural asset base				
6. Freshwater resources	NA			
7. Forest resources	Area, growing stock, health etc.	1.1, 1.2, 2.4, 3.1	1.1.a, 2.a, 2.d, 3.a, 3.b	Data available on forest resource. The challenge is to present it in the format needed for the wider green economy systems.
8. Fish resources	NA			
9. Mineral resources	NA			
10. Land resources	Trends in forest area	1.1	1.1.a	Trends in land use for forests should be integrated into broader land resource analysis
11. Soil resources	Soil condition, soil degradation	2.2	4.2.b	Some data available in SFM systems of soil condition and degradation. Need to be integrated into broader approach, especially as forest soils are often the least damaged soils.
12. Wildlife resources	NA			
Environmental quality of life				
13. Environmentally induced health problems and related costs	NA			This section focuses on quality of life from the human perspective, whereas the SFM indicators, although they address socio-economic aspects, start from the forest side
14. Exposure to natural or industrial risks and related economic losses	NA			
15. Access to sewage treatment and drinking water	NA			
Economic opportunities and policy responses				
16. R&D of importance to Green Growth	Data are collected on spending on research, training and education in the forest sector	B.10	7.4.b	

OECD indicator	Related SFM indicators	FE	MP	Comment
17. Patents of importance to Green Growth				No information on forest sector related patents, and they are not mentioned in C&I for SFM
18. Environment related innovation				The importance of innovation is accepted (especially in the forest industries), but we are not aware of monitoring of innovation
19. Production of environmental goods and services	Post-consumer recovery of paper and wood, production of renewable wood energy	6.9	5.c 6.1.i	"Environmental goods and services" are defined by OECD and Eurostat as those goods and services which have an **environmental protection** or **resource management** purpose as their prime objective (recovery of post-consumer paper and supply of renewable energy satisfy these conditions). Management of forests which are not available for wood supply or not cultivated is considered an environmental service. However, traditional SFM indicators do not distinguish these activities from other types of forest management.
20. International financial flows of importance to Green Growth	C&I systems address financial flows for SFM, but not international flows.	A.4	6.2	International financial flows are addressed by the fourth Global Objective on Forest which aims to "reverse the decline in official development assistance for sustainable forest management."[21]
21. Environmentally related taxation	C&I systems for SFM consider policies and institutions to promote sustainable forest management, which would include specific taxation measures	A.3, A.4	7.2.a	
22. Energy pricing	C&I systems address the use of wood for energy	6.9	5.c	SFM analysis tends to focus on volumes of wood biomass used for energy, but not on pricing issues, which should be seen in a much wider (all-energy) context.
23. Water pricing and cost recovery	NA			

[21] Data were presented and analyzed in (UNECE/FAO, 2015)

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