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Forests and the Circular Economy

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Forests and the Circular Economy

Note by the Secretariat

Summary

This document serves as background information for item 2 and item 3(a) of the annotated provisional agenda for Forêt2019 – the Joint Session of the ECE Committee on Forests and Forest Industry and the FAO European Forestry Commission.

It provides information about the circular economy and similar concepts and analyses their linkages to sustainable development as well as the targets of the Global Forest Goals of the United Nations Strategic Plan on Forest 2017-2030, particularly Goal 2. The document also describes how circular economy principles are currently implemented in the forest sector and considers possible future roles for wood in a circular economy.

Delegates are invited to refer to this background document during the discussion on forests and the circular economy and to advise the ECE/FAO Forestry and Timber Section on the direction of work in this area. The Joint session is invited to:

(a) Discuss the concept of the circular economy, associated concepts and how they relate to the forest sector;

(b) Provide comments to this document, which will serve as blueprint for a publication on the topic;

(c) Discuss and approve the “Geneva vision for the circular economy in the forest sector”;

(d) Advise on the future work of the Joint ECE/FAO Forestry and Timber Section towards a “zero-waste, carbon neutral, circular forest sector by 2030”and on the possible development of the Forest Sector Roadmap to the Circular Economy 2030.

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I. Introduction

A. Circular economy

1. In recent years, the circular economy has gained increasing prominence as a tool which presents solutions to some of the world's most pressing cross-cutting sustainable development challenges. An economy in which waste and pollution do not exist by design, products and materials are kept in use, and natural systems are regenerated, promises accelerated implementation of the 2030 agenda, particularly Sustainable Development Goal (SDG) 12 on sustainable consumption and production.

2. The circular economy is a horizontal approach, supporting progress towards several other SDGs, such as SDG 6 on water, SDG 7 on energy, SDG 11 on sustainable cities, SDG 13 on climate change, SDG 15 on sustainable use of natural resources.

3. Since 2015, the European Commission has actively promoted the circular economy through the adoption of a "Circular Economy Action Plan", establishing measures that support Europe's transition towards a circular economy. The plan includes a programme of action covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials, as well as a revised legislative proposal on waste (including a 30% target on wood recycling). The proposed actions aim to contribute to "closing the loop" of product lifecycles through greater recycling and re-use, and to bring benefits for both the environment and the economy.

4. The circular economy aims to use materials and services efficiently to ensure that "the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimized" (European Union, 2015)[1]. The concept can be broken down into the following processes: "efficient use of primary resources and energy sources; recycling; eco-design; remanufacturing; refurbishment and reuse of products and components; product life extension; product as service, sharing models and a shift in consumption patterns" (CEPS, 2018).

5. The circular economy model distinguishes between technical and biological cycles. Technical cycles recover and restore products, components, and materials through strategies like reuse, repair, remanufacture or (in the last resort) recycling. In biological cycles, only biologically-based materials (such as food, cotton or wood) are designed to feed back into the system through processes like composting and anaerobic digestion. These cycles regenerate living systems, such as soil, which provide renewable resources for the economy.

6. A comprehensive approach to the circular economy (see Annex I) considers various inputs and outputs in the product lifecycle, including energy supply from renewable sources, land use and management, and the conservation of soil, water and biodiversity. It "includes all kind of material streams with different utilization routes. Organic recycling (biodegradation) and even the capture and utilization of CO2 from industrial processes or the atmosphere are included" (Carus, M., Dammer, L., 2018).

7. However, the concept of the circular economy does not guarantee sustainability. In order to assure sustainability, it is important that the circular economy does not rely substantially on fossil-based and other non-renewable materials with large environmental footprints, and it is equally important that the increased production of bio-based products does not compete with food production and does not have a negative impact on ecosystems, the climate, or risk of natural disasters etc.

[1] CEPS, 2018: The Role of Business in the Circular Economy;

B. How the circular economy relates to the green economy and the bioeconomy concepts

8. Circular economy, green economy and bioeconomy are mainstreamed as global sustainability concepts and are joined by the common ideal to reconcile environmental, social and economic goals. They complement each other in a number of ways.

9. The bioeconomy "encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries" (European Commission, 2012). In other words, the bioeconomy can be defined as the "knowledge-based production and utilization of biological resources, biological processes and principles to sustainably provide goods and services across all economic sectors" (FAO, 2019). It involves two dimensions of sustainable production:

(a) The use of renewable biomass and efficient bioprocesses;

(b) The use of enabling and converging technologies ("life sciences, agronomy, ecology, food science and social sciences, biotechnology, nanotechnology, information and communication technologies (ICT), and engineering" (European Union, 2012)).

10. Bio-based materials have a good potential for recycling and biodegradation, and they are well adapted to circular designs and closed material loops. Bio-based products and services can help reduce pollution and waste generation, while the circular economy embraces new consumption patterns and the reduction of raw material needs.

11. Based on this notion, a new concept, the circular bioeconomy, emerged recently. The circular bioeconomy "increases the resilience on renewable biological resources with increased resource efficiency and circular material loops". In a narrow sense, the circular bioeconomy is the sum of all activities that transform biomass into a different product streams and ecosystem services. In a broader sense, it transforms all main economic sectors by leveraging the potential of emerging bio and nanotechnologies and reducing the use of non-renewable resources to the minimum (EFI, 2018)[2]

12. Another concept, which is a part of the circular economy, is the cascading use of biomass. The cascading use is "the efficient utilization of resources by using residues and recycled materials for material use to extend total biomass availability within a given system. The cascading use of wood takes place when wood is processed into a product and this product is used at least once more either for material or energy purposes." (Carus, M., Dammer, L., 2018)[3].Cascading is the result of recycling and remanufacturing in the circular economy. It is related to the waste hierarchy but starts before the waste is produced with the decision of how to use the fresh biomass.

13. To adequately address the potentially significant increase of demand for bio-resources, and thus the potential impacts on land use, food production and related ecosystem services, the production of bio-based products must take into account the reusability and recycling possibilities early on at the design and planning stages of the production cycle.

14. The green economy[4] remains relevant, and acts as an 'umbrella' concept for encompassing environmental and social dimensions within economies. Nevertheless, in the context of the forest sector, it is useful to apply the circular and bioeconomy concept as it represents an opportunity for ambitious transitions to a more sustainable trajectory.

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[2] EFI, 2018, A Forest-based Circular Bioeconomy for Southern Europe: Vision, Opportunities and Challenges;

[3] Carus, M., Dammer, L., 2018, The Circular Economy – Concepts, Opportunities and Limitations http://bio-based.eu/nova-papers/;

[4] The green economy, according to UNEP, is a system which results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive.

II. The role of the forest sector in a circular economy

A. Circular economy and the Global Forest Goals, particularly Goal 2

15. To protect and maintain global forest resources and ensure a continuous provision of all forest benefits, the (UNSPF) sets "a global framework for actions supporting the sustainable management of all types of forests and trees outside forests" (UNFF, 2015)[5].

16. The six Global Forest Goals at the core of the UNSPF, cover various forest management objectives including the preservation and maintenance of forest resources and ecosystems; the provision of all forest functions, as well as the governance, collaboration and financing needed for sustainable forest management.

17. As regards the circular economy, its principles (i.e. efficient use of primary resources; eco-design; reuse and recycling), when combined with sustainable management, production and consumption patterns, contribute to the sustainable provision of forest ecosystem services. Therefore, the links between the UNSPF and the circular economy are reciprocal. Global Forest Goal 1, for instance, aims at stabilizing and enhancing the resource base on which a circular-bio-based economy would have to be built, while Goal 3 ensures that the proportion of forest products from sustainably managed forests increases significantly.

18. Whether in terms of strict economic gains from wood products production, or broader benefits from subsistence use and the provision of other ecosystem goods and services, the extension of circular economy practices to the forest sector promises to enhance benefits through the efficient use of scarce forest resources. In this sense the circular economy also supports the implementation of the Global Forest Goal 2: "Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest dependent people" (Table 1).

19. The implementation of the circular economy will have an impact on how forest-based benefits are extended and distributed to the human populations. While some circular economy activities based on forest ecosystem services (e.g. timber extraction for wood products or recreation services) provide benefits mainly for local populations, others (e.g. climate change mitigation, biodiversity, soil and water conservation) extend to broader regional and global contexts.

20. Countries with large forest areas and wood products industries will rely on forests for generation of income and employment, while other countries may derive their principle economic benefits from recreation and tourism, or the provision of ecosystem services to populations concentrated in urban areas (ECE, 2015)[6].

21. Evidently, sustainable forest management is needed for the successful contribution of the forest sector to the circular economy while the principles of the circular economy contribute to the sustainable use of forest resources.

Table 1
The GFG2 and the circular economy

Targets of the GFG 2 "Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest dependent people"	*Examples of the circular economy activities in the forest sector, contributing to the implementation of the GFG 2 targets*
2.1 Extreme poverty for all forest dependent people is eradicated.	Enhanced economic opportunities arising from more and efficient use of forest resources and new opportunities in the re-use and recycling of wood-based products.

[5] UNFF, 2015: United Nations Strategic Plan for Forests, available at:https://documents-dds-ny.un.org/doc/UNDOC/GEN/N17/184/62/PDF/N1718462.pdf?OpenElement;

[6] ECE, 2015: Forests in the ECE Region: Trends and Challenges in Achieving the Global Objectives on Forests.

2.2 Increase the access of small-scale forest enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets.	Integration into value chain of small-scale forest enterprises in local value-added production, including buildings and other wooden construction elements, wooden furniture, etc. Reuse of forest residues for bioenergy, recycling of cellulose based bioplastics and textiles, of paper and post-consumer wood (e.g. for panel boards and furniture production).
2.3 The contribution of forests and trees to food security is significantly increased.	More efficient use of forest biomass to provide modern wood energy for cooking; provision of diverse and healthy food combined with consideration of food outputs in the design of silvicultural systems supporting circular economy
2.4 The contribution of forest industry, other forest-based enterprises and forest ecosystem services to social, economic and environmental development, among others, is significantly increased.	Integration of forest-based value chains with other key sectors (e.g. construction, chemical industry, textiles) fostering extension of wood benefits (C sequestration) and forest-based ecosystem services;
2.5 The contribution of all types of forests to biodiversity conservation and climate change mitigation and adaptation is enhanced, taking into account the mandates and ongoing work of relevant conventions and instruments.	Sustainable forest management and conservation of forest ecosystems, cascading use of wood, carbon capture in wood construction and products.

Source: own elaboration based on the targets of the UNSPF GFG2[7]

B. Challenges and opportunities for the forest sector in a circular economy

22. Forests are pivotal for climate regulation, water resources management, and biodiversity conservation, as well as cultural values and local development. Forest ecosystems are a source of bio-based products, which can substitute for non-renewable materials, and they have the capacity to naturally restore and recycle the quality of their resources. Consequently, forestry is strategically well placed to contribute to the development and implementation of a multitude of circular economies.

23. Yet, there are likely but largely unknown effects on enhanced raw material competition, price changes, changes in trade flows, industrial production geography, and employment effects, all of which need to be carefully assessed and analysed. The same goes for addressing the need to manage economic risks induced by the effect of climate change on forests or the need to hedge against biodiversity risks induced by economic interests in efficient wood raw material production for a circular economy.

24. One key role of the forest sector in a circular economy lies in the fact that it provides biodegradable raw material – a strategic resource that can be used for the creation of a number of advanced, reusable and recyclable bio-materials. These materials can feed into various value chains and prompt transformation in several strategic sectors of the economy such as construction and manufacturing (e.g. automotive, home and IT appliances, textiles, packaging, etc.). The development of innovative cellulose-based materials will not only allow the closure of production-consumption loops with a smaller environmental footprint, it will also create economic growth and generate employment in service sectors supporting this production, including research and development, design and product development, marketing, consulting, sales, etc. Major wood components—cellulose, hemicellulose, lignin and extractives—serve as the basis for the production of various outputs such as construction materials, chemicals, biofuels, heat and electricity, bioplastics, packaging, food and feed ingredients, textiles, and pharmaceutical components.

[7] The UNFSPF clarifies that Goal 2 and its targets also contribute to the achievement of, among others, Sustainable Development Goal targets 1.1, 1.4, 2.4, 4.4, 5.a, 6.6, 8.3, 9.3, 12.2, 12.5, 15.6 and 15.c, as well as Aichi Biodiversity Targets 4, 14 and 18.

25. Circular value chains based on wood depend on the natural cycle of forest regeneration. Natural dynamics of growth and regrowth are measured over the years through forest inventory techniques to allow the conservation and use of forest resources on a sustainable basis. Forest restoration, afforestation and reforestation play a key role in safeguarding ecosystem services and ensuring the provision of timber in the long term, and as such should be considered as a vital part of all forest-based value chains.

26. Different parts of the tree are used to manufacture various products, starting from the highest to the lowest quality grade. In a typical tree, harvested for sawmilling, less than two-thirds is taken from the forest for processing, the remainder is either left, burnt, or collected as fuelwood by the local inhabitants. After sawmill processing, only 28% of the original tree becomes lumber and the remainder becomes residues (Table 2).

Table 2
Partition of a typical harvested tree

Tree part or product	*Portion (%)*
Left in the forest	
Top, branches and foliage	23.0
Stump (excluding roots)	10.0
Sawdust	5.0
Sawmilling	
Slabs, edgings and off-cuts	17.0
Sawdust and fines	7.5
Various losses	4.0
Bark	5.5
Sawn timber	28.0
Total	100.0

Source: FAO, 1990[8]

27. Wood-based products and production residues can or should be used, reused and recycled to the maximum extent possible. All remaining material decomposes at the harvest site, providing organic material for forests soils, or can be used for bioenergy production.

28. Based on the generalised wood-based product flow presented above, various circular value chains within the forest sector can be identified. They become more and more complex and diverse, in particular due to the development of new-technology-based products. They also overlap at different stages through cascading use, reuse and recycling of by-products and residues from one production process to another.

29. The European Confederation of Woodworking Industries (CEI-BOIS), the Confederation of European Paper Industries (CEPI), the Confederation of European Forest Owners (CEPF) and the European State Forest Association (EUSTAFOR) have recently developed an illustrative overview of 99 benefits of a tree which feed into various value chains in 14 different industries[9]

30. Since a tree can be used in a vast number of different ways, the number of potential value chain connections and combinations creates a very complex system of dependencies.

31. In the forest sector, industrial symbioses established by cooperating partners, using side streams and by-products of the wood manufacturing sector, have been in place for a long time. Likewise, existing best practices in the forest sector are already largely aligned with the principles of the circular economy.

[8] FAO, 1990: Energy Conservation in the Mechanical Forest Industries. FAO Forestry Paper 93 http://www.fao.org/3/t0269e/t0269e08.htm#TopOfPage

[9] http://www.cepi.org/system/files/public/static-pages/What%20a%20tree%20can%20do%20-%20poster%20only.pdf

32. To explain the potential of the forest sector in a circular economy, some leading illustrative examples of wood-based value chains (wood-based construction, textiles production, bioplastics and wood waste streams) are presented in more detail in Annex III.

III. The way forward

33. In the last several years, the circular economy concept has been gaining attention in policy, business and academic circles. The publication of the European Union's Circular Economy Package[10] in 2015 created momentum around the concept. Many member States and businesses have initiated circular economy strategies, with the aim to transform production chains and consumption patterns. This momentum is likely to continue in the upcoming years if policy support continues and is translated into ambitious measures.

34. The concept of the circular economy is quite broad and leaves room for flexible interpretation as regards related sectors and activities. Its successful implementation requires breaking the silos of sectors and linking with the objectives of other policy agendas, such as initiatives promoting green growth and green jobs, climate change mitigation, and the 2030 Agenda for Sustainable Development.

35. Forests and forest-based products are well positioned to play a key role in the circular economy by providing a renewable source of raw materials and fostering a low carbon-economy. Consequently, a more coordinated approach aiming to tap into the full potential of the forest sector can turn that sector into a sustainable pillar of the circular economy.

A. The ECE/FAO Forestry and Timber Section's related mandates

36. The ECE/FAO Forestry and Timber Section implements the Warsaw Integrated Programme of Work (WIPoW) which aims to assist member countries and regional economic integration organizations to achieve the overall goal to sustainably manage forests so that they provide forest goods and services to benefit society by providing the best available information; facilitating policy dialogues and communication; and building capacity.

37. The Joint Section's work on green economy and the circular economy results from the mandate included in Work Area 2 of the WIPoW and represents a continuation of work initiated by the adoption of the Rovaniemi Action Plan for the Forest Sector in a Green Economy (RAP).

38. As a result of the mid-term review of the Rovaniemi Action Plan in 2018, the Joint ECE/FAO Working Party on Forest Statistics, Economics and Management (JWPFSEM) stressed the need for further discussion on the future of the Rovaniemi Action Plan and the need to link the Joint Section's work more with the Sustainable Development Goals. Member States concluded that there would be a need for a guiding tool or roadmap for the sector "such as the RAP", after the completion of RAP implementation in 2020. The guidance on the characteristics of the roadmap included, among others, the need for the roadmap to have a stronger link to the up-to-date international political context and a focus on the latest economic, social and political trends.

39. Such approach is outlined in the "Geneva vision for a circular economy in the forest sector" (Annex II). which could serve as blueprint for developing a Forest Sector Roadmap to the Circular Economy 2030.

B. Towards a Forest Sector Roadmap to the Circular Economy 2030

40. Building on the conclusions of the mid-term review of the Rovaniemi Action Plan for the Forest Sector in a Green Economy and the recommendations of the fortieth Session of the Joint ECE/FAO Working Party on Forest Statistics, Economics and Management, the following approach can be used as a starting point for discussion at the Forêt2019 Joint

[10] European Commission: http://ec.europa.eu/environment/circular-economy/index_en.htm

Session of the ECE Committee on Forests and Forest Industry and the FAO European Forestry Commission.

41. Member States could work towards a shared vision of the "zero-waste, carbon-neutral, circular forest sector by 2030" (see Annex II). To help achieve this, a new ECE/FAO roadmap could be developed as a framework to support the implementation of the circular economy in the forest sector. It could address the following questions:

(a) How to define the circular economy in the forest sector context and which circular economy principles most apply (e.g. a brief scoping paper on "the circular economy in the forest sector" could be developed for this purpose);

(b) How to conserve and enhance forest resources stocks and balance forest resources flows through sustainable forest management;

(c) How to optimize the components and materials yields by circulating products, at the highest utility at all times in both technical and biological cycles;

(d) How to foster the circular system effectiveness by incorporating negative externalities into decision processes (e.g. carbon footprint and the impact on the forest ecosystem services).

42. The roadmap, which could be called the "Forest Sector Roadmap to the Circular Economy 2030" would guide forest sector stakeholders on how to improve sectoral practices in order to secure sustainable access to forest-based raw materials and boost competitiveness and the creation of green jobs through innovative circular forest-based value chains.

43. The Roadmap structure would build on consecutive value-chain stages in the forest sector and include the following priority areas (Figure 1):

(a) Sustainable supply of forest resources to feed existing and new forest-based value chains (linked to forest resources monitoring and sustainable forest management);

(b) Resource-efficient processing of forest raw materials at initial stages of forest value chains (e.g. harvest, on-site material sorting and processing, and primary processing facilities);

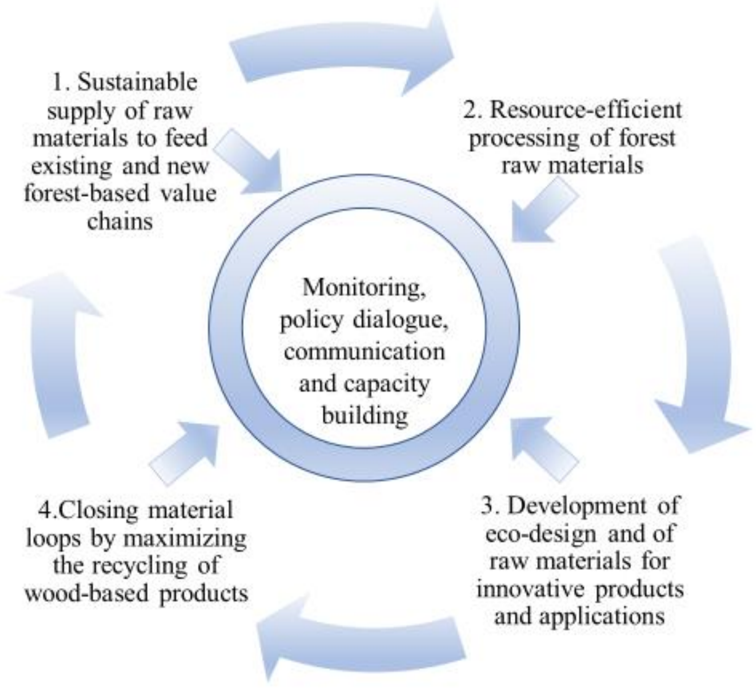
(c) Development of eco-design and of new raw materials for innovative products and applications (linked to advanced forest-based value chains e.g. textiles, bioplastics);

(d) Closing material loops by maximizing the recycling of wood-based products (linked to sustainable consumption models and recovery of post-consumer wood);

(e) Monitoring, policy dialogue, communication and capacity building.

Figure 1

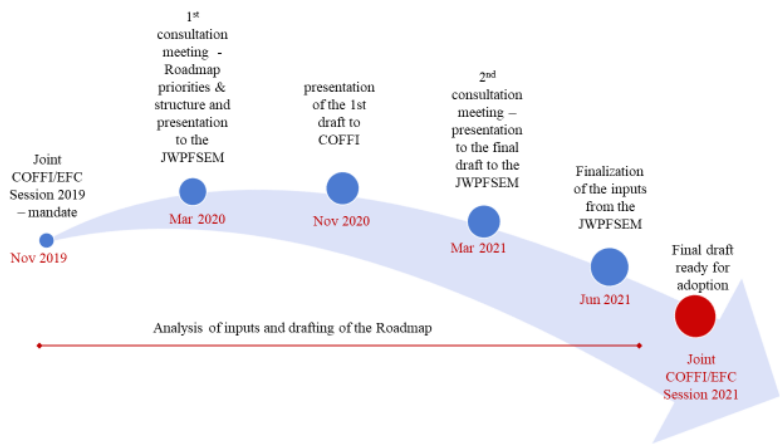
Suggested priority areas for the Forest Sector Roadmap to the Circular Economy 2030



44. A preliminary proposal, as summarized above could be used as a starting point for a discussion during the Forêt2019 and for further debate and modification, through a consultation process leading to the development of a draft Roadmap2030 for adoption during the Joint ECE COFFI and FAO EFC session in 2021 (Figure 2).

Figure 2

Method and timeline for the development of the Forest Sector Roadmap to the Circular Economy 2030



45. A detailed procedure for the development of the Roadmap2030 would build on experiences from the multi-stakeholder process which served for the development of the Rovaniemi Action Plan for the Forest Sector in a Green Economy, and it would use the tools for the participatory process set in the UNECE/FAO Guidelines for the Development of a Criteria and Indicator Set for Sustainable Forest Management.

46. A final draft of the Roadmap2030 could be adopted during the Joint ECE COFFI and FAO EFC Session in 2021. Its priority areas and implementation timeline would be fully integrated with the work areas of the ECE/FAO Integrated Programme of Work 2021 -2025.

47. In order to increase the capacity of member States to implement the circular economy in the forest sector, during the implementation period, the Roadmap2030 could be completed with further country pledges, good practice examples and policy guidelines.

C. Points for Consideration

48. The delegates of the Joint Session are invited to:

(a) Discuss the concept of the circular economy, associated concepts and how they relate to the forest sector;

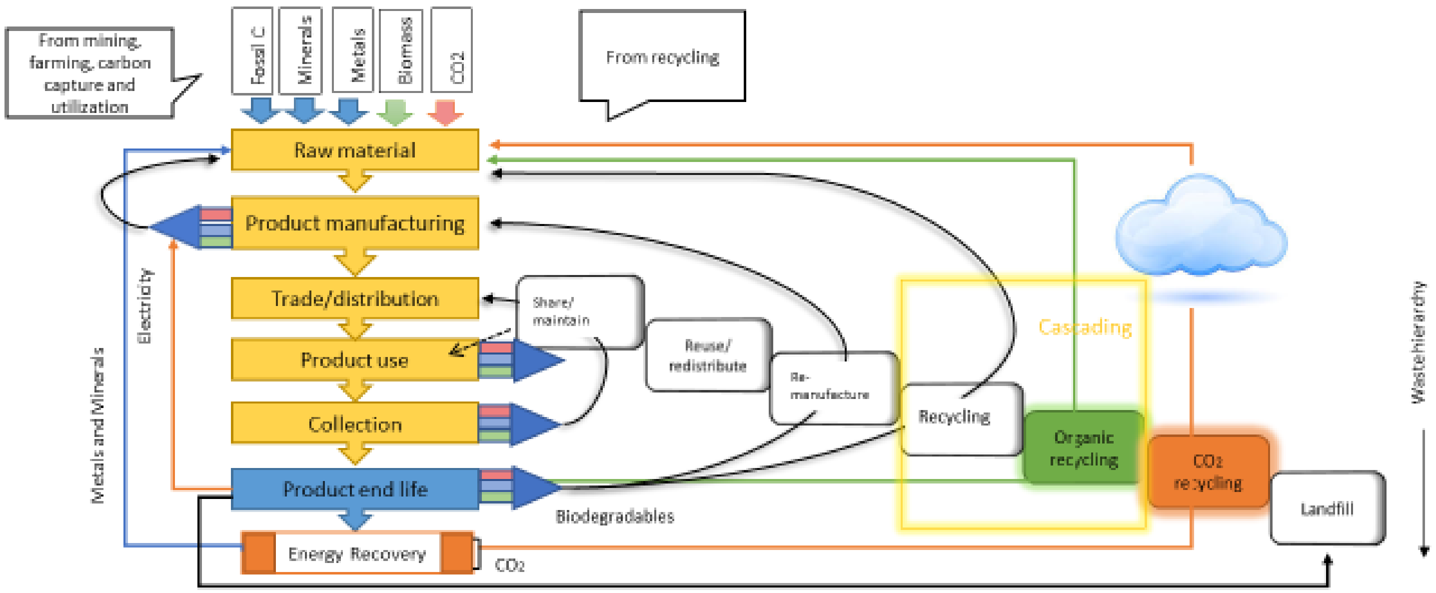
(b) Provide comments to this document, which will serve as blueprint for a publication on the topic;

(c) Discuss and approve the ‘Geneva vision for the circular economy in the forest sector’;

(d) Advise on the future work of the Joint ECE/FAO Forestry and Timber Section towards a “zero-waste, carbon neutral, circular forest sector by 2030”and on the possible development of the Forest Sector Roadmap to the Circular Economy 2030.

Annex I

Comprehensive circular economy graph.



Source: Carus, M., Dammer, L., 2018, The Circular Economy – Concepts, Opportunities and Limitations http://bio-based.eu/nova-papers/;

Annex II

Geneva vision for the circular economy in the forest sector

1. Wood is an important natural resource, one of the few that are renewable. It is prevalent in our everyday lives and the economy. It has been used for thousands of years for fuel, as a construction material, for making tools, furniture and paper.

2. Wood products are designed to allow durability and reuse.

3. The wood-based value chains are well-integrated thanks to forest sector skills in upscaling valuable feedstocks for applications in and outside the forest sector.

4. Wood-based industries have a significant capacity of recycling that has been strongly imbedded in their operations for decades.

5. The production and processing of wood uses much less energy than most other materials, giving wood products a significantly lower carbon footprint.

6. Wood is widespread as feedstock for the production of cellulose and its derivatives. They serve multiple modern applications which substitute for materials that require larger amounts of fossil fuels to be produced.

Turning challenges into opportunities

7. In the context of the increasing scarcity of natural resources, plastic pollution and climate change, wood-based products can play a key role in providing a renewable source of raw materials and fostering low-carbon economy.

8. Consequently, there is an urgent need to capture all the economic and environmental benefits of a more circular approach in the production and use of wood.

9. Rethinking and improving the functioning of wood-based value chains in a more coordinated approach across the actors of the forest sector as well as with key players (producers, retailers, recyclers and consumers) from other sectors will allow the forest sector to become a key pillar of the circular economy.

10. **Therefore, we the COFFI and EFC member States, share the vision of a sustainable and competitive forest sector as a foundation for wood-based value chains** for production of durable and recyclable products in a low carbon and resource efficient economy.

A strategic vision for the forest sector

11. An innovative and sustainable forest sector, where design and production take into account the need to reuse, repair and recycle will lead to a more prosperous economy with considerable benefits to the environment and the society.

12. Therefore, the forest sector needs a strategic vision, setting out what a circular forest sector could look like.

13. This vision needs to promote innovative solutions to sustainable use of wood material, resource-efficient processing, development of new materials and eco-designs and to closing the material loops by maximizing the recycling of wood-based products.

14. Moving decisively towards a more sustainable and circular use of forest-based products will bring prosperity and jobs to the forest sector.

15. Already in December 2013, member States adopted the Rovaniemi Action Plan for the Forest Sector in a Green Economy (RAP), which included proposals for sustainable

production and consumption of forest products ensuring the development of green jobs in the forest sector and the long-term provision of forest ecosystem services.

16. Building on the recommendation of the RAP and bearing in mind the ambition to implement the Sustainable Development Goals (SDGs) in particular SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action) and SDG 15 (Life on Land) **we, the COFFI and EFC member States, will work towards a "zero-waste, carbon-neutral, circular forest sector by 2030".**

Turning vision into reality

17. To achieve this vision, we are requesting the ECE/FAO Forestry and Timber Section to develop a roadmap to support the implementation of the circular economy in the forest sector. The roadmap should address the subsequent strategic questions allowing circularity to be placed at the core of forest sector activities:

(a) How to define the circular economy in the forest sector and which circular economy principles apply the most to the forest sector (e.g. a "circular economy in the forest sector" definition or "a circular economy international standard" could be developed for that purpose);

(b) How to preserve and enhance forest resources stocks and balance forest resources flows through sustainable forest management;

(c) How to optimize the components and material yields by circulating products at the highest utility at all times in both technical and biological cycles;

(d) How to foster the circular system effectively by addressing negative externalities (e.g. carbon footprint and the impact on the forest ecosystem services).

18. The roadmap will guide forest sector stakeholders on how to improve sectoral competitiveness and the creation of green jobs through innovative circular wood-based value chains.

19. It will aim to tap into the full potential of the forest sector as a strategic pillar of the circular economy.

20. The roadmap will be submitted for adoption to the next COFFI and EFC session in 2021.

21. It can be further complemented with country pledges, good practice examples and policy guidelines.

Annex III

Leading examples of emerging wood-based value chains

1. Wood-based construction

1. The construction sector has a large significance for the economy as a whole due to its material throughput, the scale of its employment and income generation, and the crucial role its products play in human lives. The sector also has one of the highest carbon footprints. Therefore, its transformation towards a fully circular economy has strategic implications for the attainment of a sustainable and low carbon economy, reducing carbon emissions, environmental impacts, and waste on a potentially massive scale. The use of renewable materials, wood in particular, will be an important component in this transformation.

2. Wood as a material has a number of benefits compared to other building materials, including fitting accuracy, earthquake safety, good insulation, aesthetic qualities, and impact on human health. It has traditionally been used in single family buildings, at various rates in different geographic regions. With the emergence of the engineered wood products, wood has also been increasingly used in large-scale construction, including multi-floor residential buildings, office buildings, and public buildings. In particular, the development of glued laminated timber (glu-lam) and cross-laminated timber (CLT) elements and modules has enabled this development.

3. One construction technique appears to be very interesting from the circular economy perspective. The “off-site construction" is the planning, design, fabrication and assembly of building elements at a location other than their final installed location to support the rapid and efficient construction of a permanent structure. This technique is characterized by an integrated planning and supply chain optimization strategy and minimum waste.

4. The economic competitiveness of wood-based construction varies between regions and market segments. Still, it is often more expensive compared to established construction methods. However, it can be expected that in the near future, wood-based construction will become more competitive due to development of know-how and standardization of modern construction techniques (Hetemäki et al., 2017)[11].

5. From the circular economy perspective, wood-based construction offers significant potential. The European building construction sector, for example, accounts for 42% of total energy consumption, 35% of total greenhouse emissions, 50% of extracted materials and 30% of water consumption (Hurmekoski et al., 2017)[12]. Wood-based construction practices, when sustainably provisioned, cause less environmental impact compared to the use of non-renewable materials such as steel and concrete. In particular, the production of wood-based construction materials entails reduced energy consumption and CO_2 emissions related other common construction materials, as they can contribute to reducing the overall material use and thereby the amount of waste, energy for transport weight, and related emissions[13].

6. Wood-based products also contribute to climate change mitigation. It is done by two main mechanisms: carbon storage and substitution. Substituting wood for steel, concrete, and other construction materials that are more energy-intensive, avoids fossil fuel consumption and consequent CO_2 emissions (substitution). While trees sequester CO_2 through photosynthesis in forests replanted after harvest, the wood-based products resulting from

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[11] Hetemäki, L., Hanewinkel, M., Muys, B., Ollikainen, M., Palahí, M. and Trasobares, A. 2017: Leading the Way to a European Circular Bioeconomy Strategy. from Science to Policy 5. European Forest Institute;

[12] Hurmekoski, E. 2017: How Can Wood Construction Reduce Environmental Degradation? European Forest Institute;

[13] Hetemäki, L., Hanewinkel, M., Muys, B., Ollikainen, M., Palahí, M. and Trasobares, A. 2017: Leading the Way to a European Circular Bioeconomy Strategy. from Science to Policy 5. European Forest Institute;

harvest store the carbon for the duration of the life cycle of the product (storage). And note that circular economy applications promise to extend this life cycle.

7. Construction is also one of the most significant sectors causing the depletion of natural resources, namely fossil fuels, sand, iron and other minerals. The circular thinking is therefore increasingly important for the sector. A wood-based structural frame can cut the total material consumption of construction in half and the weight of the structural frame by 70% compared to a concrete frame (Pasanen et al., 2012)[14]. A lighter structural frame not only allows a reduced material input to the foundation, but the industrial prefabrication of wood elements and modules provides an efficient means for minimizing waste at the construction site. (Hetemäki et al., 2017).

8. However, the most significant waste volumes related to buildings are created in the renovation and at decommissioning of the buildings. The EU Waste Framework Directive (2008/98/EC) requires that 70% of non-hazardous construction and demolition waste must be prepared for re-use, recycled or undergo other material recovery by 2020. At the time of introducing the directive, the recycling rate of construction waste in the EU27 was on average 63%, and for wood 30%, with significant differences between countries. One-third of demolition wood is used directly for energy production, which from the waste hierarchy perspective is regarded as the least favorable option.

9. Finding more efficient recycling options for demolition wood will be a challenge, partly due to chemical impregnation of wood or the use of oil-based glues, paints and other material mixes[15]. However, one important aspect in this regard will be cascading use, which will extend the lifetime of wood material in the production loop before combusting. For instance, the following sequence of applications could be applied: beam > floor board > window frame > oriented strand board > fiberboard > combustion (Vis et al., 2016)[16].

10. Wood sourcing for construction needs to build on principles of sustainable forest management. It has been estimated that even a theoretical 100% market share of wood construction of all buildings in Europe would translate to a maximum direct demand of 400 million m3 of wood (Hurmekoski et al., 2017). This is equivalent to around 50% of the annual growth of EU forests, and 45 million m3 more than the total industrial roundwood production in the EU in 2016. With reduced assumptions of wood penetration, the impact of increased wood construction on the demand for wood resources remains relatively small: for example, with a 20% market share the increase in roundwood demand could be around 50 million m3 in the EU (Hetemäki et al., 2017).

11. Industrial wood construction has relatively short construction times and can have a positive impact on the environment, particularly in terms of carbon sequestration. Moreover, it is a cost-effective way to meet the demand for housing in many countries. Therefore, new policies and incentives favoring wood construction could have positive benefits in terms of energy consumption, climate change mitigation, and social welfare. There is also a need for development of international building-standards and systems for timber construction. This would give architects and builders greater security in their choice of wood as a building material.

2. Textiles industry

12. The fashion industry, including textiles, clothing and footwear industries, is one of the largest industries in the world. In 2016, it was worth around 2.4 trillion USD and, if compared to individual countries' GDP, it would be the world seventh largest economy (McKinsey,

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14 Pasanen, P., Korteniemi, J., and Sipari, A., 2012: The Carbon Footprint of the Lifecycle of a Passive Residential Building. Case study: the climate effects of an apartment building;

15 Hetemäki, L., Hanewinkel, M., Muys, B., Ollikainen, M., Palahí, M. and Trasobares, A. 2017: Leading the Way to a European Circular Bioeconomy Strategy. from Science to Policy 5. European Forest Institute

16 Vis M., U. Mantau, B. Allen (eds.), 2016. Study on the optimised cascading use of wood. No 394/PP/ENT/RCH/14/7689. Final report. Brussels 2016

2016)[17]. With a steadily growing middle class, the demand for fashion is rapidly increasing. Until 2030, an additional 63% increase of global fashion consumption is projected, compared to 2015 (Global Fashion Agenda, 2017)[18].

13. Consequently, the demand for textile fibers is growing. Their global production was around 105 million tons in 2017, more than double the production volumes of 1990 (Textile Exchange, 2018)[19]. Synthetic fibers (mainly polyester) accounted for 69%, cotton for 23% and man-made cellulosic fibers (MMCF) for 7%. Wool, leather and silk accounted for less than 1% of the global market. As cotton production is expected to stagnate due to limitations related to availability of arable land and water, the demand for MMCF is projected to grow.

14. The raw material for MMCF is called dissolving pulp, and its production has more than doubled since 2000. Around 75% of dissolving pulp is used for viscose production in the textile industry and the rest is applied in diverse high-end markets (EFI, 2017a). The MMCF market is dominated by viscose, with 96% share (Vehvilainen, 2015)[20].

15. From the circular economy perspective, carbon emissions of geographically extended value chains have to be taken into account when evaluating the circularity of MMCF production. Dissolving pulp is mainly produced in Europe and exported to China and India, where most global textile production takes place. Ready-to-wear garments are then exported back to Europe and North America.

16. As regards the recycling in the textiles industry as a whole, less than 1% of materials used to produce clothing is recovered for the production of new clothing. 12% of material inputs to the production process is used in the form of cascading to other industries (e.g., in lower-value applications such as insulation material, wiping cloths, and mattress stuffing). 73% of materials used for clothing end up in landfills or are incinerated, while the remaining share is largely lost in the production process (Ellen Macarthur Foundation, 2017). This lack of circularity in terms of recycling and reuse is one of the key reasons for the significant environmental impact of the textile industry. This impact can be evaluated in three dimensions.

17. First, the textiles and apparel industry, when combined with the global footwear industry, accounts for approximately 8% of the world's greenhouse gas emissions, almost as much as total GHG emissions from the European Union (Quantis, 2018) and more than all maritime shipping and international flights combined (Ellen Macarthur Foundation, 2017). In line with anticipated increases in global production, the apparel industry's climate impact is estimated to increase by 49% by 2030, which would be equivalent in scale to current United States of America emissions (Quantis, 2018).

18. Second, enormous amounts of water are used in the production of clothing, with the growing of cotton being responsible for a significant share of it. On average, 10,000 liters of water are required to grow one kilogram of cotton (Chapagain, 2005). At the same time, the textile industry accounts for up to 20% of global industrial water pollution due to the use of chemicals in the production process (Kant, 2012).

19. Third, viscose production requires the use of the toxic chemical carbon disulfide in the production process, and, in older plants, more than 50% of this chemical is released into the air (ECE, 2014).

20. However, the conclusions about the environmental impact assessment between viscose, cotton and polyester depend on the emphasis put on different criteria in lifecycle analysis studies, which are often produced by the respective businesses themselves. (Viitalia, 2016)[21].

[17] McKinsey, 2016. The State of Fashion 2017

[18] Global Fashion Agenda, The Boston Consulting Group, 2017. Pulse of the Fashion Industry

[19] Textile Exchange, 2018. Preferred Fiber & Materials Market Report 2018

[20] Vehvilainen, M., 2015: Wet-spinning of cellulosic fibres from water-based solution prepared from enzymetreated pulp, Tampere University of Technology, Publication; Vol. 1312

[21] Viitala, E-J., 2016: The promise of slipper. Forest science magazine. 3-4/2016. http://www.metla.fi/aikakauskirja/full/ff16/ff163181.pdf;

21. For instance, the water footprint of MMCF is 10-20 times less than cotton, but the energy footprint of cotton is lower than that of contemporary MMCF (Shen et al. 2010)[22]. With respect to greenhouse gas emissions, viscose's impact is on average 3-4 times lower than the emissions related to the production of polyester, and on average 2-3 times lower than those related to production of cotton. Lyocell, a specific kind of MMCF, has a production footprint 170 times lower on average than polyester's and 130 times lower than cotton's (ECE, 2014).

22. MMCF is not currently recycled on a major scale. However, research is ongoing in this area, and several different methods of recycling MMCF are under development (Textile Exchange, 2018).

23. Finally, the development of newer production methods has significantly improved the production methods for viscose, decreasing the impact of released chemicals. In addition, other types of MMCF have been developed such as lyocell. This fiber can be produced using the environmentally friendly amine acid, which is wholly reclaimed at the end of the manufacture, transforming it into a closed looped system. Also, lyocell stores more carbon in the fiber than is necessary in its production process (Kalnbalkite, 2017)[23]. It can thus be seen as a truly "green" fabric (ECE, 2014).

3. Bioplastics

24. Forest-based biomass serves as a raw material for a range of chemical products which can substitute for synthetic materials derived from petroleum, of which plastics are the most significant category.

25. The production of plastics has grown more than twenty times in the last 50 years: from 15 million tons in 1964 to 311 million tons in 2014 (World Economic Forum, 2016)[24]. They can be found in all areas of life, but among the numerous plastics applications, packaging is the most significant, accounting for 26% of total use (Hetemäki et al., 2017).

26. There are different types of plastics for different uses, some of them can be recycled or reused, but in general, their production and use is connected to major environmental challenges and an increasing threat the human health. Their life cycle involves CO_2 emissions, creation of non-biodegradable waste, along with micro- and nano-pollution of water and food chains.

27. Bioplastics are derived from biomass, e.g. from corn, sugarcane, hemicellulose or cellulose etc., and they represent a promising alternative to plastics. However, in the view of the circular economy, it is important to mention that not all bioplastics entirely decompose into the natural environment. In most cases, biodegradable bioplastics will only break down in a high-temperature industrial composting facility, not in the household compost bin or in the natural environment. Accommodating these materials would thus require new investments in composting infrastructure. On the other hand, some plastics do not decompose at all.

28. Generally, bioplastics can be divided into three categories:

(a) Bio-based and non-biodegradable;

(b) Bio-based and biodegradable;

(c) Fossil-based and biodegradable.

29. Bio-based non-biodegradable plastics include a group of chemically identical alternatives to the most used plastic counterparts such as polyethylene terephtalate (PET), propylene (PE), polypropylene (PP) and polyvinyl chloride (PVC). As the value chain only requires adaptation at the beginning, while the properties of the products remain identical to their fossil versions, they are also referred to as 'drop-in' bioplastics. As the period from the development to commercialization of these materials is considerably shorter, compared to

[22] Shen, L., Worrell, E., and Patel, M.K., 2010. Environmental impact assessment of man-made cellulose fibres. *Resource Conservation Recycling* 55;

[23] Kalnbalkite, A., Zihare, L., Blumberga, D., 2017. Methodology for Estimation of Carbon Dioxide Storage in Bioproducts. Elsevier Energy Procedia 128 (2017) 533-538.

[24] World Economic Forum, 2016: The New Plastics Economy. Rethinking the Future of Plastics.

other biomaterials with new physical and chemical features, their market potential is the highest.

30. Another large group in the category of bio-based non-biodegradable plastics includes many technical performance polymers such as bio-based polyamides (PA), polyesters (e.g. PTT, PBT), polyurethanes (PUR) and polyepoxides (resins). Some of their typical applications are textile fibers (seat covers, carpets), automotive applications like foams for seating, casings, cables, hoses, and covers etc. Usually, their operating life lasts several years. Therefore, they are referred to as durables.

31. Bio-based and non-biodegradable bioplastics will not decompose but can be recycled.

32. The next category, bio-based and biodegradable bioplastics, includes starch blends made of thermo-plastically modified starch and other biodegradable polymers as well as polyesters such as polylactic acid (PLA) or polyhydroxyalkanoate (PHA). Unlike cellulose materials (regenerate-cellulose or cellulose-acetate), these materials have been available on an industrial scale only for the past few years. So far, they have primarily been used for short-lived products such as packaging, yet this large innovative area of the plastics industry continues to grow thanks to the introduction of new bio-based monomers (molecules which form polymers). Bioplastics in this group can be composted in natural or adapted conditions and several of them, primarily PLA, can also be recycled.

33. The last category: fossil-based and biodegradable bioplastics is comparatively small group, mainly used in combination with starch or other bioplastics because they improve the application-specific performance of the latter by their biodegradability and mechanical properties. These biodegradable plastics are currently still made in petrochemical production processes. However, partially bio-based versions of these materials are already being developed and will be available in the near future (European Bioplastics, 2018)[25].

34. There is still a lot of confusion in the international market about what bioplastics are, which bio-materials were used for their production, and to what extent they are actually bio-based. Some independent certification and labelling schemes have been emerging, but they rather focus on informing consumers on pragmatic features of the products, such as if the product is bio-based, bio-degradable or compostable, than specification of their exact composition. In this context, it is difficult to estimate what the market share of the cellulose-based bioplastics is, but it is certainly growing.

4. Wood waste streams

35. In the context of a circular economy, wood has a high value as a raw material and there are several utilization options for side streams created bysawing and trimming, e.g. wood off-cuts can be used by companies that produce smaller components. Many production side-streams are processed into other products. Leftover pieces can be a raw material for these streams; even the smallest off-cuts can be used for particleboard or pellets. Sawdust and shavings can be used in filling material for packaging, in animal bedding, in composting (e.g. dry toilets which save water), or in energy production.

36. In particular, wood-based fuels offer a natural extension to forestry and wood industry end of life cycles by capturing the value of harvesting waste, bark and processing residues, and providing a valuable by-product for forest industries both in energy use at the mill and for sales to local households and other processing industries. These applications, especially the use of mill residues to generate heat and electricity at the mill site, have long been established practice in many locations.

37. In smaller wood industry companies, heat from wood waste enables an important first step into value-adding by providing energy for kiln-drying of sawn wood, which in turn allows better accuracy in dimensioning and remanufacturing wood products for new market segments and end-uses. Charcoal, pellets and briquettes can be produced from wood

[25] European Bioplastics, 2018: What are bioplastics? https://docs.european-bioplastics.org/publications/fs/EuBP_FS_What_are_bioplastics.pdf

processing waste with relatively low investments, and these open up the consumer market for wood fuel.

38. In large-scale forest industry, harvesting waste, bark and processing residues are used to generate both heat and electricity for internal and external uses. The largest pulp mills are often self-sufficient in energy with a surplus, allowing them to sell heat to local users and electricity to the national grid. Apart from energy, they develop different residue components (e.g. chemicals, lignin, process gases) into new products with partner companies.

39. Existing good practices in circularity, eco-efficiency and in resource savings do not always guarantee sustainability of the value chain. When residual volumes of biomass are retrieved to produce a new biochemical compound, additional gains in resource efficiency can be achieved. However, consideration of other potential uses of such residual streams is important in determining whether this approach is sustainable in the long term. For instance, leaving a certain proportion of forest biomass at the harvest site, thus contributing to forest soil formation and related ecosystem functions, may be more sustainable in the long term.

40. The linkage between sustainable forest management and circular efficiencies in industrial applications needs to be carefully considered and may have counter-intuitive implications. For example, a recent study in Sweden (The Working Forest, 2019)[26] revealed that virgin paper has a lower carbon footprint than recycled paper when it comes from places where forests are sustainably managed and the environmental impact of producing electricity used for its manufacture is low.

41. This can be done using new technologies (e.g. IT for forest monitoring, design and cut of ready to use wood construction elements, organization of information and redistribution channels), product innovations (e.g. development of new wood-based bio-products), training (e.g. in eco-design or in life-cycles management), and policy contexts that support the circular economy. All these factors can enhance co-operation between various actors in the forest sector, as well as in other sectors, in order to create profitable business models and job opportunities along the entire length of forest-based value chains.

[26] The Working Forest, 2019: Non-recycled Paper is Better for the Climate https://www.workingforest.com/non-recycled-paper-is-better-for-the-climate/;