

focus paper

Lenzing Group
Wood and pulp
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Wood and pulp

Growing global demand for wood-based biomass and alternative land use is putting pressure on the world’s forests, which provide fresh water, oxygen, climate regulation, flood resilience, biodiversity, recreation, and valuable raw materials to society.

We care for wood in all its aspects. Our focus is therefore on sustainable sourcing through certification, responsible consumption and the highly efficient use of wood through biorefinery, supported by internal and external expertise.

We promote conservation solutions to protect ancient and endangered forests. Innovation in alternative cellulose sources such as textile recycling is a strategic priority for the Lenzing Group.



Lenzing's “Naturally Positive” sustainability strategy

“Naturally Positive”, the Lenzing Group’s sustainability strategy, was developed from the results of the materiality analysis and is firmly rooted in the Lenzing Group’s Better Growth corporate strategy.

Within the People – Planet – Profit dimensions, the sustainability strategy defines the seven strategic focus areas in which Lenzing can do most to create a more sustainable world. It is the basis for Lenzing’s approach for contributing to the United Nations’ Sustainable Development Goals (SDGs).

Lenzing’s wood and pulp supply is connected to all of these focus areas, but especially to:

- Raw material security
- Decarbonization
- Partnering for systemic change

According to the updated materiality analysis in 2021 for sustainability reporting, raw material security / wood and pulp supply is one of the three top material topics for Lenzing.

Strategic focus areas of sustainability and the corresponding SDGs



Figure 1: Lenzing’s “Naturally Positive” sustainability strategy and UN Sustainable Development Goals

The SDGs are a collection of 17 goals adopted by all Member States of the United Nations in 2015 to address global economic, social, and environmental challenges and achieve a more sustainable future by 2030.

Guided by its “Naturally positive” sustainability strategy, and in particular by the principles laid down in the Lenzing Wood and Pulp Policy, the Lenzing Group is committed to contributing to the UN Sustainable Development Goals by its responsible wood and pulp sourcing. For more information on Lenzing’s approach to the SDGs, please see the “[Sustainable Development Goals](#)” focus paper.

To set the pathway of the ambitions in the “Raw material security” strategic focus area, a number of targets have been defined (Table 1):

Color code	On track	Status	SDG
Conservation project Albania	To implement a conservation solution of 20 ha in Albania in combination with a social impact project by 2024	2024	1, 15
Measure(s)	Lenzing reforests 20 ha of degraded land in Albania	2024	
	Lenzing establishes a training center for local communities in Albania	2024	
	Lenzing supports interdisciplinary vocational trainings and school partnerships in Albania	Yearly	
Progress made in 2023	The scope of the project has been significantly expanded to other countries in Western Balcan to include the Kosovo, North Macedonia and Montenegro. This expansion was funded by Austrian Development Agency (ADA) and Lenzing, and is coordinated by Inspiring Cooperation Empowering People (ICEP). In 2023 10.778 trees were planted, which culminates in additional 5 ha of afforested area. For more information on this project please see the chapter " Biodiversity and ecosystems ".		
Conservation area Brazil	To implement conservation solutions on 15,000 ha at the new pulp mill in Indianópolis (Brazil) by 2030	2030	15
Measure(s)	Lenzing increases the protected area at the site in Indianópolis (Brazil) from 13,000 ha to 15,000 ha	2030	
Progress made in 2023	Lenzing achieved this goal in 2022 and increased the total conservation area in Brazil even further than the target, to more than 19,000 ha in 2023.		
Conservation projects	To engage in further conservation, biodiversity protection and restoration activities in regions where forests are at risk or should be improved by 2025	2025	15
Progress made in 2023	Lenzing supported several projects outside of its value chain in 2023 for example a project in Austria for protection of wild bees, for a detailed description of all projects please see " Biodiversity and ecosystems " chapter.		

Table 1: Sustainability targets regarding the "Raw material security and biodiversity" strategic focus area

The cellulose cycle – from nature back into nature

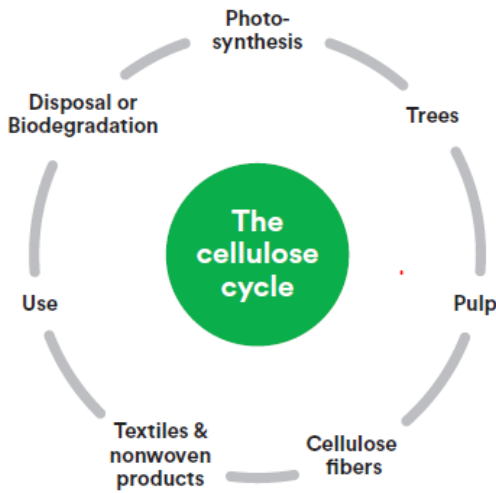


Figure 2: The cellulose cycle

biopolymer cellulose is used by the Lenzing Group for fiber production. At the end of their useful life, the fibers can biodegrade to their original compounds: carbon dioxide and water. (For details and applications in consumer products, see the Focus Paper [“End of Product Use”](#))

The cellulose cycle is the basis for Lenzing’s business model and provides opportunities to address some of the most challenging societal topics, such as climate change or emerging circular economy solutions.

LENZING™ fibers are made from dissolving wood pulp and are part of a closed natural material cycle, the “cellulose cycle”.

It starts with photosynthesis, a biochemical process that produces the organic building blocks for all plant life on earth from carbon dioxide and water by utilizing energy from the sun. One of its major products is the world’s most important biological construction material, cellulose. The

The principle of photosynthesis

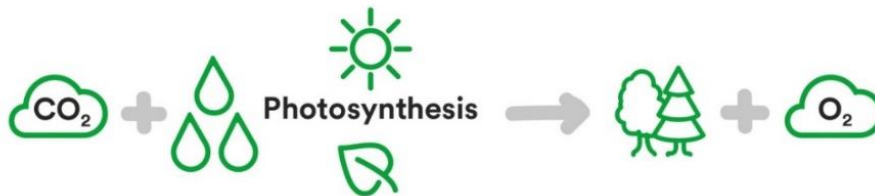


Figure 3: The principle of photosynthesis

Responsible sourcing of wood and dissolving wood pulp

Wood and dissolving wood pulp are Lenzing’s most important raw materials. The Lenzing Group assumes responsibility by focusing on sustainable sourcing covered by certifications, responsible consumption and the highly efficient use of these valuable resources. Lenzing sources wood and dissolving wood pulp from semi-natural forests and plantations (as defined by the Food and Agriculture Organization of the United Nations¹), not from natural or ancient and endangered forests.

Precise figures for the absolute amount of wood purchased and dissolving wood pulp sourced are not provided for confidentiality reasons. As an indicative estimate, total fiber sales of nearly 1 million tons require a pulp input of about the same amount. The amount of wood required to produce this dissolving wood pulp cannot be stated

exactly, especially given all the different processes and species that our suppliers use. Assuming a dissolving wood pulp yield from wood of 40 percent, a rough estimate for the total wood input would be 2.5 million tons (dry matter), split up between Lenzing's own production and purchased dissolving wood pulp.

Wood as a natural and renewable raw material plays an important role in replacing fossil-based products and helps mitigate climate change through carbon sinks in forests and wood products. For more information on the climate effects of and on wood and pulp sourcing, see the "Forestry and climate change" chapter below.

To ensure responsible sourcing of wood and pulp, Lenzing follows these guiding principles and due diligence processes:

Guiding principles

- Centrally managed wood and pulp procurement
- Strict Wood and Pulp Policy
- CanopyStyle Initiative
- Global Lenzing Supplier Code of Conduct
- Preference for long-term contracts and direct contacts with wood and pulp suppliers

Due diligence processes

- Regular audits on wood certification standards (FSC[®], PEFC)²
- Internal audit management system
- Wood and pulp certification according to FSC[®] and PEFC standards
- Additional third-party verification as part of the CanopyStyle Initiative and internal supplier audits

Management of sustainable wood and pulp sourcing

Centrally managed wood and pulp procurement

Processing wood into fibers requires a special quality of pulp for an intermediate step. This intermediate is called dissolving wood pulp. It has a higher cellulose content than paper pulp and has to meet special purity requirements for criteria such as non-soluble particles content.

The Lenzing Group sources dissolving pulp for its fiber production in two ways (Figure 4): from its own pulp mills in Lenzing (Austria), Paskov (Czech Republic), and Indianópolis (Brazil), and on the other hand in the open global market, mostly under long-term supply contracts.

The new pulp production facility in Indianópolis (Brazil), was implemented in the LD Celulose joint venture together with the Brazilian Dexco (formerly Duratex) group. Lenzing holds a 51 percent stake of this site, while Dexco has a 49 percent stake. The pulp plant began operating in 2022 and almost reached its nominal capacity of 500,000 tons in the same year. It is among the most productive and energy-efficient facilities in the world, and was designed based on European Union's Best Available Techniques (BAT)³, and is powered by renewable energy. The pulp produced is 100 percent FSC[®] certified^a and is bleached totally chlorine-free (TCF).

^a Lenzing Group licence code FSC-C041246

Sourcing of wood and dissolving wood pulp – the value chain

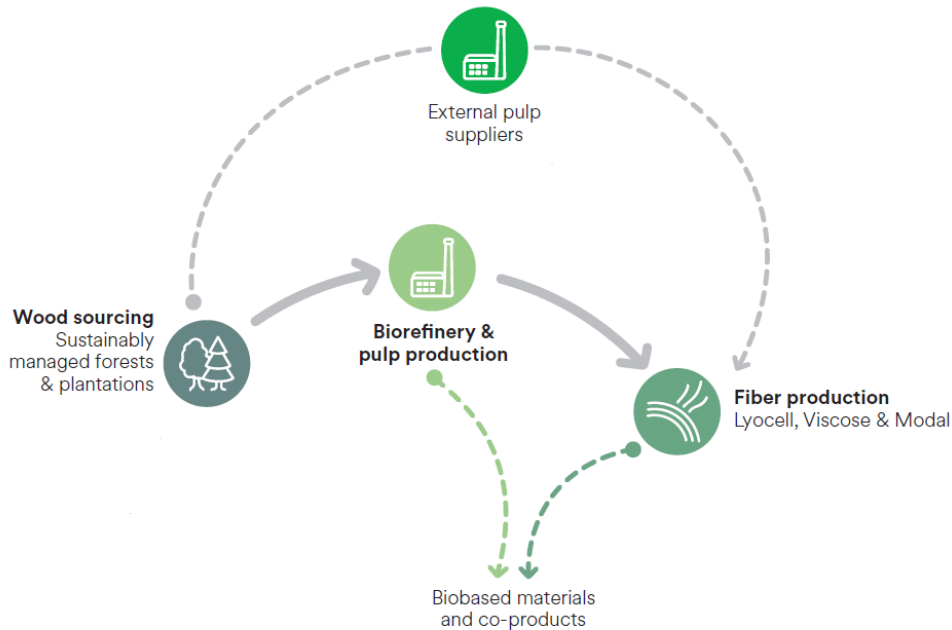


Figure 4: Sourcing of wood and dissolving wood pulp – the value chain

Wood purchasing and pulp purchasing are handled by different teams within the Lenzing Group (Wood Procurement, Pulp Trading GmbH). Lenzing aims to minimize purchasing risks such as major price fluctuations and supply bottlenecks through reliable, long-term supply relationships and active supplier management.

Supplier selection and evaluation is based on environmental, social, and governance standards (ESG) as well as economic criteria.

All of the Lenzing Group's suppliers are evaluated for sustainability in the production chain. Lenzing conducts regular audits as well as specific evaluations of both new and established suppliers for sustainability and compliance with environmental and safety standards.

Suppliers are interviewed regularly and evaluated under environmental and safety aspects with the support of external experts. A final assessment is then conducted. It affects the overall supplier assessment and constitutes a major criterion for long-term cooperation with suppliers.

All suppliers must comply with the Lenzing Global Supplier Code of Conduct. In addition, wood and pulp suppliers have to comply with the Wood and Pulp Policy and meet or exceed the criteria for Controlled Wood according to the FSC® standard, which is part of the due diligence process. Pulp is purchased with a minimum requirement of the FSC® Controlled Wood standard. For wood procurement, Lenzing applies its own due diligence system (DDS) – see the box on page 11.

In addition to its own dissolving wood pulp production in the facilities in Lenzing, Austria; Paskov, Czech Republic and Indianópolis, Brazil, Lenzing procures dissolving wood pulp in the global market.

Lenzing's Wood and Pulp Policy

In its [Wood and Pulp Policy](#), Lenzing is committed to procuring wood and dissolving wood pulp exclusively from non-controversial sources.

Controversial sources include wood derived from:

- illegal logging or the trade in illegal wood or forest products
- destruction of high conservation values in forestry operations, including ancient and endangered forests, and endangered species habitats
- plantations established after 1994 through significant conversion of natural forests or conversions to non-forest use
- introduction of genetically modified organisms in forestry operations
- violation of traditional, community and/or human rights
- any violation of the ILO Core Conventions as defined in the ILO Declaration on Fundamental Principles and Rights at Work

Following these principles, Lenzing is generally committed to avoiding wood and pulp from such regions as the Canadian and Russian boreal forests, coastal temperate rainforests, and tropical forests of Indonesia, Amazonia and West Africa. If Lenzing sources from these regions, Lenzing aims to ensure that these sources are at least certified by FSC®, that science-based conservation planning is supported in that area, and conservation solutions are supported to protect such ancient and endangered forests.

Regular risk assessments, audits, on-site visits and independent third-party certification of sustainable forest management programs ensure compliance with the policy and Lenzing's commitment to no-deforestation.

If Lenzing discovers that it has sourced wood or dissolving wood pulp from controversial sources, it will first engage with the supplier to encourage practices consistent with Lenzing's Wood and Pulp Policy. If the response is unsatisfactory, arrangements with the supplier will be terminated with a reasonable lead-time. Very few such cases have occurred in recent years. There were three in 2020, one in 2021 and none in 2022.

Lenzing also strives to establish long-term partnerships with its wood and pulp suppliers and seeks to do business personally and directly with forest owners and pulp mills.

Global Supplier Code of Conduct

The Lenzing purchasing departments operate in accordance with the ethical, ecological, social, and economic principles described in the company's [Global Code of Business Conduct](#) (CoBC). The selection and evaluation of suppliers is also based on environmental, social, and governance standards (ESG).

The [Global Supplier Code of Conduct](#) outlines Lenzing's expectations for supplier conduct with regard to health and safety at work, labor and human rights, environmental protection, ethics, and management practices. Consequently, Lenzing's suppliers are required to provide safe working conditions, treat employees with respect, act fairly and ethically, and use environmentally responsible practices wherever they manufacture products or perform services on behalf of the Lenzing Group. By setting strict requirements, the Global Supplier Code of Conduct helps promote an environmentally and socially conscious supply chain.

Wood and dissolving wood pulp certification in the Lenzing Group

Lenzing's wood procurement management system ensures that all wood is sourced from legal and sustainably managed sources. The following figures show the certification status of all wood input into Lenzing's production, whether obtained directly through its own procurement for in-house dissolving wood pulp mills or indirectly through dissolving wood pulp suppliers. The basis for the percentage is dissolving wood pulp by weight, in order to summarize both inputs in a consistent way.

Lenzing demonstrates that wood sourcing complies with its high standards through verification based on FSC® and PEFC certification systems (Figure 5). More than 99 percent⁴ of wood and dissolving wood pulp used by the Lenzing Group is either certified by FSC® or PEFC or inspected in line with these standards.

This is done either by directly purchasing certified and controlled wood or by executing an internal Due Diligence system (DDS, see box 1 on page 11) which is in accordance with these two standards.

Also, the additional CanopyStyle verification audit was renewed in 2019, and the final audit report, which was published in the second half of 2020, confirmed compliance with the CanopyStyle Guidance. Another audit was held in May 2022 which final audit report was published in the first half of 2023.

All Lenzing Group production sites are FSC® CoC (Chain of Custody) certified. The multi-site certificate for PEFC CoC currently covers five sites. Purwakarta (Indonesia), Nanjing (China) and Mobile (Alabama) have successfully been added due to growing market interest in certified fibers and customers' expectations (Table 2).

For Central Europe PEFC is used for sourced wood, based on strict, rigorously enforced national forestry laws, as FSC® certification of forests is not widespread in this region. Therefore, most of the wood sourced is procured with a PEFC certificate and receives FSC® Controlled Wood status at the corresponding Lenzing site after a due diligence process. The Lenzing site has held the PEFC Chain of Custody certification as its main certificate for two decades. This has been complemented by an FSC® Chain of Custody certificate that covers all Lenzing production sites since 2016. All wood input for the Lenzing Group is either FSC certified or controlled or inspected in line with this standard (Figure 7).

All Lenzing Group production sites are FSC® CoC (Chain of Custody) certified (Table 2), confirming that Lenzing is entitled to market fibers as FSC® certified.

Due diligence System (DDS) for wood procurement

Formal traceability systems ensure that the origin of all purchased timber is known. Lenzing's approach and systems also include the company's public commitment to sustainable sourcing (see Wood and Pulp Policy).

Regardless of whether the wood used comes from certified forests or not, Lenzing seeks to ensure its stakeholders can trust that it originates from sustainable sources. Lenzing therefore uses its own Due Diligence Systems to verify that 100 percent of the purchased wood has been harvested in compliance with national legislation and according to its Wood and Pulp Sourcing Policy.

To increase credibility, Lenzing strives to verify these traceability systems by independent third parties, such as FSC® and PEFC Chain-of-Custody, FSC® Controlled Wood certification. The target of 100 percent coverage by third-party systems has been met every year since 2010*. Information on achieved forest certification shares and third party verified traceability systems are published in Lenzing's Sustainability Report, which is also independently verified by external auditors (KPMG). Lenzing can therefore state that its raw material comes from sustainable sources.

Lenzing's wood and pulp sourcing due diligence

Wood and pulp policy

Lenzing is committed to no-deforestation and excludes controversial wood sources.

Global Supplier Code of Conduct

The Global Supplier Code of Conduct outlines Lenzing's expectations for supplier conduct with regard to health and safety at work, labour and human rights, environmental protection, ethics, and management practices.

Certification

To increase credibility, Lenzing verifies its supply chain traceability against independent third parties, such as FSC®, PEFC and Canopy-Style.

Due diligence system

The due diligence system verifies that the purchased wood and pulp has been harvested and produced in compliance with national legislation, FSC and PEFC Chain of Custody Standards and according to the Wood and pulp policy.

Sustainability Report Audit

Information on achieved forest certification shares and third party verified traceability systems are published in Lenzing's Sustainability Report, which is also independently verified by an external auditor. Lenzing can therefore state that its raw material comes from sustainable sources.

Legislation

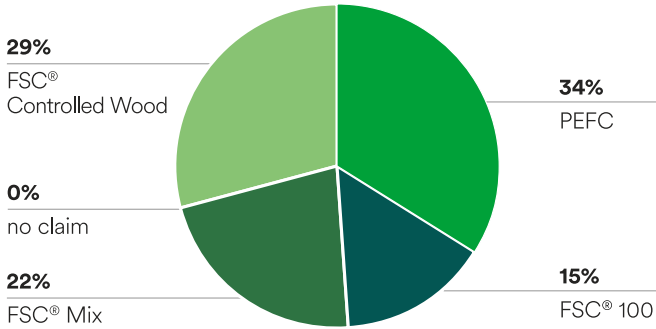
The purchased wood has to be harvested in compliance with national and other relevant legislation.

Site	Country	Main products	FSC® CoC	PEFC CoC
Lenzing	Austria	Viscose, modal, lyocell, dissolving pulp	•	•
Paskov	Czech Republic	Dissolving pulp	•	•
Purwakarta	Indonesia	Viscose	•	•
Nanjing	China	Viscose, modal	•	•
Heiligenkreuz	Austria	Lyocell	•	n. a.
Grimsby	United Kingdom	Lyocell	•	n. a.
Mobile	USA	Lyocell	•	•
Prachinburi	Thailand	Lyocell	•	n. a.
Indianópolis	Brazil	Dissolving pulp	•	n. a.

Table 2: Forest Certification status of Lenzing Group's production sites

Certification status

Figure 19

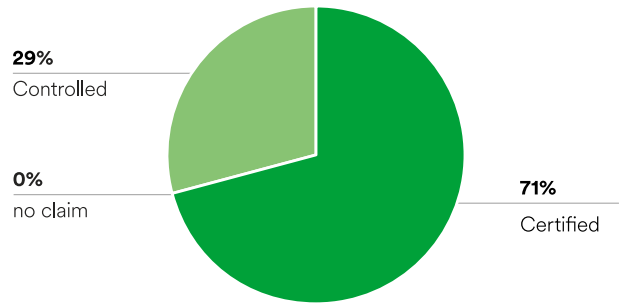


Certification status of total wood input at Lenzing fiber production sites via own and purchased dissolving wood pulp. Basis: dissolving wood pulp by weight.

Figure 5: Certification status

Certification status – overall certified and controlled wood

Figure 20

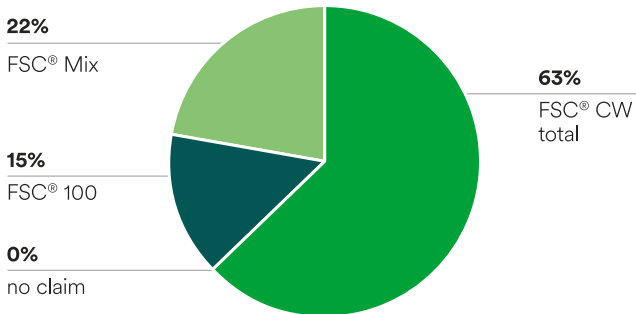


“Certified” is the sum of “FSC® Mix”, “FSC® 100%” and “PEFC” and represents the amount of pulp available to make fibers with the corresponding Chain of Custody certificate.

Figure 6: Certification status - overall certified and controlled wood

Certification status – FSC® Mix and FSC® controlled wood

Figure 21



“FSC® CW Total” is all controlled wood, FSC® Controlled Wood, plus PEFC certified wood that has been accepted as FSC® Controlled after the Lenzing due diligence process. The share of FSC® Mix represents the amount of pulp supplied with an FSC® Mix Chain of Custody certificate.

Figure 7: FSC® Mix and FSC® Controlled Wood

Pulp suppliers can hold more than one forest related certificate. Most of the pulp suppliers located in North America also carry Sustainable Forest Initiative (SFI) certification, which is a national member of and fully endorsed by the global PEFC certification scheme.

What is Chain of Custody?

Lenzing's Chain of Custody certifications enable its customers to have their products certified. The chain of custody documents the flow of materials, from the forest source through all supply chain stages right up to the final product.

What is a PEFC controlled source?

PEFC controlled sources is material that meets the minimum requirements accepted by PEFC. These include implemented due diligence systems comprising risk assessments and on-site audits based on the PEFC standard. All Lenzing Group's PEFC certified or controlled sources are also controlled by Lenzing's due diligence process.

What is FSC® controlled wood?

FSC controlled wood is material from acceptable sources (areas covered by the FSC system) that can be mixed with FSC-certified material in products that carry the FSC Mix label.

What is FSC® Mix?

FSC® Mix : the product is made with a mix of materials from FSC-certified forests, recycled sources and/or FSC controlled wood.. Lenzing Group uses the credit system.

History of responsible wood and pulp sourcing in the Lenzing Group

The Lenzing Group has been verifiably committed to the certification of its raw material sources for more than 25 years. Lenzing's first internal wood procurement policy dates back to 1995. It has been continuously upgraded ahead of the trends ever since. In recent years, the policy has been aligned with the CanopyStyle Initiative (see below). As of 2016, all Lenzing Group sites are certified in accordance with the FSC® Chain of Custody standard.

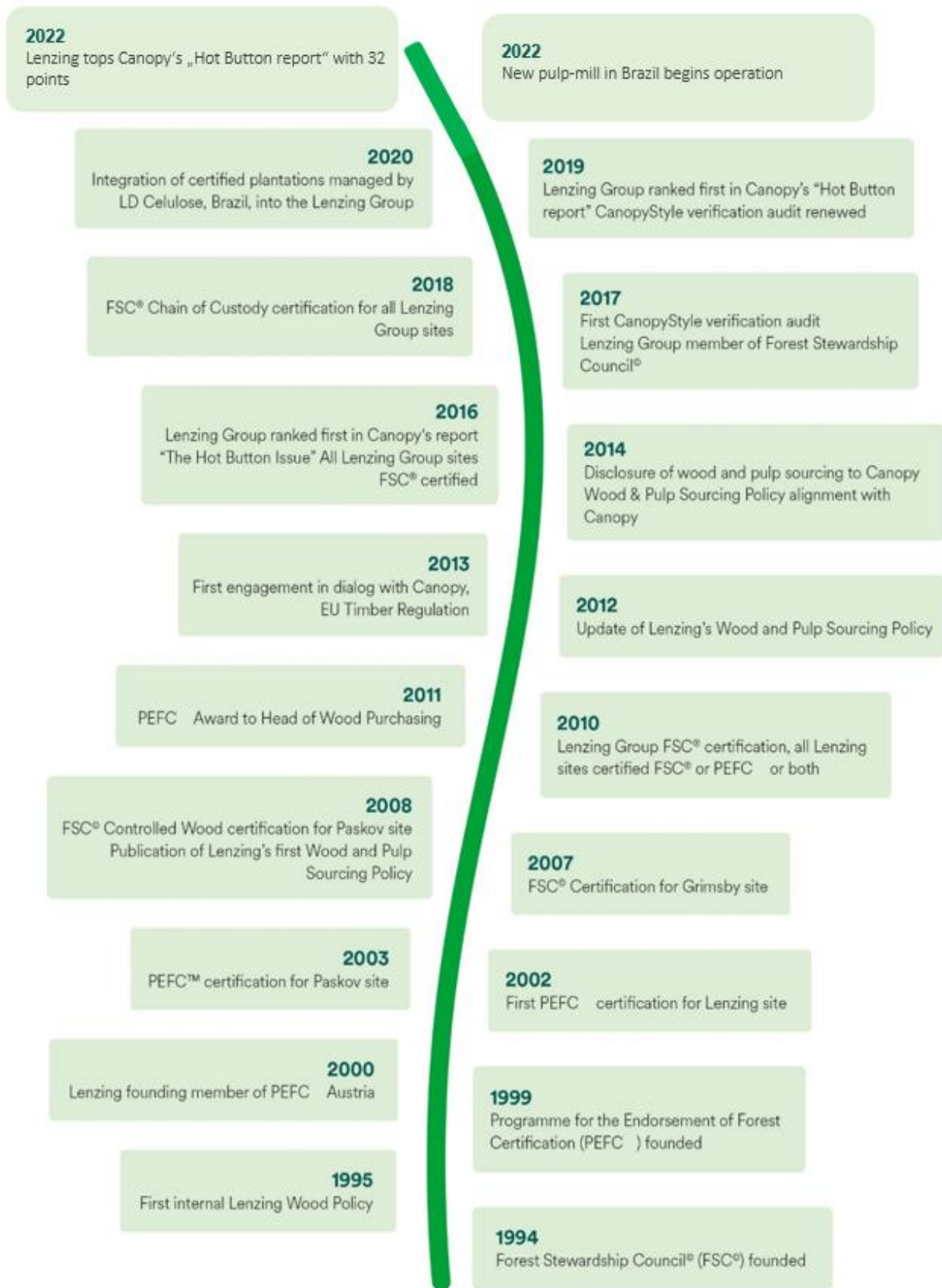


Figure 8: More than 25 years of wood and pulp certification in the Lenzing Group

Lenzing's reliable partners: small-scale forest owners and strict European forestry laws

Strict forestry laws and enforcement in Central Europe compel forest owners to engage in sustainable forest management. Since forestry operations in the region are generally small-scale, many small forest owners harvest wood for additional income and do not participate in a certification process. Experience shows that they typically operate for the long term with very cautious harvesting behavior. This characteristic small-scale forestry structure requires the Lenzing Group to procure limited quantities of wood other than that certified to FSC® or PEFC. Naturally, Lenzing's Wood and Pulp Policy forms part of all wood purchasing contracts. All wood suppliers, amounting to some 700 during recent years, are assessed once a year by a scoring system utilizing FSC® Controlled Wood criteria. **Figure 5**, "Certification status", shows this proportion of wood as "FSC® Controlled Wood".

Regional wood supply for Lenzing's own pulp mills

As wood is by far the largest volume of material purchased in the Lenzing Group, a separate procurement organization consisting of qualified, highly trained foresters has been established only for wood. The company has a track record of reliable long-term relationships with its wood suppliers. Lenzing's Wood and Pulp Policy has been agreed upon by all suppliers via personal communication. Regular formal audits are conducted, but ongoing, day-to-day, informal personal contact between Lenzing's procurement team and suppliers is even more important. In the event of serious findings regarding sustainability aspects, a contract with a supplier can be suspended or terminated.

The Lenzing Group operates two pulp factories in Europe with regional wood supply. The Lenzing site in Austria uses mainly beech wood plus small amounts of other hardwoods and spruce, whereas the Paskov plant in the Czech Republic utilizes mainly spruce. A new pulp factory in Brazil was constructed and started production in 2022, it is supplied by local wood from the surrounding eucalyptus plantations, which are managed by LD Celulose.

Regional wood sourcing in Central Europe

Lenzing is committed to the cascading use of wood. Both of Lenzing's European pulp sites largely make use of timber generated by thinning and of damaged wood from calamities, droughts or storms that is unsuitable for high-value uses in the wood industry such as furniture, flooring or construction wood, and of saw mill residue. Dissolving pulp production actually generates higher added value in the supply chain compared to paper or panel production or energy generation, making it a valuable contributor to the economics of sustainable forest management.

Sustainability criteria have long been crucial for the selection of wood suppliers. Hundreds of suppliers, a large number of them private owners, have delivered wood to Lenzing's two pulp factories in Europe in recent years. The state forests of Austria, Germany, the Czech Republic, and Slovakia are also important wood sources for Lenzing's pulp sites and supply more than 20 percent of the wood procured; these countries have strong political commitments to the sustainable management of their forests. Strict European forest regulations and reliable enforcement of these regulations and laws ensure the sustainability of Lenzing's supply partners.

Demand for fibers decreased sharply in the second and third quarter of 2020 due to the COVID-19 crisis. As a consequence, the Lenzing Group temporarily produced less of its own pulp and procured less wood. Many small deliveries from small suppliers who deliver only once a year were therefore not required, lowering the number of wood suppliers from around 700 in 2019 to some 400 in 2020. The suppliers who remained tended to supply

larger volumes and have long-term delivery contracts. In 2021 and 2022, the number of wood suppliers for the Lenzing (Austria) and Paskov (Czech Republic) site rose again to more than 600.

Regionality

In order to ensure short transportation distances and short delivery times, almost all the wood required originates either from the country where the pulp is produced or from neighboring countries. Regional^b wood accounted for 94.5 percent in 2020, 95.2 percent in 2021, and 93.8 percent in 2022 for the site in Lenzing (Austria). For the Paskov (Czech Republic) site, the regional supply rate has increased to 100 percent since 2019. For the underlying figures, please see the [Annex of Lenzing’s Sustainability Report 2023](#).

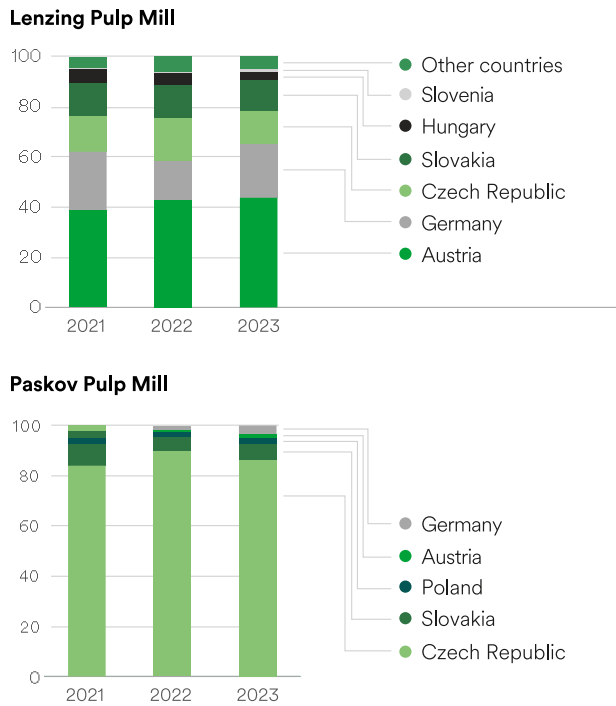
More than 90% of the wood supply for Lenzing’s own pulp mills in Europe is sourced from four countries: Austria, Germany, the Czech Republic, and Slovakia.

Wood sourcing for the Lenzing Group’s own pulp mills in Lenzing (Austria) and Paskov (Czech Republic)

Beech and spruce by country, 2021–2023.

“Other countries” for Lenzing sites are France, Switzerland, and Poland.

Figure 18



Regional wood supply originates from the country where the pulp mill is situated and from neighboring countries from which wood can be transported directly without crossing a third country.

Figure 9 : Wood sourcing for the Lenzing Group’s own pulp mills in Europe

In the recent past, wood from Belarus, Estonia, Russia, and Ukraine was exclusively sourced with FSC® certificates. Since 2020, no wood was sourced from Estonia and Russia. Wood supplies from Ukraine to the Paskov site (Czech Republic) ceased in 2016, from Belarus in 2018.

Wood logistics

Lenzing's wood logistics system moves large quantities of material and is therefore highly optimized for cost reasons. Continuous improvement in this area also leads to minimized emissions from logistics by giving preference to train transport whenever possible. The share of wood delivered to the Lenzing site (Austria) by train ranges from 75 to 80 percent. Train transport is mostly used for distances of more than 200 km; for shorter distances, road transport is often more feasible.

Local wood supply in Brazil

Lenzing constructed a new pulp mill in Brazil in a joint venture called LD Celulose together with Dexco. It started operation in 2022. Currently around 90,200 hectares of plantation are managed, including around 19,884 hectares of protected area which are not used for wood sourcing but ensure the protection of flora and fauna. These plantations operate completely in accordance with the guidelines and high standards of the Lenzing Group for sourcing wood and pulp as well as the requirements of the leading certification schemes.

An essential aspect that compelled Lenzing to enter into a joint venture with Dexco in Brazil was its track record and reputation for environmentally responsible forest management, its tradition of respect for the environment, its experience in responsible and productive forest management, and its extensive knowledge of the Brazilian Forestry Code (of 2012), which is one of the most stringent in the world. Lenzing makes a point of only working with certified and controlled wood sources to ensure supply chain sustainability. This sustainability is being maintained at LD Celulose with Dexco's forest management expertise.

Dexco has a long history of responsible forest management and shares this expertise in the joint venture. Duratex (now, Dexco) was the first company in the southern hemisphere to obtain FSC® certification in 1995, and in addition to LD Celulose's forestry unit, it is responsible for 200,000 hectares of forest. Of these 200,000 hectares, 56,000 are conservation areas, where the preservation and care of native vegetation are guaranteed by Dexco. The Dexco Forest Management Plan was adopted, which is responsible for ensuring compliance with Forest Stewardship Council (FSC®) certification criteria. The FSC® certificate provides the assurance that LD Celulose's forest management work takes account of aspects such as respect for the rights of indigenous people, the wellbeing of the professionals who work in the forest and local communities, the reduction of environmental impact, and the promotion of native forest conservation and restoration efforts.

The forest unit responsible for supplying LD Celulose's wood is in Triângulo Mineiro in the State of Minas Gerais. The area that is being transformed into the LD Celulose forest unit has been used for cattle raising, intensive agricultural activities such as soybean and coffee, and eucalyptus forestry since the 1970s. No native (primary) forest will be converted. The plantations are more than 800 km from the region that comprises the Amazon rainforest.

Lenzing actively collaborates with Canopy to ensure that the wood sourcing is in line with sustainable practices. All these measures, together with the Due Diligence System (DDS) and the certification of the supply chain ensure that wood sourcing is in line with Lenzing's Wood and Pulp policy and sustainable practices. Addressing the situation in Brazil, the measures are also set up to avoid using resources from the Amazon region.

Pulp suppliers to the Lenzing Group from the global market

The main dissolving wood pulp production regions for the global market are Europe, North America, South America, China, and South Africa. Lenzing's purchased dissolving wood pulp is mainly produced from eucalyptus, but also comes from acacia, aspen, birch, maple, and southern pine. The actual tree species vary depending on the region. Lenzing ensures that the bleaching process of all purchased pulp is totally chlorine-free (TCF) or elemental chlorine-free (ECF).

Some market pulp mills supplying Lenzing rely on eucalyptus plantations as their main wood source. Plantations provide wood at very high yields per unit area and with a very high cellulose content. This substantially reduces the land use for wood-based cellulosic fibers compared to most natural fibers. When sustainably managed, plantations reduce deforestation pressure on natural (primary) forest areas. They also consider biodiversity aspects and water management. For details, see the "Sustainability aspects in wood and pulp sourcing" chapter.

For updates and details of the pulp mill locations, please see our [website](#):

Wood and dissolving wood pulp supply in the Lenzing Group

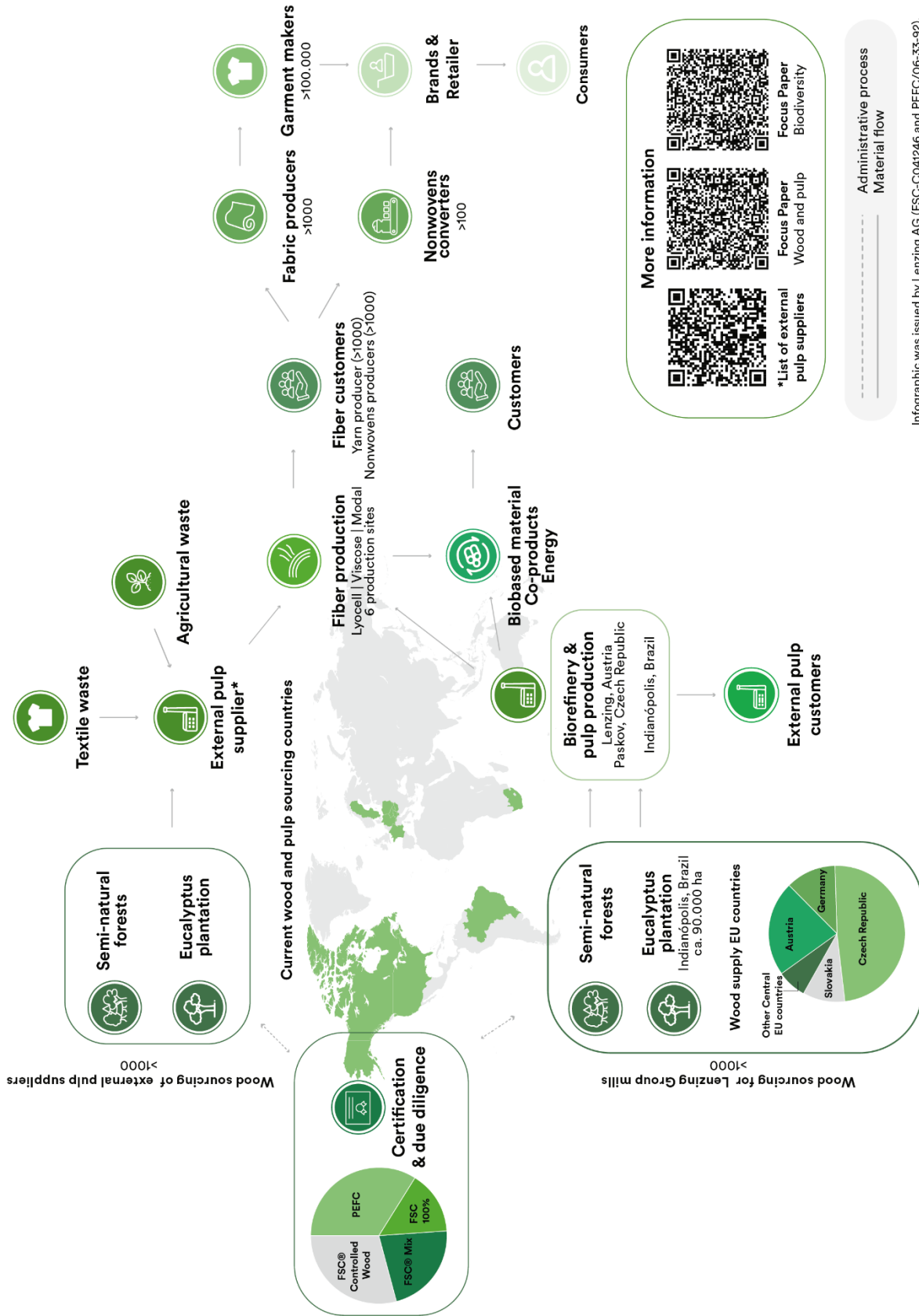
Dissolving wood pulp supply, from own production and dissolving wood pulp market (2020-2023)

Wood sourcing region	Central Europe	Europe	South Africa	North America
Wood sourcing countries	See figure 12	Mainly Scandinavia and Baltic states	South Africa	USA
Forest type according to FAO*	Semi-natural forest	Semi-natural forest	Plantation	Semi-natural forest
Wood species (most important)	Beech, spruce, birch	Birch, aspen, beech	Eucalyptus sp., Acacia sp.	Southern pine, maple, aspen
Forest certificates	PEFC, FSC®	PEFC, FSC®	FSC®	PEFC, FSC®, SFI
Wood procurement by	Lenzing Group Wood Procurement	Dissolving wood pulp suppliers		
Dissolving wood pulp produced by	Lenzing Group dissolving wood pulp mills (Paskov and Lenzing)	Dissolving wood pulp suppliers: For updates and details of the Dissolving wood pulp suppliers please see our website		
Pulping process	Sulfite	Sulfite/Kraft		
Bleaching process	Totally chlorine free (TCF)	Elemental chlorine free (ECF)		

* Carle, J., and Holmgren, P. (2003). Working paper 79. Definitions related to Planted Forests. In: Food and Agriculture Organization of the United Nations (2003). Forest Resources Assessment Program Working paper series.

Table 3: Wood and dissolving wood pulp supply in the Lenzing Group. Dissolving wood pulp supply, from own production and dissolving wood pulp market (2020-2023).

Lenzing Group's wood and pulp supply and processing value chain



Infographic was issued by Lenzing AG (FSC-C041246 and PEFC/06-33-92).
 Lenzing can therefore state that its raw material comes from sustainable and controlled sources.

Stakeholder dialog and projects

Within its “Partnering for systemic change” strategic focus area, Lenzing is strongly committed to numerous activities in different international multi-stakeholder dialogs.

CDP Forest

The Lenzing Group contributed to the Carbon Disclosure Project (CDP) in the areas of Climate and Forests for the first time in 2020. It received a double “A” score for tackling climate change and acting to protect forests. In 2021, Lenzing added the area Water and received a triple “A” rating, among only 14 companies worldwide. The same rating was achieved in 2022 among 12 companies and 2023 among 11 companies. Only 16 companies worldwide have an “A” rating for forests in 2020, 24 in 2021, and 25 in 2022 and 31 in 2023. Through its significant demonstrable actions in these areas, Lenzing has taken a leading position in corporate environmental ambition, action, and transparency. In 2021 for the first time, Lenzing reported on its activities in Brazil. The efforts to ensure legal compliance and to ensure that activities (e.g. leasing of new areas for plantations) do not contribute to deforestation in Brazil were examined. Transition risks were included and published in the risk reporting. Data were collected and extensively reported on the activities in Brazil, ensuring a share of certified or controlled wood input greater than 99 percent. The CDP forest score confirms that the production of Lenzing’s wood-based cellulosic fibers does not contribute to deforestation - through a combination of a stringent wood sourcing policy, forest certification and a dedicated collaboration with the CanopyStyle initiative.

Supporting forest conservation

In addition to activities related to its own supply chain, Lenzing supports conservation solutions in other regions outside its own sourcing areas, such as afforestation in Albania.

Lenzing supported the “Earth Day Campaign” 2019, including the restoration of the Yosemite National Park in California, USA. With the support of this initiative not only the land was restored, but also the wildlife habitat was positively impacted. In 2020, some 10,000 trees were planted. In 2021, 33,025 trees were planted, mainly in California and Colorado, as well as in Haiti. In 2022, around 1,000 trees were planted. This amounts to a total of around 60,000 trees since 2019 that have been planted with the support of Lenzing.

Lenzing also provided support to political leaders in the protection of ancient and endangered forests in Canada (Broadback Forest Quebec, Vancouver Island) and Indonesia (Leuser Ecosystem). For the UN Conference of Parties on Biodiversity #15 in 2022, Lenzing supported the letter of “World’s MMCF Producers Call on the Convention of Biological Diversity to support conserving at least 30% of the world’s forests by 2030”.

Albania’s forest areas have some of the greatest need for improvement in Europe. New forest management approaches were recently implemented by the government to address environmental problems and fulfil the current needs of society with respect to the sustainable use of natural resources. Lenzing implemented a project in Albania, in which it wants to afforest 20 hectares with the help of the local community.

For more information on these projects, see the chapter [“Biodiversity & ecosystems”](#) of the [Sustainability Report 2023](#) or the [Focus Paper “Community engagement”](#).

Forest Europe and national forest strategies

The Forest Europe political process was initiated in 1990 by the Ministerial Conference on the Protection of Forests in Europe, which comprises 46 states, to promote sustainable forest management in Europe. A set of

indicators grouped into six different criteria was developed to measure the sustainability performance of European forests and set targets for improvement⁵. Current efforts focus on climate change adaptation⁶, water protection, and biodiversity⁷. As a major buyer of wood in Europe, the Lenzing Group supports these targets, which aim to ensure the continued and improved function of forests in their ecosystems while maintaining the long-term availability of wood as a raw material.

The European Forest Strategy is currently in development. Lenzing contributed to an open consultation in 2021, calling for a consistent approach to regulation in the forest sector, and highlighting the forest-based bioeconomy as an important source for renewable carbon for materials within the European Green Deal.

For further content details, see the “Sustainable forest management” section.

The European and Austrian bio economy strategy

In the European bioeconomy strategy, the replacement of fossil raw materials is largely dependent on using wood and forest products as a major source of the required materials. As the European Forest Institute (EFI) report “Seeing the wood in the forest”⁸ states: “The Green Deal needs wood”. On the basis of the European strategy, the Austrian bioeconomy strategy was published in 2019⁹. The current phase calls for the development of an action plan. Lenzing is represented in the bioeconomy platform and provided input on the strategy and the development of the action plan since 2019 through workshops and an online consultation. The action plan aims to balance the need for mobilizing timber as a raw material for the bioeconomy with assuring and improving the vitality and resilience of forests through adequate forest management. The strategy is prominently placed in the government working program and its implementation is assured.

The underlying studies have already shown a gap between increasing demand for renewable resources for materials and energy on the one hand, and the possible supply on the other hand, which is mainly limited by the available land area. One topic of the action plan of particular relevance to Lenzing is the continued development of the biobased circular economy, to which Lenzing will contribute accordingly.

In 2021, the development process of the Bioeconomy Strategy was linked to the Circular Economy Strategy. A catalog of actions was published in 2022.

Austrian Forest Strategy and Austrian Forest Dialog

The basis for the development of this strategy was the first Austrian Forest Program in 2007.

The Austrian Forest Dialog is a policy development process involving 85 organizations, including forest owners, government and non-government organizations, as well as industry associations. Lenzing supports this activity through its membership of the “Forst Holz Papier” industry association.

As a response to the work of Forest Europe (see “Sustainable Forest Management” chapter) to define criteria for sustainable forest management and to set targets for improvement, the Austrian Forest Dialog (Walddialog) set seven thematic areas for this program. Progress was assessed in the “Austria’s Forests 2017” report and the update in 2020¹⁰.

The criteria and indicators were developed for Austria on the basis of the Pan-European Criteria and Indicators for Sustainable Forest Management (SFM) in order to monitor the progress in sustainable forest management. The Criteria describe various aspects of sustainable forest management and contain sets of indicators. Targets are set and monitored for the indicators.

Criterion	No. of indicators	No. of targets	Highlights
1: Contribution to climate protection	4	4	Large and increasing stocks of wood. Forest are important carbon sinks
2: Forest health	5	14	Forest damage is a continuous challenge
3: Productivity and economic aspects	9	14	Wood increment exceeds consumption
4: Biodiversity	14	32	Diversity of tree species improving, share of deadwood nearly doubled since 1990s. High share of protected forests: 22.1 % of forest area under nature conservation law
5: Protective functions	5	5	The protective effect of forests safeguards human habitats - soil, water, infrastructure
6: Social and economic	21	45	The use of wood promotes climate protection and green economy Exports from value-added chain of forest products is one of the most important items of Austria's foreign trade
7: Austria's international responsibility for sustainable forest management	6	7	Austria takes big efforts to promote sustainable forestry on the international level

Table 4: Criteria and highlights in the "Austria's forests 2020" report

The Austrian Forest Strategy 2020+ is structured along these seven thematic areas and has developed a vision, a strategy broken down into 49 targets, to address key challenges in the thematic fields. This vision involves a sustainable forest management system for the multifunctional purpose of the forest as a basis for the forest-based economic sector, while providing added value for society.

CanopyStyle Initiative

Lenzing cooperates with the Canadian NGO Canopy and maintains a continuous dialog with members of the CanopyStyle initiative to ensure responsible wood sourcing and prevent the world's ancient and endangered forests from ending up in textiles and fibers.

Canopy publishes the Hot Button Report, an annual ranking of all wood-based cellulosic fiber manufacturers based on their wood and pulp sourcing performance, transparency and innovation. In recent years, Lenzing has shown continuous improvement in all of these criteria: Lenzing's Wood and Pulp Policy has been aligned with the CanopyStyle initiative for years, and in 2020, the geographical locations of pulp suppliers were publicly

disclosed in more detail (see <https://bit.ly/3tpvjgN>). Regarding alternative cellulose sources, Lenzing is the first company to produce and market lyocell fibers on a commercial scale using pre-consumer cotton scraps and post-consumer garments (for more information, please see the “REFIBRA™ technology” chapter). Furthermore, Lenzing takes an active part in the Zero Discharge of Hazardous Chemicals (ZDHC) initiative and proactively advances the track- and traceability of its fibers within the value chain.

In Canopy’s latest Hot Button Report¹¹, published in 2023, Lenzing is ranked 2nd and received a dark green shirt for the third time and improved its score from 31 buttons in 2021 to 32 in 2023, continuing its long record of top rankings.

WOOD Kplus competence center

Many Austrian companies, including Lenzing, and scientific bodies have joined forces in the “Kompetenzzentrum Holz”. This is a leading research institute in wood and wood-related renewable resources in Europe. Its core competences are materials research and process technology along the entire value chain – from raw materials to finished products. It develops methods and basic principles and performs applied research at the interface between industry and science.

A strategic dissertation supported by the Lenzing Group, finalized in 2020, aimed to achieve a deeper understanding of societal perceptions of sustainability in the global sourcing of wood. Sustainable forest management as a concept appears to be contested in the debate on environmental and social governance. The project systematically analyzed perceptions of this concept in scientific literature, in sustainability reports of large corporations, and in NGO communications. For more information, please see the resulting publications.^{12,13,14,15}

Greenhouse Gas Protocol process on carbon removals/land use

The Greenhouse Gas Protocol has launched a process to develop new standards or guidance on how companies should account for the following activities in their greenhouse gas inventories: carbon removal and sequestration, land use, land use change and bioenergy. One starting point for the initiative is the criticism of carbon neutrality in bioenergy and emissions from biogenic sources.

In Lenzing’s view, sustainably managed forests and plantations are key elements for climate change mitigation through carbon sequestration in the forest, harvested wood products, and the replacement of fossil-based materials that have high carbon footprints. Moreover, sustainably managed semi-natural forests offer the most successful means of protecting biodiversity and enabling people to enjoy the benefits of forests in the form of recreation or micro-climate benefits (“ecosystem services”), for example.

The outcome of these ongoing considerations will have a decisive impact not only on the wood-based fiber industry but on the entire wood-based bioeconomy. Lenzing participated in the review group to comment on the draft guidance in 2022, and contributed to a pilot for the guidance in 2023, and to the “Technical Working Group +” from 2023 onwards.

FSC® - Forest Stewardship Council®

Individual sites of the Lenzing Group have been FSC® chain of custody certified since 2007. The Group multi-site certification covering all sites was received in 2010. In 2017, the Lenzing Group joined FSC® as a member, contributed to the 2017 General Assembly, and is involved in the “Fashion and FSC® – from forest to consumer” initiative.



The first brands are now bringing FSC®-certified garments with Lenzing's fibers to the market.

Program for the Endorsement of Forest Certification, PEFC

The Lenzing Group was a founding member of PEFC Austria in the year 2000 and participates in working groups and projects. Lenzing relies mainly on PEFC certification for wood sourcing in Central Europe.

UNECE/FAO/PEFC Forests for Fashion Initiative

In partnership with the UNECE and FAO, the Forests for Fashion initiative by PEFC is linking forest-based materials from sustainably managed forests with the world of fashion¹⁶.

In the Forests for Fashion exhibit at the UN headquarters in July 2018, a capsule collection was shown by Spanish designer María Lafuente using the world's first PEFC-certified fabrics, produced by Textil Santanderina from Lenzing™ fibers. A recent exhibition was shown at the Sustainable Fashion Week in Madrid 2020 with fabrics by Santanderina containing Lenzing's TENCEL™ fibers:

<https://www.pefc.org/news/pefc-promotes-forests-for-fashion-at-sustainable-fashion-week-in-madrid>

Are there alternative cellulose sources?

Lenzing is constantly investigating the ecological and economic suitability of alternative sources of raw material for cellulosic fibers. As not only wood, but all plants contain cellulose, annual plants and waste from food production are a potential source of cellulose for fibers. In addition, bacterial cellulose and recycled cellulose of various origins are considered as new raw material sources.

Recycled textiles are a particularly promising potential source of alternative cellulose, Lenzing developed the REFIBRA™ technology, incorporating pre-consumer cotton scraps into the pulp. For more information on this topic, please see the chapter "[Resource use and circular economy](#)" of the latest Sustainability Report.

Any plant-based material can potentially serve as a source of cellulose and hence dissolving pulp for fiber-making. Lenzing has undertaken extensive research into many different alternative non-wood cellulose sources. Studies have been conducted on sources such as annual plants like hemp, straw, and bamboo. In general, annual plants have a higher growth rate per hectare than trees. Additionally, certain species have a higher cellulose content. Some of them are already available in large quantities, especially in the form of agricultural waste. This can produce an attractive cellulose yield per hectare; however, the advantages over wood, the traditional source of cellulose, need to be assessed on a case by case basis.

In its research, Lenzing identifies promising new cellulose sources and carefully considers their availability, technical feasibility, and economic scalability as well as the overall ecological impact with respect to Lenzing's climate target and circularity approach.

Non-wood-based cellulose may be challenging to use for a number of reasons. Dedicated research into the following ecological and economic aspects for industrial-scale production is necessary:

- **Availability**

Alternatives such as bamboo, straw, and various annual plants do not yet meet Lenzing's requirements in terms of availability regarding the quality and amount. Many sources from annual plants are only available in the harvesting season and are difficult to store for year-round use.

Annual plants are thus especially suitable for seasonal production campaigns. Despite specific benefits and high annual growth per hectare, the material is very bulky and more costly to transport. This favors obtaining the raw materials locally and keeping production capacities small.

Some wastes from agriculture and food industry are considered as a cellulosic raw material. The available amounts tend to be small compared to the capacity of a dissolving wood pulp mill.

- **Environmental sustainability**

The conversion of forest to agricultural land for annual plants is a worldwide phenomenon that increases the pressure on all kinds of forests. Its drawbacks can be seen with oil palm production, for example. Sustainably managed forests store much more carbon per hectare than annual crops. Therefore, this trend adversely affects the CO₂ balance of the entire value chain. The carbon balance must be thoroughly calculated while including all co-products from annual plants.

Important factors for the environmental impact of the process include energy consumption and the use of process chemicals in pulp production. They depend heavily on the actual process and vary significantly from one annual plant to the next.

Dissolving pulp can be made with cotton linters, as seen in the viscose industry in some regions. However, the pulping process uses substantial amounts of chemicals and energy. As most cotton linter pulp facilities are not state-of-the-art, resource use, emissions, and waste can be high for cotton linter pulp.

Another important factor in the sustainability performance of annual plants is the management of the agricultural areas. Highly productive sites need far more fertilizers and pesticides than forests, causing other environmental issues. For example, the overall environmental profile of large-scale bamboo plantations is known to be unsatisfactory.

- **Technical feasibility**

Apart from not causing additional environmental issues, fibers produced using alternative feedstock must meet the same quality criteria as wood-based fibers. The biorefinery process for wood-based fibers is closely aligned with the raw material. This keeps quality and efficiency high and yields climate-neutral bioenergy as a co-product. With non-wood feedstocks, less bioenergy may be generated as a co-product, requiring additional energy sources for processing the feedstock into dissolving pulp and resulting in a potentially negative environmental impact.

Annual plants contain more mineral components and organic substances that have to be removed to produce high-quality dissolving pulp. This purification process typically requires the use of aggressive chemicals and causes waste issues. It is a big challenge to develop new sustainable technologies for these materials while maintaining product quality and ecological safety. On the other hand, in woody plants like trees, these components are mainly concentrated in the bark, which is easily removed in the first stage of the process.

Experience from the paper industry with these sources is of limited use, since dissolving pulp has to meet very different quality and purity requirements. While modern breeding and harvesting concepts have been developed, a new biorefinery process for annual plants still has to be adapted to the special requirements, not to mention the circulation management for process chemicals and treatment of impurities originating from the plants. So far, no established industrial process meets these prerequisites.

Based on current data, the sustainable, renewable production of cellulose on a large scale is still best achieved using wood from sustainably managed forests instead of the aforementioned alternatives. At the same time, it is Lenzing's aspiration as an innovation leader to overcome these challenges and find new solutions.

Current solutions

The most promising approach has proved to be cotton upcycling. Lenzing devised the first industrially implemented solution with its REFIBRA™ technology, which uses a large amount of textile waste as feedstock and represents an important step towards achieving a circular economy.

In some cases, specialty products can be made, as e.g. in Lenzing's collaboration with Italian Orange Fiber, using pulp from orange peel waste. (See Sustainability report 2021 for more detail.). Another TENCEL™ Limited Edition is a fiber using hemp pulp, developed together with Candiani Denim in 2022. (See Sustainability Report 2022 for details.).

Sustainability aspects in wood and pulp sourcing

Global forests and wood resources

The total worldwide forest area amounted to 4.06 billion hectares in 2020, which is about 31 percent of the global land area. This area declined overall by 179 million hectares in the period 1990 – 2020¹⁷, which compares to the twice the size of Venezuela. An estimated 420 million ha of forest has been lost through deforestation this period, primarily as a result of illegal logging in tropical countries. Forest areas in Europe (including Russia) and Asia have actually expanded, by some 23 million ha and 38 million ha, respectively²⁶.

The demand for forest products is predicted to triple by the year 2050³³ due to a shift to a bioeconomy based on renewable resources instead of fossil fuels, with a large share of materials in the economy made of forest-based resources. To meet this demand in a responsible way, forests must be sustainably managed and used. The necessary expansion of forests will be primarily achieved via intensely managed plantations and will invariably go hand in hand with climate change mitigation.

The global wood market

Wood is one of the most important renewable resources of our planet. Approximately 4 billion cubic meters of wood were harvested in 2018¹⁸.

Nearly half of the world's wood harvest is used directly for energy. Industrial wood accounts for about 56 percent of total usage. Within the industrial wood segment, the majority is used for construction, panels, furniture and other materials shaped from wood. Around 19 percent of global wood is processed into pulp (paper pulp and dissolving wood pulp for fibers). The man-made cellulosic fiber industry supplying textiles and nonwovens accounts for less than 1 percent of global wood use¹⁹. These estimated figures are subject to some uncertainty due to the statistics available, which provide amounts in cubic meters or tons, and the conversion factors are not always easy to determine.

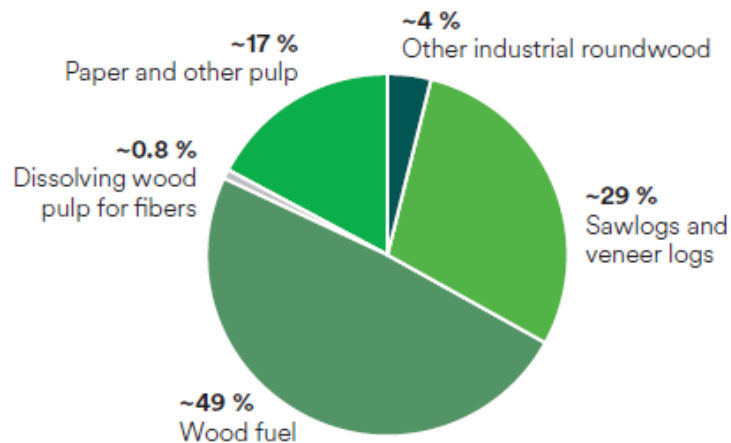


Figure 11: Global wood market 2018. Source: FAO database, CIRFS, The fiber year and Lenzing estimates. Percentages of cubic meters.

Considering the available cellulose resources, dissolving wood pulp can be sourced in a sustainable way, and has high potential for growth that is ecologically sustainable²⁰. The future growth of the wood-based fiber industry can be sustained by growing forest resources in certain regions of the world, especially in Europe, North America and China²¹.

How much wood does the Lenzing Group use?

Assuming a dissolving wood pulp yield of about 40 percent, a rough estimate for the total annual wood input to produce approx. 1 million tons of fiber would be 2.5 million tons (dry matter) for both Lenzing’s own production and purchased dissolving wood pulp. The amount of wood required to produce dissolving wood pulp varies according to process conditions and wood species used by the Group’s suppliers.

Sustainable basis for Lenzing’s wood sourcing in Europe

Following centuries of forest overexploitation, the silvicultural principle of sustainability was developed 300 years ago by German foresters to ensure an adequate supply of wood²². This means trees are only felled at the rate at which they can grow back. At present, European forests are growing steadily in size²³.

Strict forest laws are enforced in Central Europe to safeguard sustainability. It is important to note that these laws obviously apply to all forest owners in a country, unlike voluntary certification schemes that only cover the participating entities.

European forests play a key role in the stability of ecosystems. In addition to protecting soil from erosion, forests regulate the local climate and water supply, and sustain biodiversity. Moreover, they provide a service for society as recreational areas and a basis for tourism in many regions. All these functions can be provided in parallel with controlled wood extraction.

Approximately 42 percent of the land area of the EU-28 consists of forested land. The comparable figure for Austria is about 47 percent. Lenzing sources wood in Europe mainly (more than 90%) from four countries: Austria, Germany, the Czech Republic, and Slovakia. In these countries – as in all European countries – the forest area has steadily increased in recent decades (Table 5), while growing stock has actually increased by 28% (Figure 12) due to lower levels of harvest than growth. Timber harvesting in these countries accounts for approx. 65-70 percent of annual net growth (net annual increment), which equals two-thirds of the sustainably available potential.

- Slovakia
- Czech Republic
- Germany
- Austria

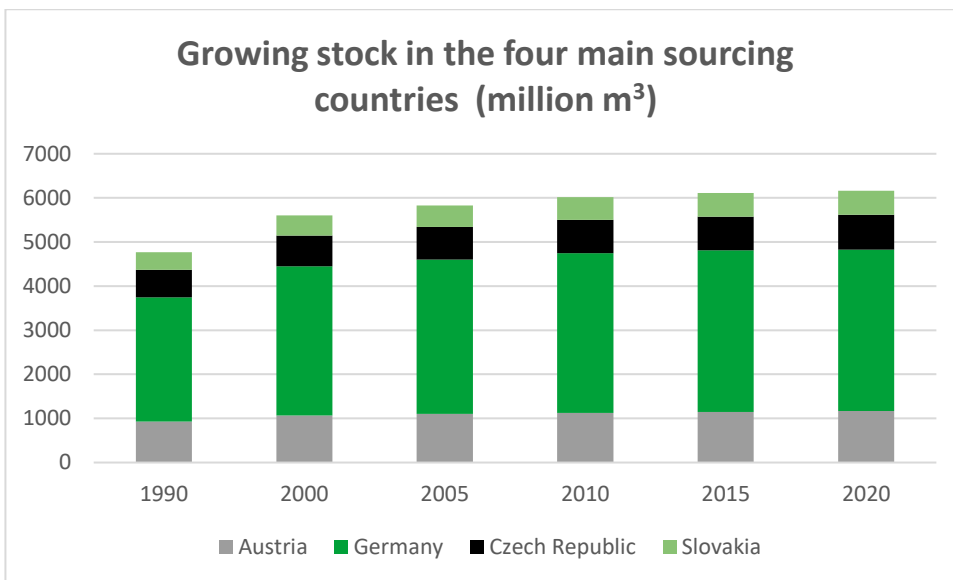


Figure 12: Growing stock in the four main sourcing countries of Lenzing's pulp mills in Europe (million m³).
Source: Forest Europe ²⁴

Country	Austria	Germany	Czech Republic	Slovakia	Source
Share of forest area (%)	47 %	32 %	34 %	39 %	FAO-FRA 2020: according to national statistics, Austria has 48%
Forest area in 2020 (1000 ha)	3899	11419	2677	1926	FAO-FRA 2020

Forest area increase (1990-2020) (%)	3.3%	1.8%	1.1%	1.3%	FAO- FRA 2020
Certified forest area PEFC+FSC® (% , 2019)	75 %	78 %	69 %	67 %	PEFC Global statistics; Slovakia: FRA 2020
Forest area with some kind of special protection	approx. 25 %	approx. 80 %	approx. 30 %	approx. 40 %	Forest Europe 2020 ²⁴ , Austria: Walddialog 2020 ¹⁰
Growing stock increase (1990-2020) (%)	26%	30%	27%	34%	Forest Europe 2020 ²⁵

Table 5: Selected forest indicators for the four main sourcing countries of Lenzing's pulp mills in Europe

Societal aspects of forestry

Sustainability assessment constitutes a complex interplay between ethics and the social and natural sciences²⁶. The developed countries predominantly focus on environmental issues (forest health, climate change, etc.), while the developing countries or “Global South” have a stronger emphasis on socio-economic issues such as the role of forest management in poverty alleviation²⁷. This knowledge can, in the long run, provide a basis for more harmonized assessment criteria of the sustainability of wood sourcing for a global company like Lenzing.

Lenzing's Wood and Pulp Policy²⁸ refers to societal aspects, especially human rights, in wood sourcing covered by the wood certification systems used by Lenzing: FSC® and PEFC. Together with national laws, they ensure that traditional, community, and civil rights are observed, and that labor conditions comply with or exceed ILO Core Conventions²⁹. The underlying basis for ethical behavior in the Lenzing Group is laid down in Lenzing's Business Code of Conduct and its Supplier Code of Conduct, which outline the importance of compliant and sustainable business conduct.

Sustainable forest management

Lenzing supports the concept of sustainable forestry as defined by the Ministerial Conference on the Protection of Forests in Europe and adopted by FAO:

“The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and their potential to fulfill, now and in the future, relevant ecological, economic, and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.”

To promote sustainable forest management in Europe, the Forest Europe political process was initiated in 1990 by the Ministerial Conference on the Protection of Forests in Europe, which includes 46 states.

Criteria and indicators (C&I) have emerged as a powerful tool to promote sustainable forest management (SFM). Since the United Nations Conference on Environment and Development (UNCED) in Rio in 1992, several different international processes and initiatives have developed criteria and indicators as a policy instrument to evaluate and report progress towards sustainable forest management (SFM). FOREST EUROPE is the pan-

European policy process for the sustainable management of the continent's forests. It develops common strategies for its 46 participating countries and the European Union on how to protect and sustainably manage forests. The Forest Europe process has developed a pan-European C&I set, which consists of 6 criteria and 35 quantitative indicators (describing the forest status and changes) as well as 17 qualitative indicators (describing the national forest policies, institutions and instruments towards SFM).

As a major buyer of wood in this region, Lenzing supports the pan-European criteria for Sustainable Forest Management:

1. Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles;
2. Maintenance of forest ecosystems' health and vitality;
3. Maintenance and encouragement of productive functions of forests (wood and non-wood);
4. Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems;
5. Maintenance, conservation and appropriate enhancement of protective functions in forest management (notably soil and water); and
6. Maintenance of other socio-economic functions and conditions.

SFM was also recognized by the United Nations General Assembly 2007, and taken into the FAO agenda³⁰, adding a seventh point to the criteria or thematic elements,

Legal, policy and institutional framework

Following on from these criteria, a set of indicators for SFM has been created and is continuously developed. It is used to assess the status of European forests, set targets for improvement and track progress towards the targets. In Austria, for example, the multi-stakeholder organization "Walddialog" (Austrian Forest Dialog) manages the monitoring and reporting (see Austrian Forest Strategy and Austrian Forest Dialog).

Forests are more than raw materials for production

Forests provide much more than just raw materials for production. Apart from their beauty and recreational value, they fulfill a multitude of environmental functions and are essential for climate regulation. People benefit from ecosystem (goods and) services. Not all benefits of ecosystems to people can be measured in monetary terms. It is therefore important to include other values as well, such as health, social or conservation values. The sustainable management of forests ensures that the different ecoservices provided are maintained and protected together with the supply of material for the wood-based industry. This is the core element of foresters' job description and an important part of their training. For more information on this, please see the "Biodiversity and ecosystems" Focus Paper.

Figure 13 provides an overview of the functions of forest ecosystems associated with the provisioning of wood.

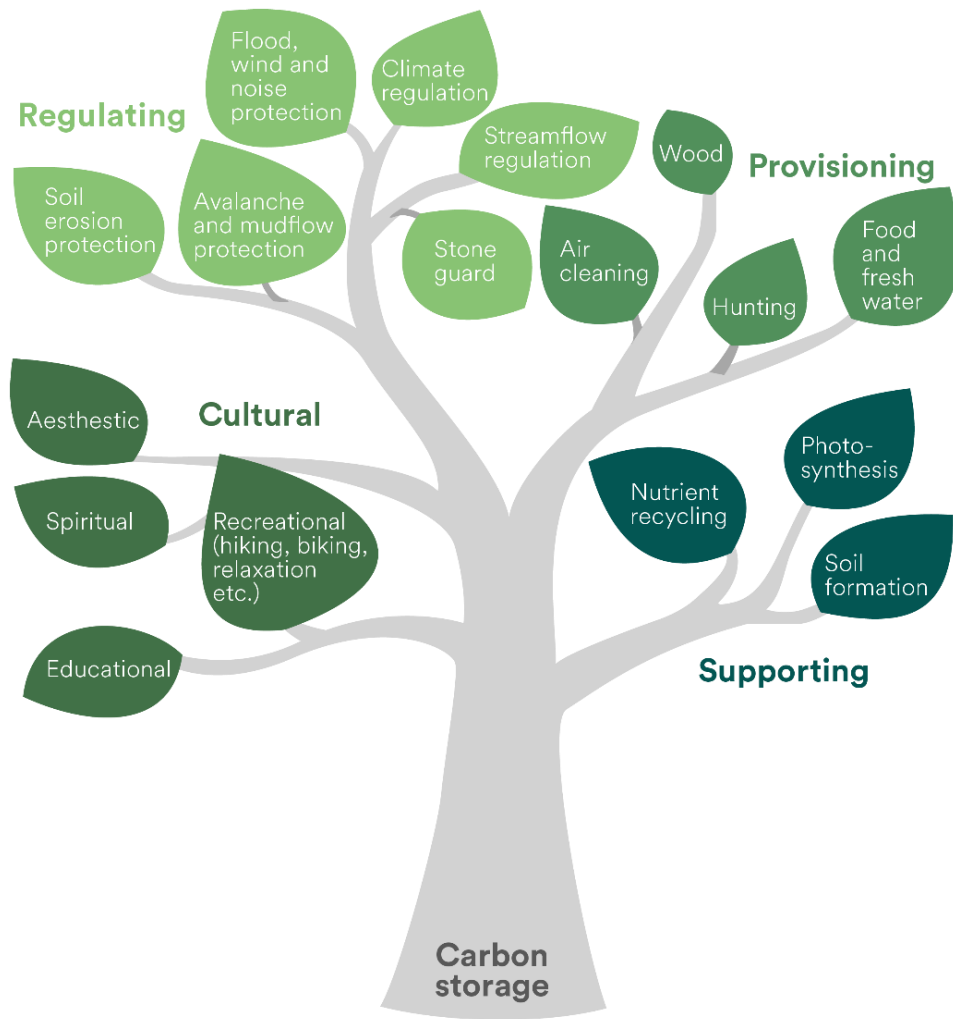


Figure 13: Functions of forest ecosystems, adapted from Lambini et al. 2019³¹ and WRI 2005.³²

The concept of ecosystem services is increasingly used to describe the links between the natural environment, e.g. forests, economic activities, and society. For more details on Lenzing’s activities in ecosystems, see chapter [“Biodiversity and ecosystems”](#) in the latest Sustainability Report or the [“Biodiversity”](#) focus paper.

Climate protection by use of forest products

Accordingly, not only sustainably managed forests, but also forest-derived products such as buildings, furniture, or textile or nonwoven products made from wood-based cellulose fibers are important carbon reservoirs depending on their product lifetime. This makes a significant contribution to reducing the CO₂ content of the atmosphere^{33, 34}. In addition, forest-derived products can replace other materials that have a higher climate-warming impact.

A recent study by P. Holmgren³⁵ estimates the overall and positive climate effect of the European forests and the forest-based industry sector to be -806 million tons of CO₂ equivalents annually. This refers to about 20 percent of the European Union’s fossil emissions. The effect is the sum of a net sink in the forests and in harvested forest products, the fossil emissions of the forest sector value chain, and prevented fossil emissions

through the substitution of fossil-based materials end energy. Substitution contributes nearly half of the overall benefits.

In the plantations of LD Celulose in Brazil, the carbon flows are monitored continuously according to Brazilian standards.

Wood and pulp sourcing is at the root of Lenzing’s business model. This part of the value chain harbors important climate change risks, on the one hand, as well as large mitigation opportunities through carbon removal and replacement of fossil-based materials, on the other.

Topic relevant to climate change	Details	Lenzing Group contribution
CO ₂ sequestration in sustainably managed forests	Sustainably managed semi-natural forests and forest plantations absorb more carbon in trees and harvested wood products, thus acting as a net sink over the long term. Forest areas and carbon stocks are increasing in Europe.	Wood sourcing from sustainably well-managed forests, managing own forest plantations, active engagement with pulp suppliers for improvements, and other stakeholder activities (e.g. research at WOOD K plus)
Substitution of raw materials that have large climate impacts	Fibers with smaller carbon footprints in their manufacturing process and life cycle	Offering choices for fibers with small-footprint
Adaptation of forests to climate change	Share of beech in Europe is increasing, but its uses are limited. Adaptation via higher species diversity can be faster in managed forests.	Economic valorization of beech wood for dissolving wood pulp production in Lenzing (higher value added than fuel wood use)
CO ₂ emissions from deforestation of forests	Ensure that no deforestation occurs in the supply chain	Lenzing’s wood and pulp policy, forest certificates (FSC®, PEFC), transparency through CDP Forest, implementing Canopy pathway, ranked top with dark green shirt in the CanopyStyle initiative

Table 6: How forests and wood products affect climate change mitigation

In addition to CO₂-abatement activities to reduce direct and supplier emissions, Lenzing will contribute to the decarbonization of its customers by actively developing products that reduce their value chain emissions. For product innovation examples, please refer to the latest [Sustainability Report](#).

Climate change effects on forests and plantations

In various assessments and special reports, IPCC noted increasing evidence that climate change has various impacts on forests. As reviewed by the FAO, this also poses a potential threat to the delivery of wood and non-wood goods and environmental services³⁶.

To sustain forest ecosystem functions and services amid changing climatic conditions, including climate variability and extremes, climate change is increasingly being considered in policies and approaches for sustainable forest management (SFM).

A study by Seidl et al.³⁷ evaluated the climate change vulnerability of the current SFM strategy for commercial forests managed by Austrian Federal Forests. “Vulnerability” refers to the extent to which forests are susceptible to and unable to cope with adverse effects of climate change. The vulnerability assessment is a tool for evaluating potential climate change impacts and preparing forest managers to better understand and adapt to climate change.

The study findings showed that more than a quarter of the area studied would be highly vulnerable in the second half of the twenty-first century. Negative impacts particularly concern water-limited sites on calcareous bedrock, whereas forests in higher altitude will experience predominately positive effects of climate warming.

Climate change models predict that extreme weather events such as storms and extended droughts will occur more frequently. In recent years, this has already happened in Central Europe. Both storm damage and drought combined increase bark beetle problems for spruce forests, leading to large areas of destroyed forest and a massive oversupply of low-grade timber from these calamities.

As all global regions are affected by this general trend, risks to timber supply are expected to increase. To mitigate this and other climate-related risks, Lenzing has set up a working group to implement the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

Adapting forest to climate change

Forest Europe has recently issued policy recommendations on the adaptation of forests to climate change⁶. They include measures in silviculture and practical forest management, technical capacities and infrastructure, genetics and forest reproductive material, monitoring and public awareness. Especially the transition to a broader species mix and to broadleaf trees is crucial for adapting forest ecosystems in Central Europe to climate change^{38,39}. Projections by simulation shown that in the course of such a managed transition, the carbon stock in forests can increase in parallel to continued harvesting, the overall wood harvest will decrease, and the share of hardwood harvest will increase on the long term⁴⁰.

In Lenzing's Central European wood-sourcing countries, the percentage of broadleaf forest, especially the domestic beech, is increasing⁴¹, as forests are being returned to a more natural tree species mix. According to its natural habitat, the area devoted to spruce cultivation is decreasing in Central Europe, although growing stocks are still increasing in all countries due to low felling rates. In some areas, rising average temperatures also increase the growth rate of beech, though in other areas decreased rainfall counters this trend. These effects combined lead to a higher availability of beech wood. Utilization of beech wood as a material is limited due to its properties. Manufacturing fibers provides relatively high value creation as compared to wood use for energy generation.

Water and forestry

Water is a precious resource and its scarcity in many parts of the world is a threat. Natural and semi-natural forests are part of the natural hydrological cycle and, as such, do not consume water⁴². On the contrary, forests stabilize streamflow, thereby providing protection from floods and assuring water supplies in times of low rainfall. Forested catchments supply 75 percent of the freshwater used. In addition, the more a catchment is forested, the lower the cost of water treatment⁴³.

Regarding the wood from eucalyptus plantations, Lenzing recognizes that there is concern about the ground water use of eucalyptus plantations.

Regarding the eucalyptus plantations from the Lenzing-Dexco Joint Venture in Brazil, the Lenzing Group is aware that the sustainable management of all environmental aspects including water is crucial for a long-term oriented business. Dexco has disclosed its water management and performance to CDP, and always scored A- or B since 2016. LD Celulose now is part of Lenzing Group's CDP Water disclosure since 2021.

Water issues are closely observed and studied in Brazil, including the dynamic taking place in eucalyptus plantations^{44,45}. As Eucalyptus trees utilize water much more efficiently than other cultivated plants to build up

biomass⁴⁶, water shortages can occur if these plantations are located in places with insufficient water availability, threatening water security⁴⁷. Fortunately, LD Celulose’s plantations are located in a strategic place with enough water sources, not threatening the water supply⁴⁸.

In South Africa, numerous studies addressing water use at plantations are well documented, and plantations are limited by legislative restrictions⁴⁹. Plantations in South Africa are only operated in regions with sufficient natural moisture to enable plant growth. The plantations for dissolving pulp wood do not need any artificial irrigation outside of the nurseries⁵⁰.

Technology of pulp production: the biorefinery concept

The Lenzing biorefinery concept is at the heart of Lenzing’s business model and one of the key ways in which Lenzing embeds circular economy principles. Lenzing uses the well-established and optimized magnesium-bisulfite process, involving a totally chlorine-free bleaching sequence and the recovery of process chemicals at both production sites in Lenzing (Austria) and Paskov (Czech Republic). For more information, see the [focus paper “Responsible Production”](#). In the new pulp production site LD Celulose in Indianópolis (Brazil), the Prehydrolysis Kraft process is used.

The Lenzing biorefinery concept ensures that 100 percent of wood constituents are used to produce fibers, biobased chemicals, and bioenergy, thus maximizing value creation from an economic and environmental perspective (Figure 14) Lenzing has been investing in the biorefinery concept for decades, making the company a forerunner in the production of biorefinery products on an industrial scale.

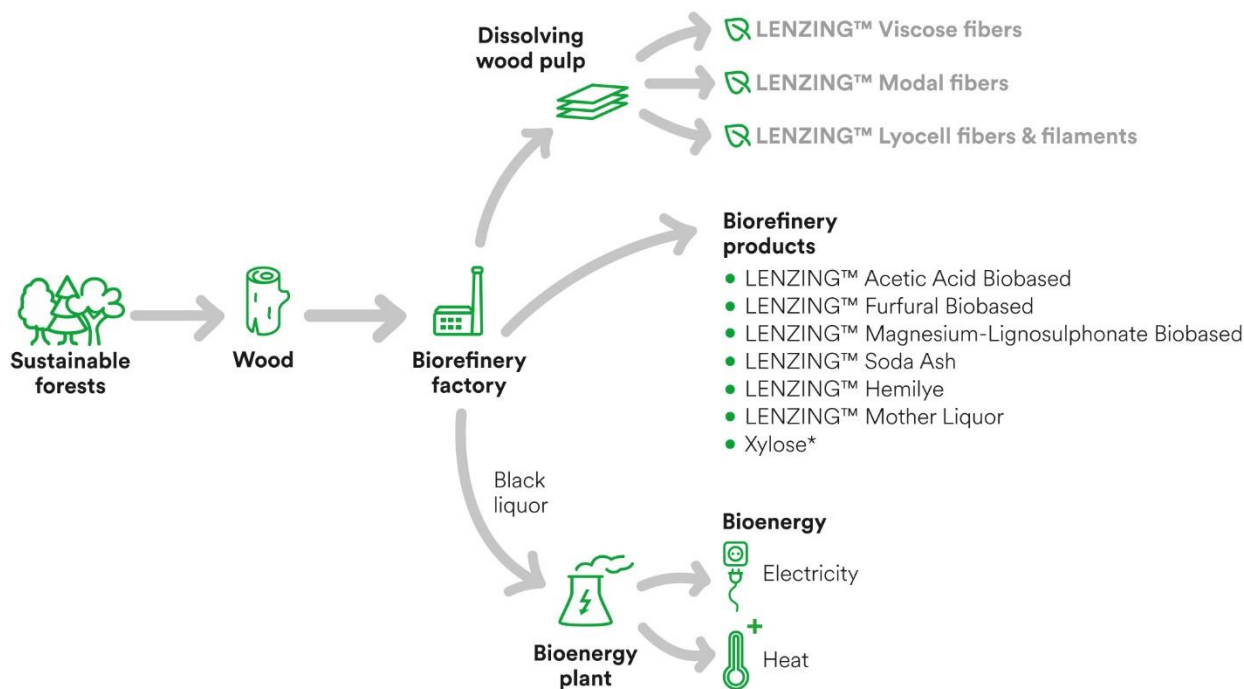


Figure 14: Highly efficient use of the raw material wood at the Lenzing Group’s biorefineries – example of the Lenzing Austria site. Wood and biorefinery products are calculated as “absolute dry”, and pulp as “air-dry”. The bioenergy produced supplies fiber production (in Lenzing, Austria) or the public power grid (in Paskov, Czech Republic). The Paskov mill produces lignosulfonate and soda as a co-products.

The key principles of Lenzing’s biorefinery concept are *cascading wood use* and a *circular economy*:

- Use of wood and its constituents as substitutes for oil-based products (recarbonization)
- Use of wood constituents multiple times along the value chain
- Production of biobased chemicals, such as LENZING™ Acetic Acid Biobased, LENZING™ Furfural Biobased and xylose⁵¹, to help increase the total material yield and value generated from wood
- Recovery and reuse of process chemicals – this is a key contributor to sustainable success and profitability
Creation of useful products that are recyclable and therefore bind CO₂ as long as possible

Site	Lenzing	Paskov	Indianópolis
Country	Austria	Czech Republic	Brazil
Capacity 2023 (tons per year of air dry pulp at 10 % moisture / 90 % dry matter)	320,000	285,000	500,000
Biorefinery products	Acetic acid, furfural, xylose, magnesium-lignosulfonate, soda ash (sodium carbonate)	magnesium-lignosulfonate, soda ash (sodium carbonate)	-
Use of energy surplus	Integrated into fiber production at site	Electricity delivered to public grid	
Main wood source	Beech	Spruce	Eucalyptus
Sustainability features	TCF bleaching		
Production technology	Magnesium bisulfite		Prehydrolysis Kraft process
Pulp cooking chemicals used	Magnesium oxide, sulfur dioxide		Sodium hydroxide, sodium sulfide
Bleaching chemicals used	Oxygen, ozone, hydrogen peroxide, sodium hydroxide		

Table 7: Pulp production in the Lenzing Group

Responsible pulp bleaching

Bleaching is necessary to yield a dissolving pulp quality suitable for wood-based cellulosic fibers, such as viscose, modal, and lyocell. Lenzing’s three biorefineries produce pulp without using chlorine, but with oxygen-based substances (totally chlorine-free – TCF). Due to the elimination of chlorine, dissolving wood pulp produced in the Lenzing Group not only has less impact on the environment and human health, but also ensures the high quality required for fiber production.

The bleaching process of all purchased pulp is at least elemental chlorine-free (ECF). Both technologies satisfy the “best available technology” standards of the European Union⁵².

For more details on Lenzing’s production processes, see the [“Responsible production” focus paper](#).

Glossary

Please note that this limited glossary does not claim to be scientifically comprehensive. The definitions are provided as a service to our readers and are intended to help them better understand the complex issues of forest conservation and forest use. In the current dynamic global discourse, methodologies are developing and definitions can sometimes be controversial.

Ancient and endangered forests

Term originating from the NGO Canopy, defined as intact forest landscape mosaics, naturally rare forest types, forest types that have been made rare due to human activity, and/or other forests that are ecologically critical for the maintenance of biological diversity and ecological integrity.

<https://canopyplanet.org/wp-content/uploads/2018/11/CanopyQuickGuideAncientEndangeredForests.pdf>

Annual plants

Herbaceous plants that die during winter above ground such as hemp or straw.

Biodiversity

This is the variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part.

This includes diversity within species, between species and of ecosystems.

Bioenergy

Bioenergy is energy derived from biomass. The term refers to various forms of energy, including heat and electricity. The biomass that contains this energy can also be referred to as bioenergy. The main sources of bioenergy are renewable resources.

Biorefinery

A biorefinery is a facility for the sustainable processing of biomass into a range of marketable biobased biorefinery products and bioenergy.

Canopy Planet Society

The Canopy Planet Society is a Canadian nonprofit organization that focuses on the conservation and protection of ancient and endangered forests.

CDP

The Carbon Disclosure Project (CDP) is a non-profit organization aims to ensure companies and also municipalities disclose their environmental performance relating to the areas of climate, forests, and water. Once a year, the data is collected on behalf of investors using standardized questionnaires. The questionnaires are conducted on a voluntary basis to collect data and information on CO2 emissions, climate risks and reduction targets, and company strategies.

www.cdp.net

Cellulose

The raw material for pulp production. Cellulose is a component of all plants. The cellulose content of wood is about 40 percent.

Dissolving pulp

Chemically digested plant material used for the production of viscose or lyocell fibers or chemically modified cellulosic products, with a very high cellulose content – about 89 to 97% - and low levels of other impurities.

EcoVadis

EcoVadis aims to promote the environmental and social practices of companies through CSR performance monitoring within the supply chain and to support companies in improving sustainability. EcoVadis operates the first collaborative platform to deliver CSR ratings from suppliers to global supply chains.

FAO – Food and Agricultural Organization of the United Nations

The Food and Agriculture Organization of the United Nations (FAO) is a specialist agency of the United Nations that leads international efforts to defeat hunger. It is based in Rome. It is also in charge of UN activities related to forests.

FSC®

The Forest Stewardship Council® (FSC) is an international non-profit organization for wood certification.

Growing stock

Volume over bark of all living trees more than (e.g. 10) cm in diameter at breast height.

International Labour Organization (ILO)

The International Labour Organization (ILO) is a United Nations agency that sets international labor standards and promotes social protection and work opportunities for all. The ILO has 187 member states: 186 of the 193 UN member states plus the Cook Islands are members of the ILO.

Paper pulp

Chemically digested plant material used for the production of all grades of paper, containing a high amount of different wood constituents.

PEFC

The Program for the Endorsement of Forest Certification Schemes (PEFC) is an international non-profit organization for wood certification.

Plantation

Forests of single species, monocultures that have been planted or seeded by human intervention and that are under intensive stand management, fast-growing, short-rotation species. Examples: poplar, acacia or eucalyptus plantations.

Primary forest

Forests composed of native species in which there are no clearly visible indications of human activities and the ecological processes have not been significantly disturbed (FAO 2020 FRA Key findings, and FAO FRA Terms & Definitions p. 14). Includes both pristine and managed forests which meet the definition.

Semi-natural forest

Forests of endemic (native) species, established either through assisted or natural regeneration, or a mix of these under intensive stand management (including forests in which assisted regeneration is performed using the same species or similar species composition as in the respective area's natural forests). Examples: many production forests in Europe, some teak plantations.

SFI

Sustainable Forestry initiative, a forest certification scheme mainly in North America.

Woody plants

Plants with a hard stem that survive winter above ground, such as trees and shrubs.

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² Licence code FSC® (FSC-C041246); PEFC (PEFC/06-33-92)

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