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fair & smart use of the world's fresh water

Viscose fibres production

An assessment of sustainability issues

August 2017

About WFN

Water Footprint Network provides science-based, practical solutions and strategic insights that empower companies, governments, small-scale producers and individuals to transform the way we use and share fresh water within earth's limits.

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Acknowledgements

The Water Footprint Network would like to thank all organisations and individuals that contributed to the development of this report, by sharing their knowledge, expertise, views and opinions.

Any incorrect information provided is solely Water Footprint Network's responsibility.

Authors

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The results and findings of this report are based on analysis done by Water Footprint Network. The partners of the initiative consider it a living document that will be adapted to the circumstances based on new findings and concepts, future experiences and lessons learnt.

August, 2017

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Scope and approach

The current report comprises the results of an assessment of the most relevant and priority sustainability issues in the production of viscose fibre along its supply chain.

The phases of viscose production included are cellulose (from wood[1]), pulp and viscose fibres production.

The types of viscose included are: standard viscose, modal and lyocell.

The assessment comprises a mapping, within viscose's production stages, of:

- viscose and its raw materials (wood and pulp) markets and key producers;
- the most prominent environmental and social issues in the production of viscose fibre at each production stage;
- the existing standards and tools addressing sustainability of the viscose supply chain
- gaps at each production stage in existing sustainability initiatives regarding the key sustainability issues at each production stage

The analysis was developed from a basis of available data and information gathered through interviews of actors in the viscose supply chain. Data on viscose producers, market and processing throughout its supply chain, from raw materials to fibres production, was collected from different publically available statistics, reports and websites[2]. Interviewees included viscose fibres and retailer brands, a textile specialist, non-profit organisations focused on sustainability, organisations developing guidance and performance measuring tools and initiatives and auditing organisations.

[1] Cellulose for viscose production may also be sourced from cotton or bamboo, but only wood in analysed in the current document, since wood from hardwood forests represents the main source of viscose's raw materials.
[2] A considerable amount of these data and information was collected during the research developed for undertaking a Water Footprint Assessment of viscose, developed for C&A and with the support of C&A Foundation

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Sustainability issues

The sustainability issues considered in this analysis are:

Air	Key processes and pollutants with impact on air quality.
Water	Water intensive processes and most relevant effluents and wastewater pollutants.
Ecosystems	Key processes with an impact on ecosystems.
Climate change	Key processes with an impact on climate change.
Social fairness/communities	Land and indigenous communities' rights, health and safety conditions of workers and impacts on surrounding communities.

For each stage of production, the key sustainability issues are identified. These refer to the aspects that are directly impacted. Aspects that are indirectly impacted are not identified, since it is assumed that by addressing the key issues, secondary impacts will cease. An example is the direct impact of industrial effluents on water quality and its indirect impacts on people and ecosystems.

Health issues for consumers, such as hazardous substances in garments, are excluded from the analysis. The three production steps (wood, pulp and fibres) are analysed independently. However, it is important to note that integrated production of pulp and fibres, allows a better control and management of chemical inputs and recovery, emissions and energy reuse and therefore is more sustainable**.**

Viscose market and production

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Viscose market

Viscose is a man-made fibre derived from cellulose dissolving pulp and its raw materials are diverse, e.g. wood, cotton or bamboo can be used. Currently, hardwood forests are the main source of cellulose used in viscose production. Cellulose is transformed into dissolving wood pulp and sold to fibre producers for filament or staple fibres production.

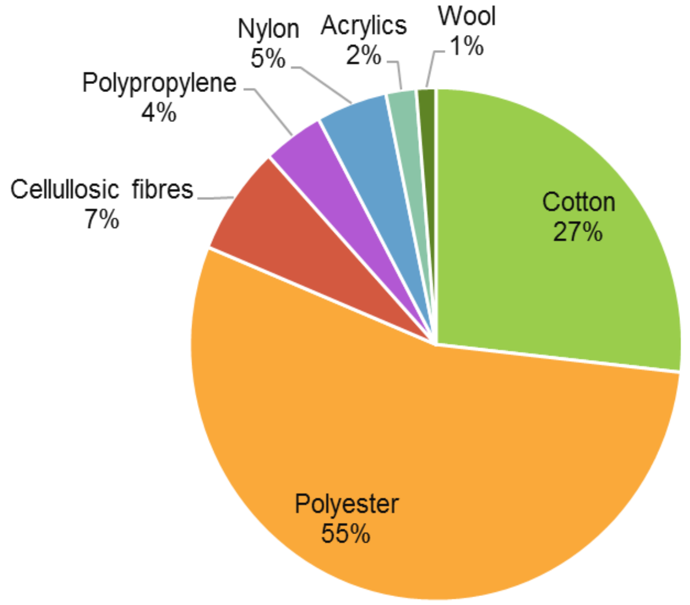
Cellulosic fibres have the third largest share of the total fibre's market, after polyester and cotton. Viscose production is growing globally with the largest share of dissolving wood pulp now being produced to make viscose for the apparel industry.

Although the current market share of viscose fibres is still relatively small when compared to cotton or polyester, a larger production of viscose for the textile industry is expected in the coming years.

Global viscose fibre production capacity grew at an average annual rate of 7.7% during the first decade of the 21st century, driven primarily by expansion in Asian countries, with China as the most notable country. China has become the world's largest viscose fibre producer, with its output accounting for approximately 62% of the global total in 2012. By 2013, China had more than doubled its viscose fibre production in comparison to 2007.

About 85% of the total viscose fibre production is produced as staple fibres and about 15% as filaments.

Global consumption of fibres at mills in 2015



The viscose industry is highly concentrated in a few corporate groups and companies, with some owning all stages of production – from forest to fibres. It is also geographically concentrated in a few regions as presented in the following sections.

Wood and pulp market

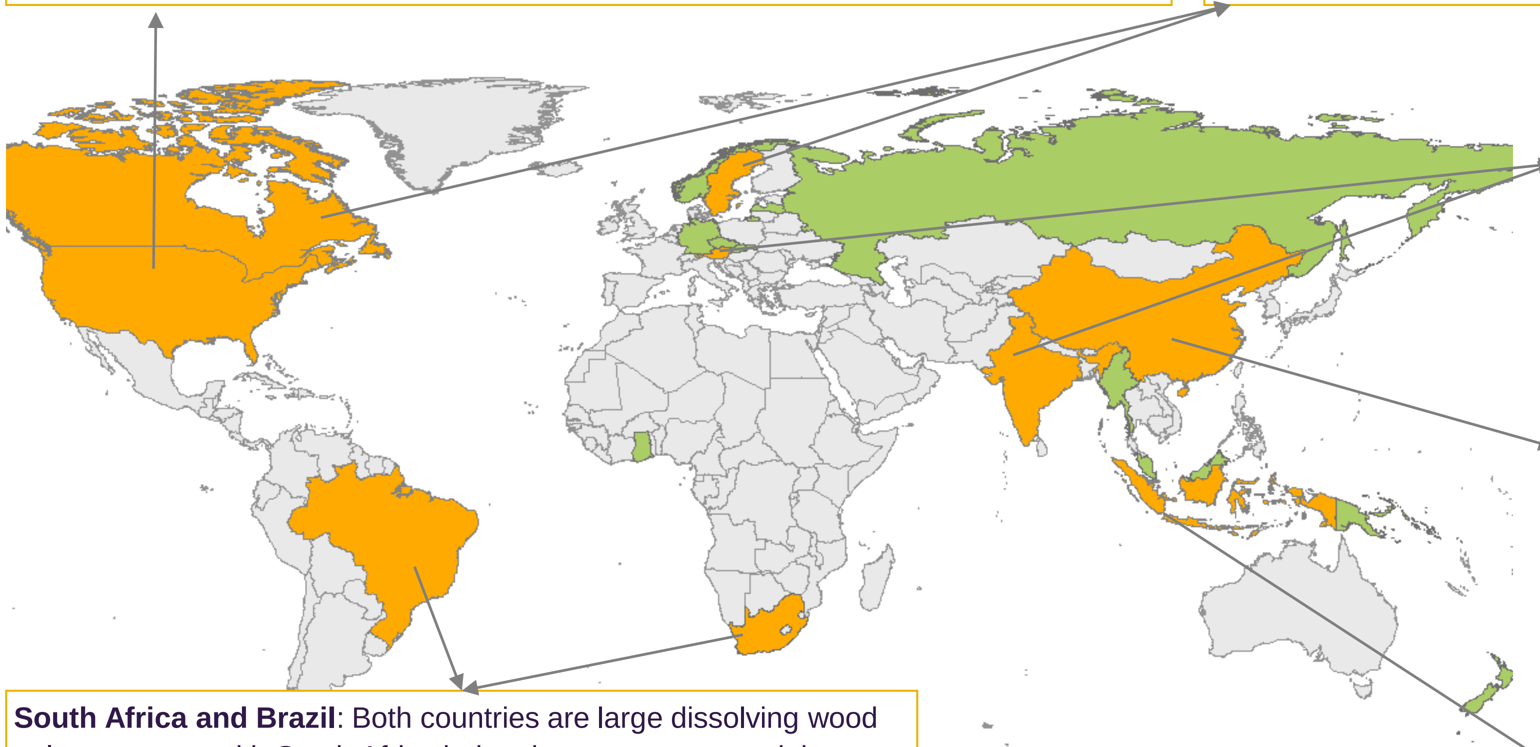
There is no publically available data on wood trade specifically for dissolving wood pulp production (and viscose), only for roundwood, which includes wood for pulp and other end products. However, from roundwood trade data together with other viscose market information, it is possible to identify some key geographies in terms of cellulose production for the viscose industry. These are presented below. Almost 70% of the dissolving wood pulp produced globally is for export. South Africa and the USA are the largest exporters and in 2015 accounted for 40% of the global export market followed by Canada, Sweden and Brazil with 34% of the global export market. The main importing region is Asia with China leading, which accounts for 51% of global imports due to its large viscose fibres production.

United States of America: USA is the world's largest producer of wood for pulp production, the world's largest dissolving wood pulp producer and the world's second largest dissolving wood pulp exporter. It is therefore expected that most of the wood used for dissolving wood pulp production is produced in the USA and that both wood and pulp are exported from the USA for viscose fibres production elsewhere in the world. The main dissolving wood pulp producers and/or exporters importing wood from USA are China, Canada and India.

Canada and Sweden: Both countries are amongst the largest dissolving wood pulp producers and exporters in the world. They are both amongst the largest roundwood producers, however they also import significant volumes of wood. Canada mainly imports roundwood from the USA, and Sweden mainly from Norway, Latvia and the Russian Federation.

Austria and India: These countries are amongst the largest dissolving wood pulp producers in the world with the data indicating that most of the wood is produced elsewhere. Austria mainly imports roundwood from Czech Republic, Germany and Slovakia. India mainly imports coniferous roundwood from New Zealand and the USA, and tropical roundwood from Malaysia, Myanmar, Papua New Guinea and Ghana.

China: China is the largest dissolving wood pulp importer in the world and is also amongst the world's largest producers of dissolving wood pulp, accounting for 3.5% of global production. China mainly imports non-tropical roundwood from the Russian Federation, New Zealand, the USA and Canada; tropical roundwood is sourced from several countries, with the largest exporters to China found to be Papua New Guinea, Solomon Islands and Malaysia.



South Africa and Brazil: Both countries are large dissolving wood pulp exporters, with South Africa being the top exporter and the second largest producer. Although South Africa is not amongst the largest wood producers, trade data indicate that both South Africa and Brazil are more likely to use national wood resources for dissolving wood production than for other uses.

Legend

Roundwood and dissoving pulp producers

Roundwood exporters to dissolving pulp producers

Indonesia: Indonesia is not amongst the largest roundwood exporters or importers. However, the country is amongst one of the largest wood for pulp producers and has the second highest rate of deforestation globally. Indonesia forests have been under the spotlight from many international organisations and numerous campaigns because of the destruction of Sumatra's natural forested area into land-use such as eucalyptus (for pulp production, including dissolving wood pulp for viscose fibres) and palm oil plantations.

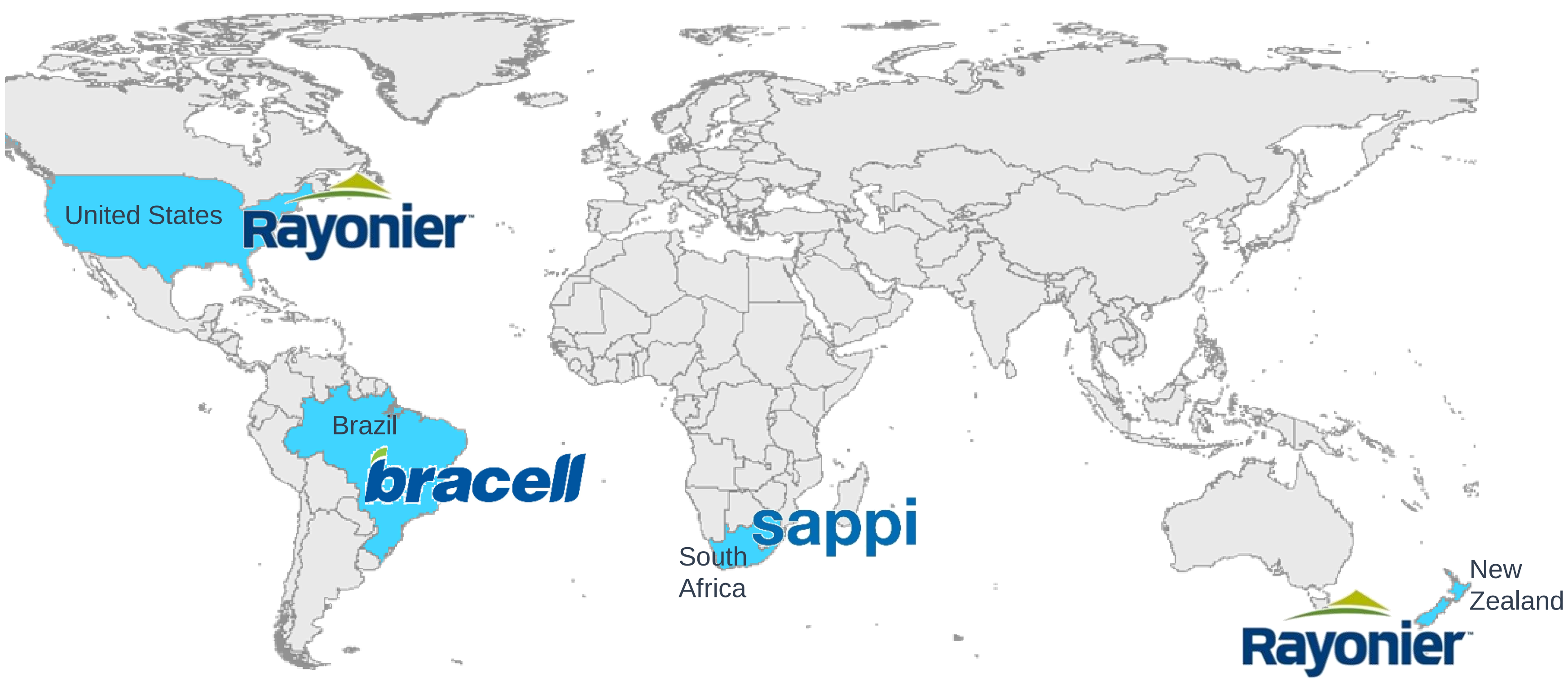
Companies involved in wood production for viscose

The key players in forest and wood production for the viscose market are Sappi, Bracell (part of Royal Golden Eagle Group) and Rayonier.

cellulose

sappi bracell Rayonier

Forest locations of main cellulose producers (for viscose)



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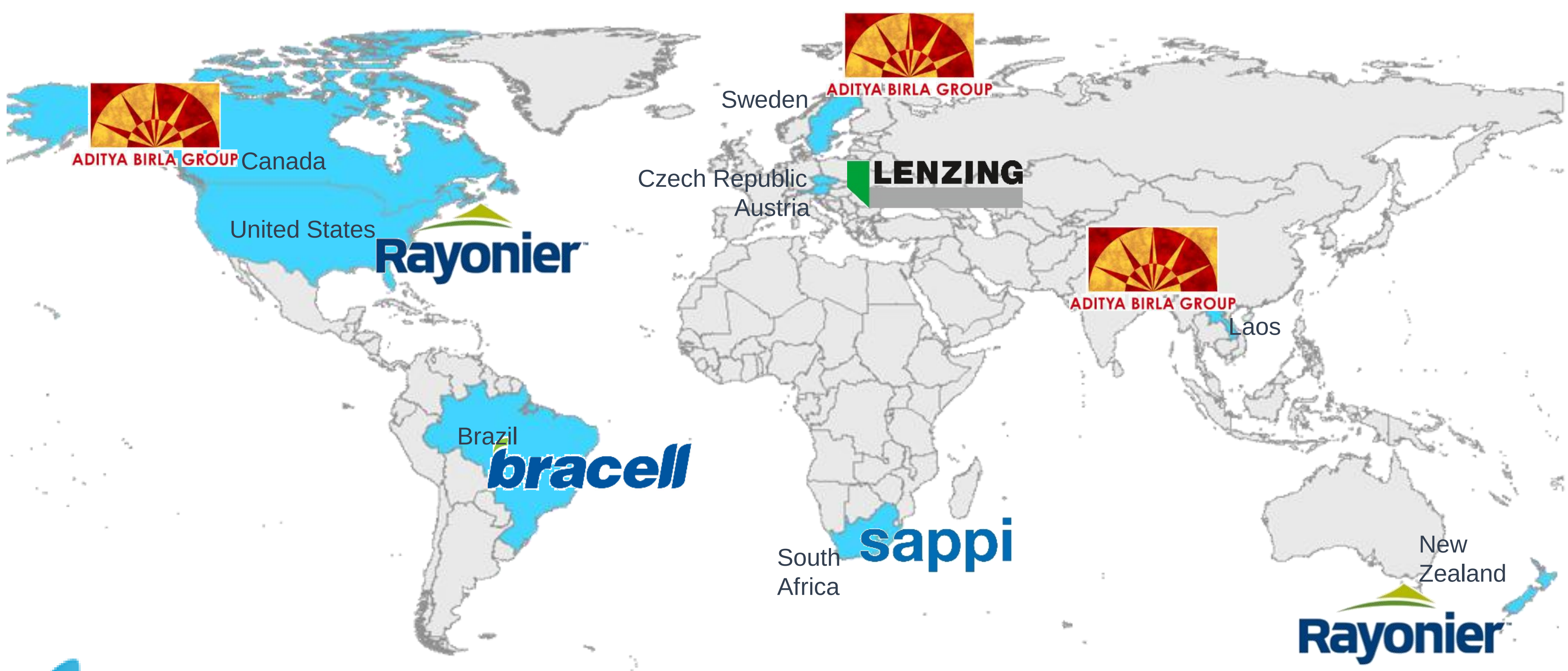
Companies involved in dissolving wood pulp production

In 2014, the total dissolving wood pulp capacity of Sappi, Aditya Birla, Lenzing, Bracell and Rayonier accounted for about 53% of global production with Sappi alone holding approximately 19% of dissolving wood pulp global production capacity. In 2009, Bracell (by then under Sateri brand), supplied 40% of the dissolving wood pulp imports into China.

pulp

sappi bracell Rayonier LENZING ADITYA BIRLA GROUP

Locations of main dissolving wood pulp producers



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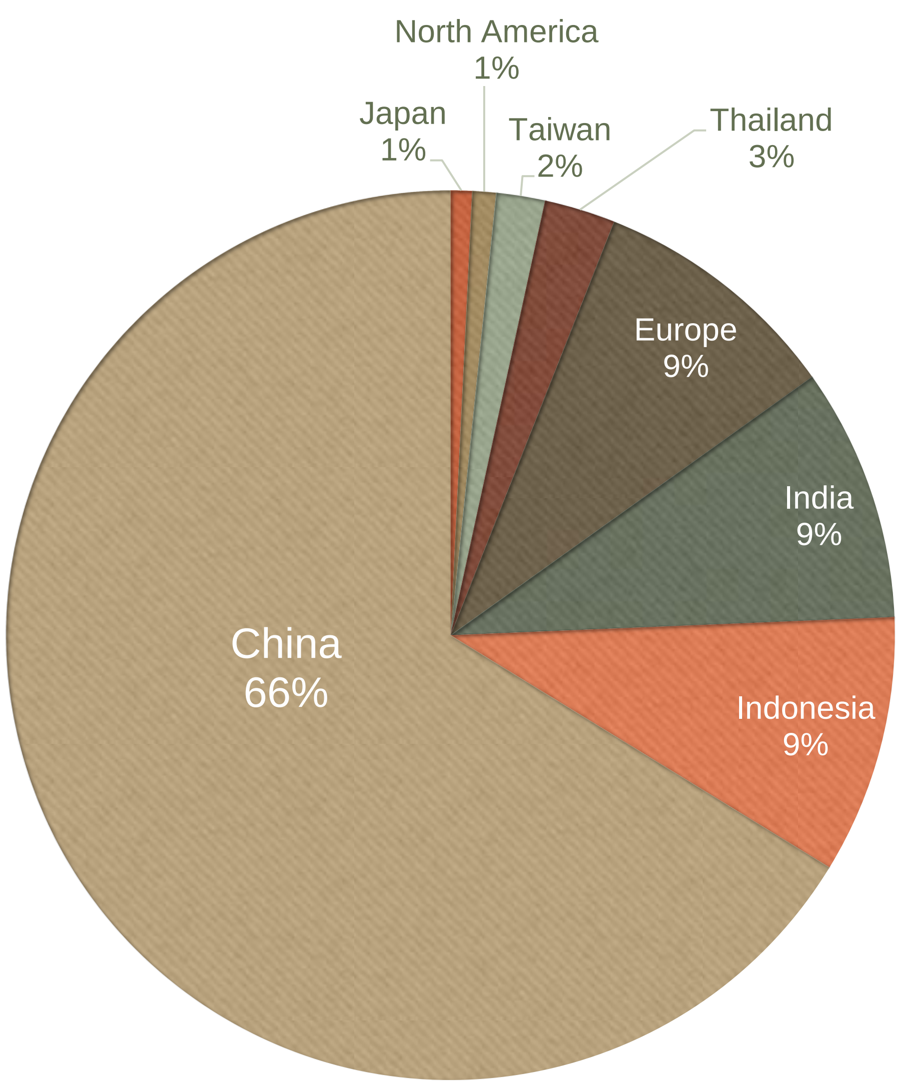
Viscose fibres market

China is the world's largest viscose producing region and its production share has been growing in the past years. In 2012 China accounted for 62% of the global total. By 2013, China had more than doubled its viscose fibre production in comparison to 2007. In 2015 China reached 66% of total production. Indonesia and India are the second largest producing regions.

World's largest viscose fibres producing regions in 2015

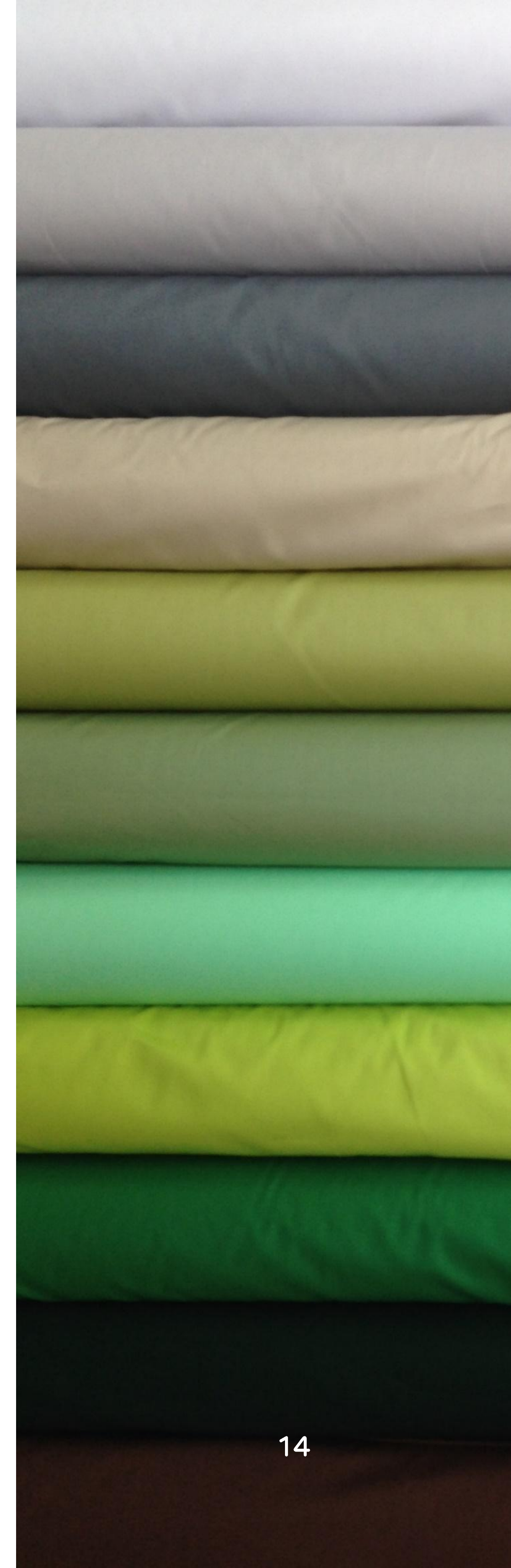


Companies involved in viscose fibres production

The two top viscose producers are Lenzing and Aditya Birla. China is the largest producing country and in 2013, 51.8% of China's viscose staple fibres produced came from five companies, namely Fulida Group, Sanyou Chemical, Aoyang Technology, CHTC and Shandong Yamei.

fibres
LENZING
Sateri
SanYou Chemical Industries
Aoyang 澳洋科技 Manasi Aoyang Technology
ADITYA BIRLA GROUP
Bohi 渤海實業 Shandong Yamei
富丽达集团 FULIDA GROUP
CHTC

Locations of main producers of viscose fibres



Viscose production processes and key sustainability issues

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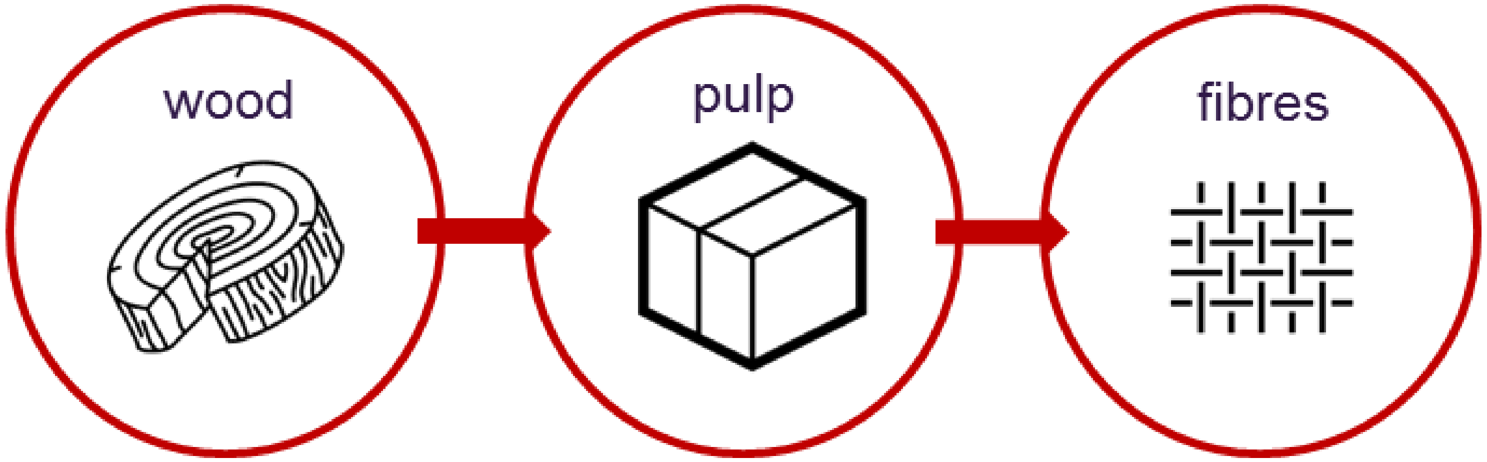
Viscose production

Viscose is derived from cellulose. Cellulose is mainly sourced from hardwood forests and plantations. Hardwood cellulose is then transformed into dissolving wood pulp.

Dissolving wood pulp is then transformed into either viscose filament yarns or staple fibres.

Schematics of viscose fibres production



The sustainability issues identified for each of the three stages of production relate to the most relevant environmental and social aspects that are directly affected. Indirect consequences, such as for instance, impacts on ecosystems or communities due to water quality degradation, are not listed.

Wood production

Currently, hardwood forests (which also include plantations) are the main source of cellulose used in viscose production.

Trees from forests or plantations for viscose production are harvested, peeled and cut into logs, usually where they are grown. Harvesting methods may vary substantially according to the type of trees, region and practices used.

The logs are transported to the mill where they are debarked. Debarking can be either wet or dry. In cold climates snow and ice need to be removed from logs to facilitate debarking. This may be achieved in special conveyors with warm water or by steam and hot water at the entrance of the debarking drum. In some cases, debarking may take place at the harvesting site.

Wood chips yard and conveyor at a pulp mill in Paskov, Czech Republic (2014)
Photo credits: Pavel P. Flickr

For instance, bark of mature eucalyptus and of fresh spruce harvested during the growth period is usually removed at harvesting site, because logs contain strong stringy fibres which are not suitable for a mill's debarker machine.

Once removed from the tree, bark may be shredded and burned or used as biofuel after drying.

For chemical pulping processes, wood logs are reduced to chips. This may happen at the wood harvesting site or at the pulp mill. If wood chips are produced at the harvest site, wood chips are often delivered to the mill in conveyors.

Key sustainability issues in wood production

It is estimated that currently 120 million trees are cut down every year for viscose production (canopyplanet.org), some of which are from endangered and ancient forest such as forests in Indonesia, Canada's boreal and temperate rainforests and the Amazon. Deforestation and degradation in endangered and ancient forests may take place for the direct use of wood and/or to replace these forests with production plantations.

Management and maintenance practices of forests and plantations grown for wood production require undertaking a series of activities that may adversely impact the environment, depending on the specific practices applied. Examples are clear-cuts and forest thinning activities, removal of natural vegetation for tree development, use of agro-chemicals, irrigation at certain stages of development, building of access routes, use of heavy machinery, etc. Wood debarking and transport also generate effluents with organic loads.

Ecosystems	Logging of ancient and endangered forest has an impact on ecosystems, since these forests are home to a wide number of endangered and protected species. Introduction of non-indigenous trees, forests/plantations logging, maintenance and management practices, especially in very intensive productions, may have adverse impacts on local ecosystems.
Social fairness/communities	Logging of forests may impact indigenous people and local communities by depriving them of their access to traditional land uses, with a diverse range of impacts from food security to communities' safety, conflicts or cultural disruptions.
Water	Chemicals used in pest control and in fertilisation, soil erosion and organic matter form debarking and transport, degrade water quality; deforestation changes hydrological patterns.
Climate change	Forests store carbon dioxide and help control climate change; deforestation decreases this capacity.

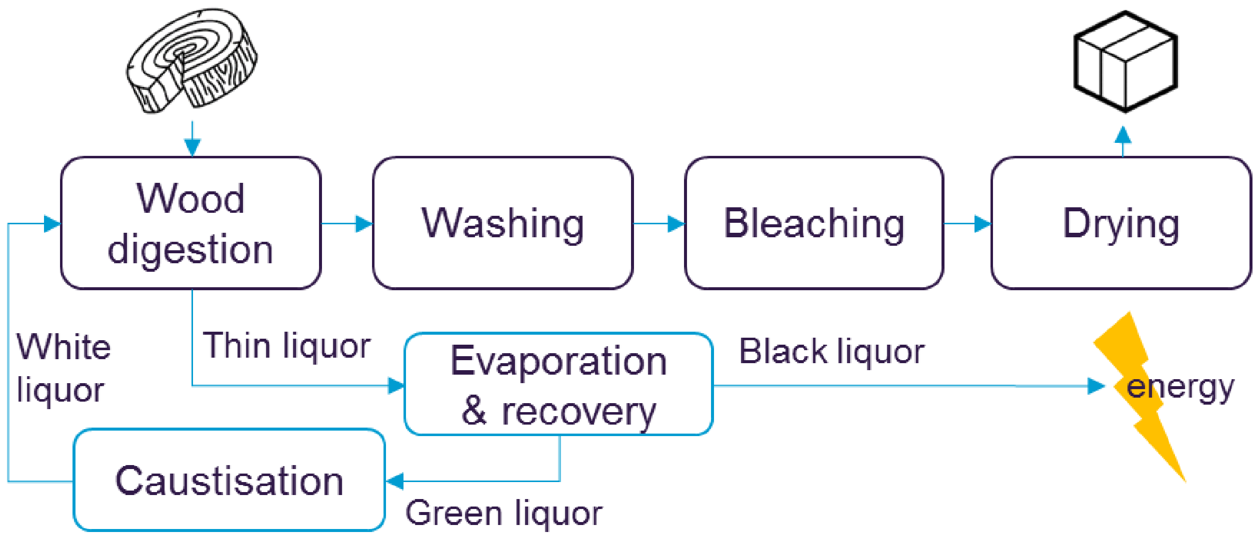
Pulp production

In pulp production, wood chips go through a process of purification and separation of the wood fibres, in a series of steps which require steam and chemicals inputs (e.g. sodium hydroxide, sodium sulphide or sulphur dioxide). Types and amounts of chemicals used and their recovery vary according to the process and methods used.

The resulting brown pulp is washed and cleaned through the process of cold caustic extraction, which increases the purity of the pulp. The resulting product of the washing process is a black liquor, which can be regarded as waste or as a by-product. Early pulp mills discharged black liquor to watercourses but nowadays it is usually recovered for energy production – the black liquor is evaporated and then burned in the recovery boiler, generating steam used in turbines to produce electricity. Pulp mills not only generate energy from black liquor and forest waste biomass for their own use but may also produce surplus energy that can be used in fibres production in the case of integrated production, or sold to others.

After cleaning and washing, the pulp is bleached with chemicals. Chemicals used in bleaching cannot be recovered. Chlorine bleaching generates toxic effluents due to the presence of chlorates and organically bound chlorine compounds, measured as AOX[1]. Therefore, many pulp mills have stopped using molecular chlorine for the bleaching of pulp. Two alternative bleaching methods are applied.

- Use of chlorine dioxide bleaching sequences. This is called ECF (elemental chlorine free).
- Complete elimination of the use of chlorine products. Bleaching is achieved from a combination of oxygen delignification with an ozone stage and/or a peroxide stage. This is called TCF (total chlorine free).



[1] *Adsorbable organic halogens*

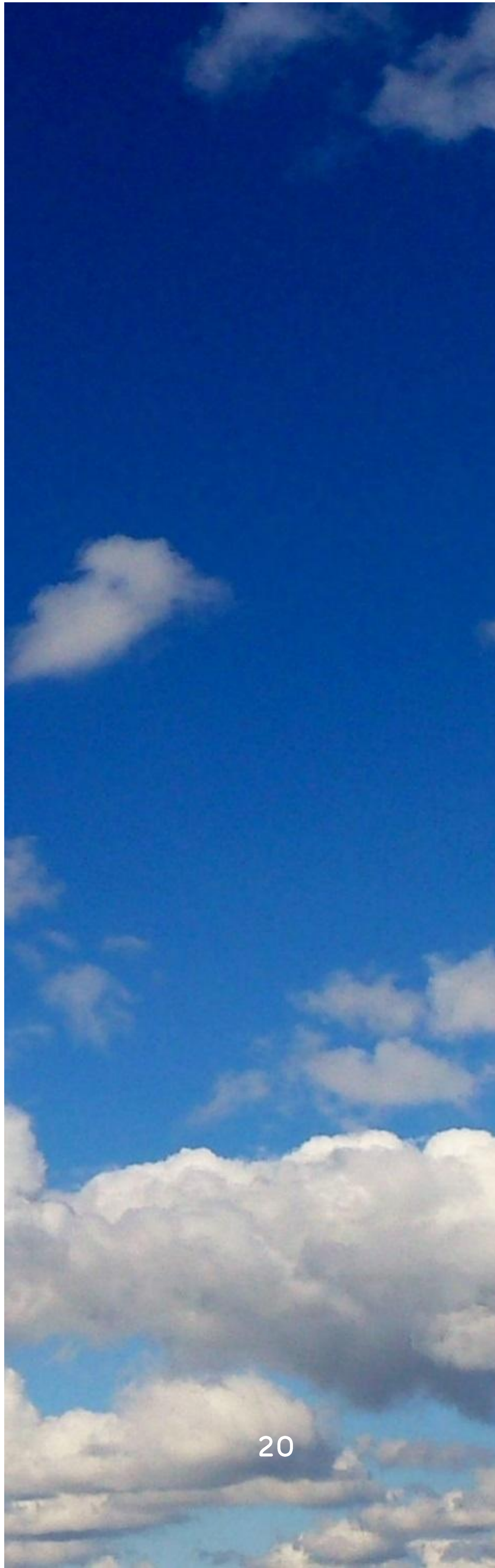
Key sustainability issues in pulp production

Pulp mills have significant emissions to air and water, mainly due to the chemicals used in processing, but also related to the organic compounds in the wood.

In the past, chemical pulp mills have caused serious air emissions of sulphur but in recent years, progress in technology has enabled a reduction in sulphur air emissions. However, some processes are still important sources of air pollutants[1].

There has also been a decrease in the use of molecular chlorine as a bleaching chemical since the 1990s, and environmental control authorities in many countries have set severe restrictions on the discharges of chlorinated organics into the aquatic environment. The reduction of these compounds is dependent on specific process measures applied at mills. However, reduction of the load of some chemical additives, the emissions of nutrients and the discharge of suspended solids are still regarded as a challenge for the pulp industry.

Air	Emissions to air in pulp production consist mainly of compounds containing sulphur, such as sulphur dioxide. Emissions also contain nitrogen oxides, dust and carbon monoxide. Chlorine compounds used during the bleaching process may be released to the atmosphere. Volatile organic compounds are emitted to the atmosphere from wood chips stored outdoors.
Water	Emissions to water are dominated by oxygen-consuming organic substances. Effluent from the bleach plant, where bleaching chemicals containing chlorine are used, contains AOX and chlorate, which have toxic effects in the aquatic environment. Chlorine bleaching may also result in dioxins emissions, which are classified as persistent organic pollutants, highly toxic to humans and the environment.
Social fairness/communities	Workers may be exposed to toxic products, from chemicals that are used in production, and to work accidents derived from explosions or leakages in chemical storage areas.



[1]Such as recovery boilers, lime kilns and on-site power plants

Fibre production

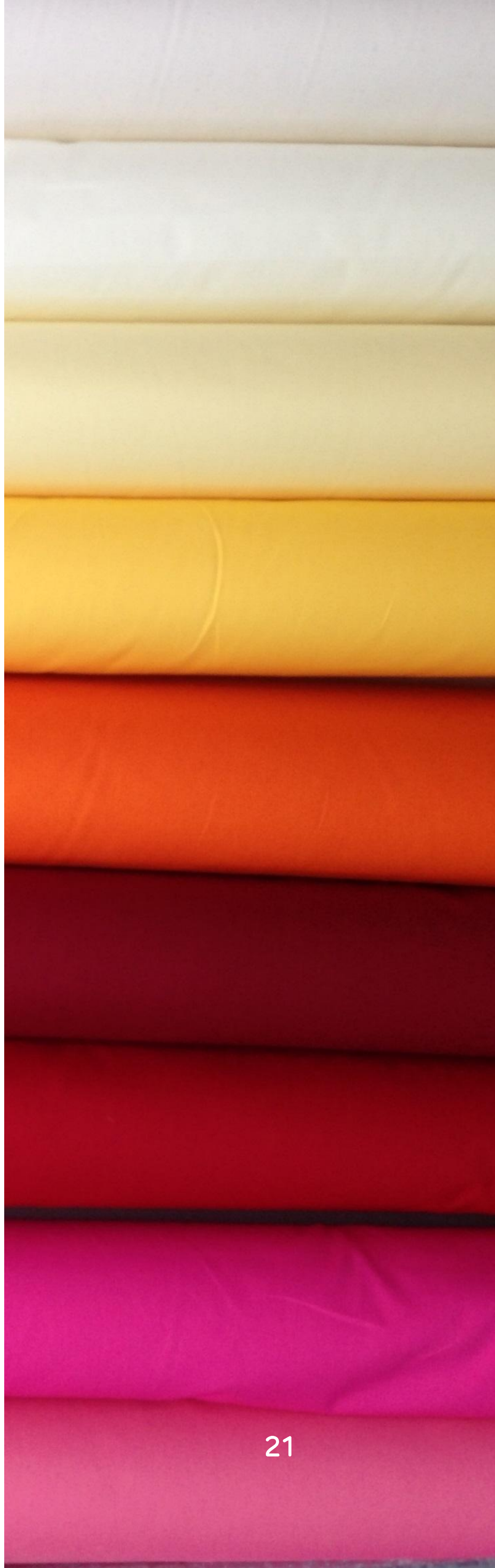
Viscose fibres' production uses the so-called 'viscose process' where the pulp is treated with carbon disulphide (CS_2) and dissolved by adding sodium hydroxide solution (NaOH). This produces a viscous orange-brown solution called 'viscose' where cellulose precipitates with carbon disulphide and the by-product hydrogen sulphide is released.

This process applies both to standard viscose and to modal fibres. Modal processing is qualitatively equivalent to viscose processing. However modal has a more intensive production, requiring larger amounts of chemical inputs and energy. Lyocell processing differs from standard viscose and modal: the solution of the pulp is undertaken by using an organic solvent – N-methylmorpholine n-oxide – instead of carbon disulphide and sodium hydroxide solution.

The solution is next turned into fibre strings. This is done by forcing the liquid through a spinneret, which works like a shower-head, into an acid bath. In the acid bath, the acid coagulates and solidifies the filaments, now known as regenerated cellulose filaments. After being bathed in acid, the filaments are ready to be spun into yarn.

In the spinning process, viscose can be turned into staple fibres or into filament yarns. In the filament form, each individual strand of viscose fibre is continuous in length, whereas in staple form, filaments are cut to short, predetermined lengths, making viscose easier to blend with other fibres. Staple fibres are cut into short pieces after the spinning bath. These short fibres are spun into textile yarns or processed into 'non-woven' products. In contrast, filament yarns are spun into long fibres which can be used immediately.

Similarly to pulp, viscose fibres also require bleaching. When viscose fibres are claimed to be TCF (Total Chlorine Free) or ECF (Elemental Chlorine Free), it means that both pulp and fibres were bleached using the same process.

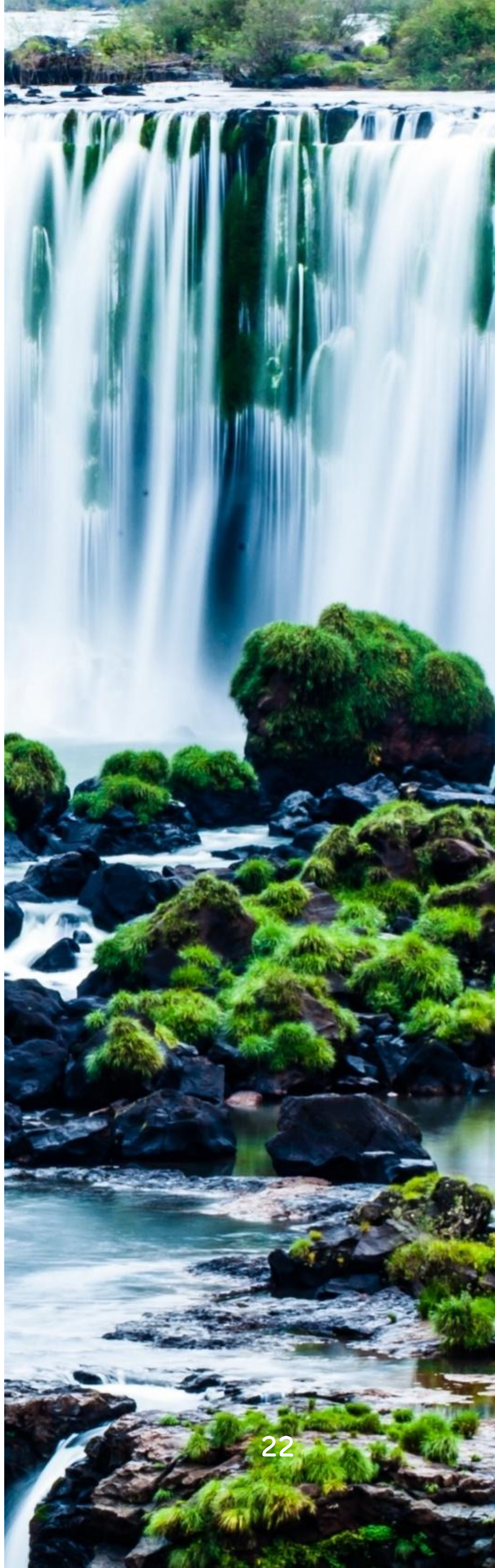


Key sustainability issues in fibres production

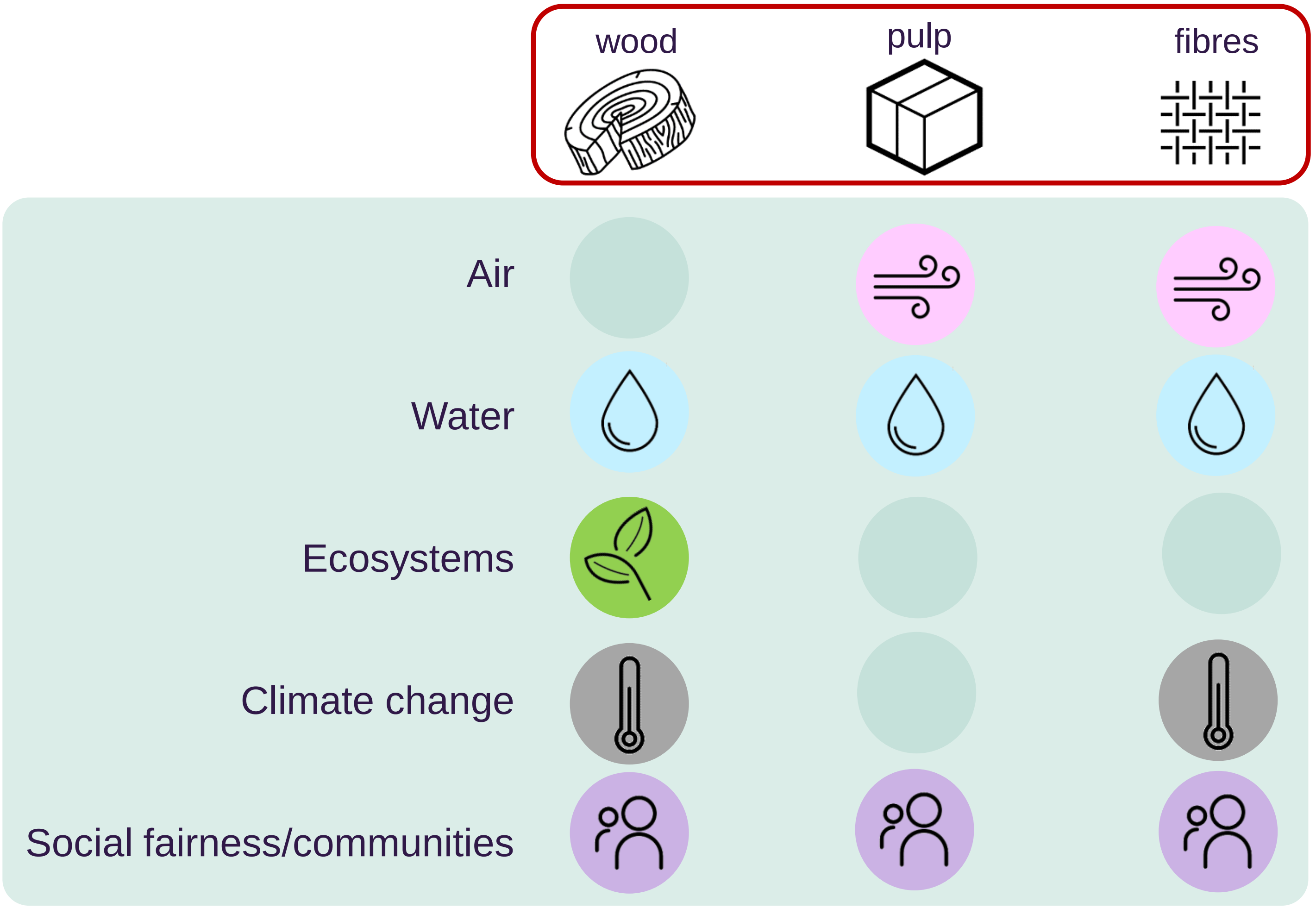
The use of carbon disulphide in standard viscose and modal fibres production generates air emissions of sulphur compounds. The amount of air emissions will depend on the quantity of carbon disulphide used in processing as well in the efficiency of recovery systems used. Emissions are greater for modal than standard viscose, since modal fibres production requires larger input amounts of CS_2. In lyocell fibres production there are reduced amounts of air emissions due to the use of organic solvents and closed loop systems which almost fully recover the chemicals used (>90% recovery).

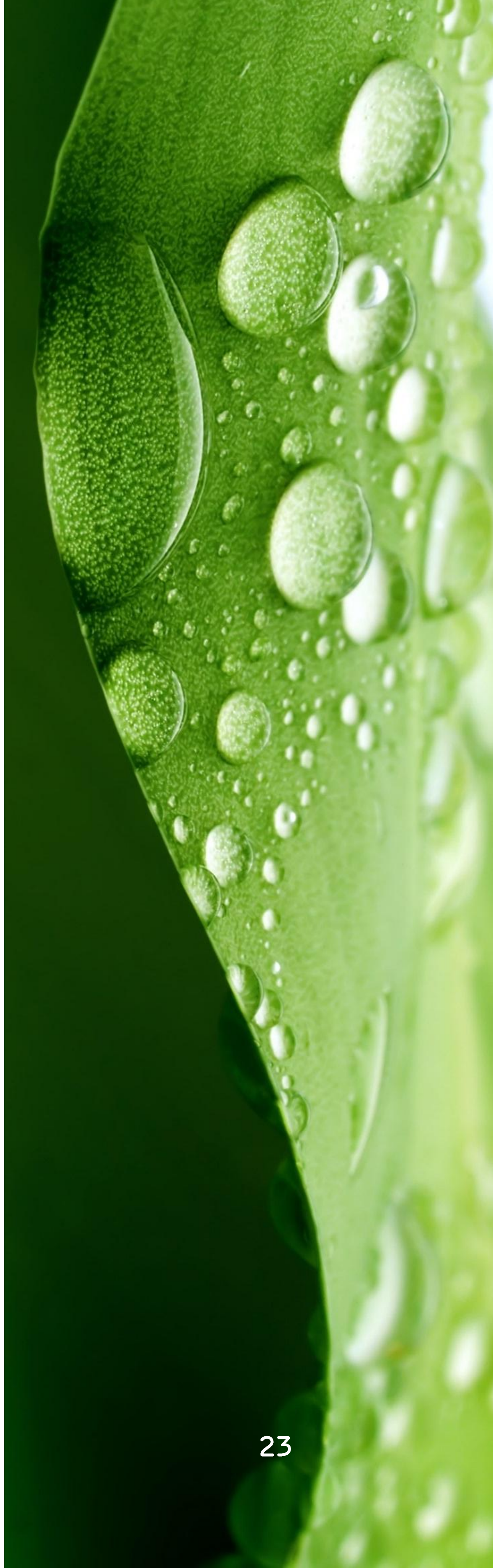
The viscose process produces large volumes of wastewater. Both the product being produced and the processes used in the production of fibres influence the quantity of wastewater created and its quality. Fibre specifications may dictate the amounts of chemicals used, such as sulphuric acid and zinc. Fibres may also require bleaching, and resulting effluents, like in pulp production, will depend on the bleaching methods applied.

Air	Emissions to air during standard viscose and modal fibres production consist of sulphur compounds, such as carbon disulphide and hydrogen sulphide. (Not applicable to lyocell)
Water	Emissions to water are dominated by oxygen-consuming organic substances from zinc sulphate used in standard viscose and modal fibres production. If bleaching is applied to fibres, effluents may contain AOX and chlorates, which have toxic effects in the aquatic environment, and dioxins which are persistent organic pollutants highly toxic to humans and the environment.
Climate change	Fibres production is an energy intensive process. Energy from non-renewable sources contributes to CO_2 emissions and climate change.
Social fairness/communities	Workers may be exposed to toxic products, from chemicals that are used in production, and to work accidents derived from explosions or leakages.



Summary of key sustainability issues





Sustainability initiatives

Although there are numerous initiatives in place to address sustainability in the textile industry, those that specifically address one or more production stages of viscose fibres or address viscose are very limited.

The current analysis focuses on the most relevant certification systems and initiatives identified during the research period. It is not intended to be a comprehensive review of all tools, guidelines and standards which may apply to specific emissions, industrial processes or projects developed under specific environmental and social requirements. It also does not cover regulatory aspects, which may play a relevant role in a product’s sustainability, but vary significantly across geographies.

For each certification system or initiative evaluated in this study, a brief summary is presented, followed by a list of the main strengths and weaknesses and perceived effectiveness.

The perceived effectiveness of the certification systems and initiatives is based on information available from reports on surveys, assessments and public consultation processes and interviews conducted during this study. However, it was not always possible to get the perception of effectiveness from all types of stakeholders and therefore information presented is qualitative and limited to the available information.

It is important to note, that as one outcome from this research, there is a general perception that there are strong limitations in mapping the supply chain and ensuring an efficient and full supply-chain custody system.

Other systems were also analysed[1], but excluded from this report for not applying to viscose fibres and its raw materials production.

(1) Fair Trade (only cotton); Cradle to Cradle and Safer Made initiatives (focused on consumers’ protection; ZHDC (focused on dyeing and finishing processes); Waste and Resources Action Programme (WRAP)

Forest Stewardship Council Certification System

FSC is a global, not-for-profit organization dedicated to the promotion of responsible forest management worldwide.

The Forest Stewardship Council (FSC) Certification System is based on a set of Principles and Criteria which set out best practices for forest management. Regional and national standards transfer the Principles and Criteria to the specific conditions and context found in each country or region.

Certification is carried out by an FSC accredited certification body, which confirms that the operation complies with all relevant FSC requirements. If it does, they issue an FSC *forest management certificate*, which is valid for five years and monitored annually to make sure the company continues to meet FSC standards. If the forest owner or manager wishes to sell FSC certified products (such as pulp), they will also need chain of custody certification.

Chain of custody certification applies to manufacturers, processors and traders of FSC certified forest products. It verifies FSC certified forest products along the production chain. At each stage of processing and transformation, chain of custody certification is needed to confirm that FSC certified wood products are kept separate from uncertified products, or mixed in approved ways.

Main strengths and weaknesses

FSC

Main strengths
National standards and open to public consultation
Strong chain of custody verification process
Comprehensive throughout a wide range of environmental and social aspects
Certification scheme under the International Social and Environmental Accreditation and Labelling (ISEAL) system

Main weaknesses
Lack of full transparency to public in auditing processes
Regarded by producers as too complex for smallholders
No non-announced audits
Some gaps in relation to agrochemicals and greenhouse gases inventory

Perceived effectiveness
Strong from NGOs' perspective **Medium** from producers' perspective

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Programme for the Endorsement of Forest Certification schemes (PEFC)

The Programme for the Endorsement of Forest Certification (PEFC) is an international non-profit, non-governmental organization dedicated to promoting Sustainable Forest Management through independent third-party certification.

PEFC is an umbrella organization. National certification systems that have developed standards in line with PEFC requirements can apply for endorsement to gain access to global recognition and market access through PEFC International. PEFC is currently the world's largest forest certification system with more than 300 million hectares of certified forests.

PEFC has standards for *Sustainable Forest Management* which cover all types of forests, group forest management certification schemes and chain of custody certification which is a mechanism for tracking certified material from the forest to the final product to ensure that the wood, wood fibre or non-wood forest produce contained in the product or product line can be traced back to certified forests.

Main strengths and weaknesses

Main strengths
National standards and open to public consultation
Good chain of custody verification process
Easy group certification for smallholders

Main weaknesses
The scheme is not under ISEAL
Highest governance forum does not have balanced participation of economic, social and environmental representatives
No requirement for members to commit to International Labour Organisation core conventions
Some gaps in relation to high value conservation areas
Lack of transparency and participation of stakeholders in certification processes

Perceived effectiveness
Strong from producers perspective **Weak** from NGOs perspective

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CanopyStyle Guide and Verification Audit

canopy

Canopy is a not-for-profit environmental organisation focused on the protection of the world's endangered forests with a specific focus on the pulp industry for viscose and paper production. Since 2012, Canopy has been working closely with viscose producers, designers and brands to ensure sustainable wood sourcing for viscose production with the aim of protecting endangered and ancient forests, under the CanopyStyle campaign. Currently over 65 brands are working with the organisation

Canopy assesses viscose fibres producers with the tools and standards outlined in the CanopyStyleGuide and the CanopyStyle Verification Audit. The performance indicators of CanopyStyle Verification Audit include amongst others, transparency and traceability of raw material sources; no conversion of natural forest to plantations; sourcing from ancient and endangered forests and other controversial sources is eliminated; must respect and uphold human rights and the rights of communities and workers; and preference to fibre sourced from forests that are responsibly managed and certified by FSC.

Canopy has engaged the top 10 viscose producers, and nine of them have policies in place committing "*not to source from the world's ancient and endangered forests, endangered species habitat or other controversial sources*". This is a pre-requisite of Canopy's audit verification framework.

Canopy discloses publically on the assessment of the performance of viscose fibres producers and ranks them according to their level of risk of sourcing from ancient and endangered forests, leadership in advocating for conservation legacies, and work to advance commercial production of alternative fibres.

Additionally Canopy addresses viscose's pulp and fibres production stages by giving preference to closed loop production and lyocell fibres.

Main strengths and weaknesses

Main strengths
Direct engagement with wood, pulp and viscose fibres producers and textile brands
Audit system enables companies to track and analyse supply chain performance in the protection of ancient and endangered forests
Incentivises producers to invest in alternative raw materials research and protection of high value conservation areas

Main weaknesses
Does not address the use of agrochemicals

Perceived effectiveness
Strong from NGOs' perspective

EU Ecolabel

EU Ecolabel is a voluntary scheme for product certification including cellulose fibres (standard viscose, modal and lyocell) managed by the European Commission. It is the only formal certification system for viscose fibres production.

Only products with a market in the European Economic Area can be certified (even if produced elsewhere in the world).

The EU Ecolabel criteria for textile products aim to promote textile products which are:

- sourced from more sustainable forms of agriculture and forestry;
- manufactured using resources and energy more efficiently;
- manufactured using cleaner, less polluting processes;
- manufactured using less hazardous substances and
- designed and specified to be of high quality and durable.

The EU Ecolabel includes all stages of viscose production and focuses on the aspects with the highest environmental impact at each stage of production. For cellulosic fibres, the criteria set minimum content levels of sustainable/legal wood (25% of FSC, PEFC or equivalent certification); maximum loads of the most relevant pollutants for emissions to air and water per unit of product in the industrial phases; does not allow the application of elemental chlorine in bleaching; and requires that a minimum of 50 % of the pulp used to manufacture fibres is purchased from dissolving pulp mills that recover value from their spent process liquors either by generating on-site electricity and steam or manufacturing chemical co-products.

Corporate social responsibility – according to International Labour Organisation (ILO) Core Labour Standards – is only required for cut/make/trim production sites.

Main strengths and weaknesses

Main strengths
Certifies environmental sustainability of viscose fibres
Emissions limits per unit of production at the industrial level
All phases of production included
Focuses on the specificities of the production processes and their impacts for establishing the criteria for a certain product

Main weaknesses
Only applicable to products with a market in European Economic Area
Requirements set for a limited number of issues and pollutants
Social aspects and water not covered for all production stages

Perceived effectiveness
Strong within European companies and consumers

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Higg Materials Sustainability Index

The Higg Materials Sustainability Index (MSI), which is publicly available provides information about the impacts of the production of materials used in the apparel, footwear, and home textile industries. Standard viscose, modal and lyocell are amongst the materials for which information is available.

The Higg MSI is a scoring system for materials production based on Life Cycle Impact Assessment (LCIA) analysis and data inputs from producers who voluntarily provide data complemented, when possible, with available data from research. It is an initiative of the Sustainable Apparel Coalition (SAC) - a private sector initiative which focuses on building a "*standardized supply chain measurement tool of environmental and social and labour impacts of making and selling apparel, footwear and textile industry products and services*."

The Higg MSI addresses environmental aspects only, namely: global warming; eutrophication; water scarcity; abiotic resource depletion (of fossil fuels) and chemistry (added chemical finishes).

For viscose all phases of raw materials production are included. The data available is from Lenzing; Aditya Birla has also provided data which are currently being assessed for data quality. Users of the tool not only have access to the scoring; they also may access metadata.

The tool provides benchmarks for each type of material/fibre. The benchmark relates to how a given material compares to other materials. Currently, SAC members and other organizations with full access to the MSI can access LCIA results, or midpoints, for all production process. SAC has plans in place for such information to be publically available to any user.

Besides Higg MSI, Sustainable Apparel Coalition has other tools, namely: the design development model, which provides a final design scoring based on choices made about materials (this tool is only available for SAC members); and the Facility and Brand Indexes, which include environmental and social aspects and scoring is provided based on the spectrum of policies and management tools in place.

Scoring results can be communicated outside an organisation under specific Terms of Use.

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Main strengths and weaknesses

Main strengths
Publically available scoring system for materials sustainability
All phases of production included
Benchmarks for materials
Users may access metadata

Main weaknesses
Data limited to inputs from producers who voluntarily join the initiative
Social aspects and forests not covered
Benchmarks only relate to how a given final product compares to another final product; benchmarks for individual processes limited to major processes

Perceived effectiveness
Strong in terms of providing a standardised metric, from brands/retailers and producers perspective **Weak** in terms of requiring a significant amount of resources within companies to verify internal data accuracy and make results actionable

Summary of certification systems and initiatives applicable to each production stage and per sustainability issue

	Wood	Pulp	Fibre
Air	FSC, PEFC, canopy, EU Ecolabel	EU Ecolabel	EU Ecolabel
Water	FSC, PEFC, canopy, EU Ecolabel	Higg Index, EU Ecolabel	Higg Index
Ecosystems	FSC, PEFC, canopy, EU Ecolabel		
Climate change	FSC, PEFC, canopy, EU Ecolabel	Higg Index, EU Ecolabel	Higg Index
Social fairness/ communities	FSC, PEFC, canopy, EU Ecolabel		

Coloured cells indicate the key sustainability issues identified at each stage of production

Main gaps and conclusions

Main gaps in addressing key sustainability issues in wood production

	Applicable initiatives	
Air	FSC, PEFC, EU Ecolabel, canopy	
Water	FSC, PEFC, EU Ecolabel, canopy	• No documentation/audit of application, handling, storage and disposal of agrochemicals required
Ecosystems	FSC, PEFC, EU Ecolabel, canopy	• Gaps in transparency for both PEFC and FSC systems • High conservation values are not fully covered in PEFC system; PEFC does not require monitoring of impacts in biodiversity or limit the introduction or use of invasive alien species • EU Ecolabel only requires 25% PEFC or FSC certified sources to be used in the product
Climate change	FSC, PEFC, EU Ecolabel, canopy	• Carbon sequestration and greenhouse gas missions are not comprehensively addressed in PEFC and FSC systems
Social fairness/ communities	FSC, PEFC, EU Ecolabel, canopy	• PECF does not require producers to assess and maintain category 5 High Conservation Values (*Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples, identified through engagement with these communities or indigenous peoples*.)

Coloured cells indicate the key sustainability issues identified at each stage of production

Main gaps in addressing key sustainability issues in pulp production

	Initiatives	
Air	EU Ecolabel	• Local ambient air quality is not taken into consideration • Chemical recovery during processing is only partially required (50%) • AOX compounds emissions are considered as a whole, but toxicity varies significantly between compounds

Water	Higg Index, EU Ecolabel	• Local water conditions are not taken into consideration
		• EU Ecolabel:
		  • only requires 50% of chemical recovery
		  • AOX compounds emissions are considered as a whole but toxicity varies significantly between compounds
		• Higg MSI:
		  • Environmental impacts based on limited data sources
		  • Data per process limited to major processing stages

Ecosystems		
Climate change		
Social fairness/ communities	Higg Index	• There are no specific initiatives addressing workers safety and health conditions in the pulp industry for viscose production. However, initiatives such as ILO Core Labour Standards may be used as guidance for the industry.

Coloured cells indicate the key sustainability issues identified at each stage of production

Main gaps in addressing key sustainability issues in fibres production

	Initiatives	
Air	EU Ecolabel	• Local ambient air quality is not taken into consideration
Water	Higg Index	• Local water conditions are not taken into consideration • Environmental impacts based on limited data sources • Data per process limited to major processing stages
Ecosystems		
Climate change	Higg Index	• Environmental impacts based on limited data sources • Data per process limited to major processing stages
Social fairness/ communities		• There are no specific initiatives addressing workers safety and health conditions in the viscose fibre industry. However, initiatives such as ILO Core Labour Standards may be used as guidance for the industry.

Coloured cells indicate the key sustainability issues identified at each stage of production

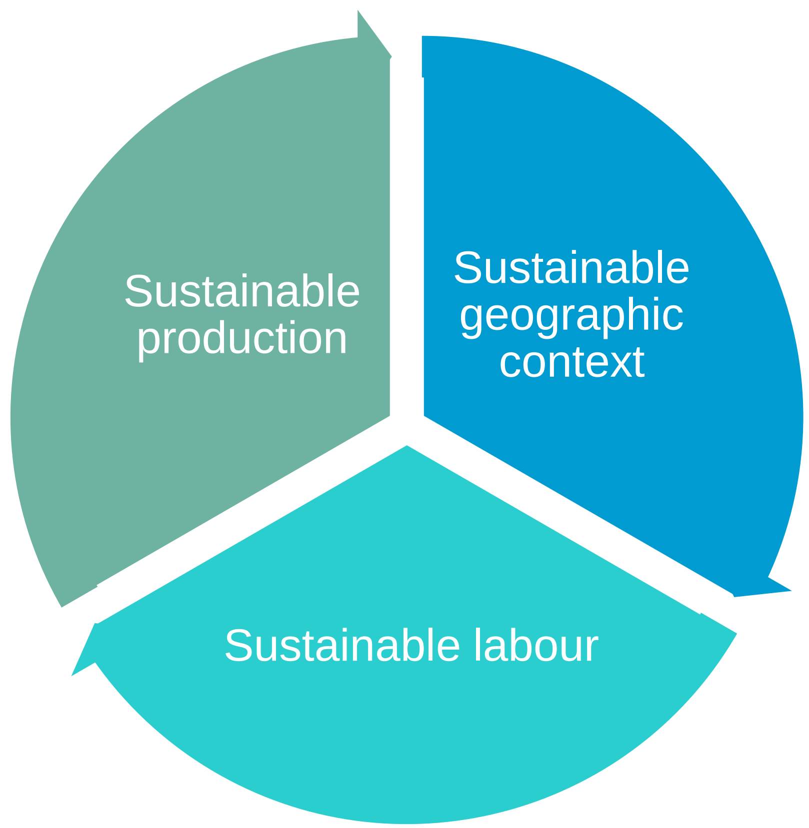
What makes viscose production sustainable?

To achieve sustainable viscose production, it is necessary to address all sustainability issues throughout the entire supply chain. Apparel brands and retailers need to focus their sustainability strategies and performance on their entire supply chain: from raw materials to end products.

A significant investment is already taking place in innovation within the viscose industry, towards more sustainable fibres. Examples are closed loop processes at industrial stages which minimise waste and emissions and promote recycling and energy production; or the use of recycled materials as sources of cellulose. These are valuable and important contributions to a more sustainable production of viscose.

Consumers, brands and retailers, manufacturers and producers of raw materials all have a role to play in increasing the demand for and supply of sustainable viscose. Improving access to information about how sustainability issues are being addressed at each stage of viscose production and in the locations where it is produced will support this movement toward sustainable viscose.

- Sustainable raw materials:
  - Comply with best available forest certification systems for wood-based raw materials and audit to avoid Ancient and Endangered Forests
  - Apply best agriculture management practices for crop-based raw materials
- Industrial processing:
  - Maximise efficiency of natural resources use
  - Minimise the use of chemicals and maximise their recycling and reuse in all stages of production
  - Minimise emissions and waste in all stages of production



- Understand and monitor local social and environmental issues
- Understand and address risks to and impacts of own operations on local social and environmental issues
- Understand impacts from others and contribute to local sustainability by engaging and collectively working with local stakeholders

- Ensure human rights and labour conditions meet best international practices and conventions

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Conclusions

There are several initiatives addressing sustainability issues in textile production, some of which focus on, or cover viscose fibres and their raw materials production. All of these initiatives are valuable and are contributing to production of more sustainable viscose. However, there are important gaps which need to be addressed in order to progress towards sustainable viscose production.

1. There is a general trend across the textile industry of assessing the sustainability of the production of textile fibres, at the product level (e.g., viscose, cotton or polyester fibres, etc.). In doing so, specific processes used in the production of the fibres in question are assessed for their environmental impacts. The results of a specific analysis such as this are then used to be representative of all fibres of this type. This may result in inaccurate product comparisons given that there are different processes that can be used in the fibre production chain, with variations in the types and scale of environmental impacts. Applying the results from specific assessments to generally apply to all fibres produced can lead to misleading comparisons and results.

2. Logging of endangered and ancient forests for viscose production, directly for pulp production or for replacement with eucalyptus plantations, which threaten ecosystems, the rights of local communities and contribute to climate change, is currently the sustainability issue getting the most notice in viscose production. Due to its visibility and initiatives such as CanopyStyle, the issue is being addressed with the involvement of the largest viscose fibres producers and apparel brands and with robust systems in place. These efforts should continue and be supported by all viscose fibres producers and apparel brands, and should focus on strengthening the systems' robustness by addressing their main gaps.

3. Sustainability issues in the industrial phases of viscose production do not draw media or the public's attention the same way as deforestation, since impacts are not so immediately "visible". Therefore, there are substantial gaps in sustainability certification systems and initiatives when it comes to the industrial stages of viscose fibres production. Two questions must be addressed for industrial stages of viscose fibres production to be sustainable:

    - **Are best practices and best available technologies being applied, i.e. is production resource efficient?**
    - **Are sustainability limits being violated at the production locations?**

Pulp and fibre production processes generate hazardous/toxic emissions to air and water, are energy intensive and pose direct risks to workers and indirect impacts on surrounding communities and ecosystems. However, the magnitude of impacts is greatly dependent on the processes and management practices applied in production. For viscose fibres production to be sustainable, all processes need to be resource efficient and the industry should move toward best available technology and best practices across all production stages.

Viscose fibres production cannot be sustainable if the production processes are occurring in locations which suffer from unsustainable use of resources, e.g. degraded air quality, water scarcity, high water pollution levels. Where air and/or water quality standards and environmental flows are not being met, production activities are contributing to these unsustainable local conditions. When these thresholds of air or water quality or water availability have been crossed, the impacts on human and ecosystem health are greater than in locations where they have not been crossed. Therefore, it is essential to the assessment of the sustainability of viscose fibres production to consider where the production has occurred and what the local environmental conditions are in those locations.

On the positive side, the viscose industry is highly concentrated in a few corporate groups, concentrating efforts to improve the sustainability of viscose fibres production with a small group of companies. The main viscose fibres producers are already engaged in initiatives towards sustainable wood sourcing. Industrial processing technologies and practices that improve the sustainability performance of viscose production are available **and some producers are already applying them and investing in innovation for more sustainable production.** These factors combine to create a conducive and enabling environment for sector engagement and collective efforts towards more sustainable production at the industrial stages of viscose production.

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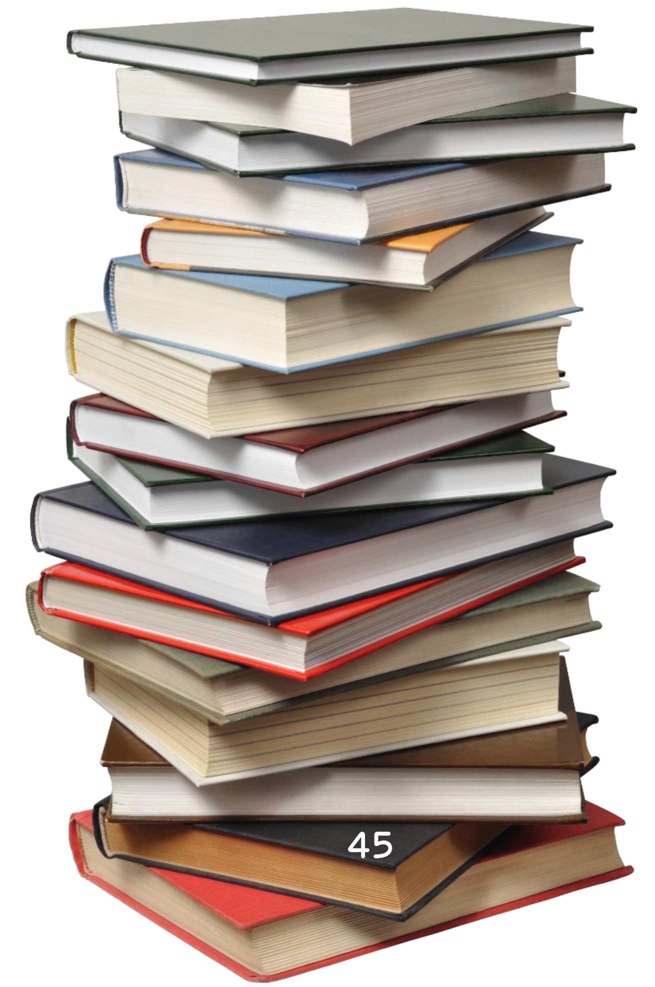

Interviewees

- ASOS www.asos.com
- Canopy www.canopyplanet.org
- Lenzing www.lenzing.com
- NEPCON www.nepcon.org
- Sustainable Apparel Coalition www.apparelcoalition.org
- Textile Exchange www.textileexchange.org
- Textile expert

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