Outlook on Global Fiber Demand and Supply 2030

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Abstract

The Covid-19-induced decline in global fiber demand has already recovered by 2021. This article tries to explore the outlook for the global fiber market until 2030, both in terms of top-line demand as well as in terms of the composition of supply from different fiber types. Demand is expected to reach 142 million tons, based on underlying population and per-capita consumption growth. Supply growth is expected to come almost exclusively from man-made fibers, given natural fibers are supply-constrained. Among man-made fibers, wood-based cellulosic fibers will benefit from the increasing trend towards sustainability, which synthetic fibers cannot cater to.

Historical fiber market growth

Fibers are the basis of many products we use every day, not just in clothing applications, but also in less apparent end uses such as household wipes, filters, automotive interiors, or even battery separators. With the rise of many of those end uses, the global fiber market grew at a compound annual growth rate of 2.8% over the last five decades, from roughly 27 million tons[1] in 1970 to 113 million tons in 2021 [1].

Over the full period, this can be broken down to 1.5% annual population growth [2] and another 1.3% annual growth in per-capita fiber consumption. In the first half of that period (1970-1995), 73% of total growth was attributable to population growth alone. That changed in the following years: since 1995, the majority (73%) of growth came from an increase in per-capita fiber consumption (see Figure 1), which reached 14.4 kg, almost double the 7.3 kg in 1970. This coincided with disposable income in many developing countries reaching levels where more people could afford to buy larger amounts of textile and nonwoven products.

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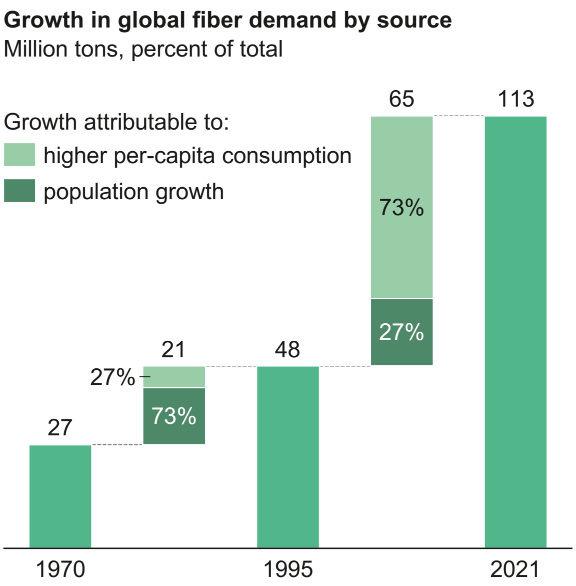

Figure 1: *Growth in global fiber demand by source, 1970-2021*

[1] Note that all fiber market volumes in this article refer to the sum of staple fibers and filaments, but do not include spunmelt nonwovens, since the process does not involve fibers

The global fiber market in the Covid-19 pandemic

In the Covid-19 pandemic, global fiber demand – similar to many other discretionary expenditures – experienced a major decline based on a weakness of end markets. In most countries, strict measures to fight the pandemic led to consumers unable or unwilling to shop. A weighted average calculated from statistics of apparel retail sales of 42 countries, published by statistical offices and national banks, suggests a -19% nominal decline in global apparel demand 2020 compared to 2019 [3]. At the same time, the high demand for medical and hygiene products caused a significant increase in demand for nonwoven fibers [4]. 2021 marked the first year of recovery from the pandemic. Global consumer demand for apparel exceeded pre-pandemic levels starting May 2021 and ended the full year roughly on the same level as 2019 (see Figure 2).

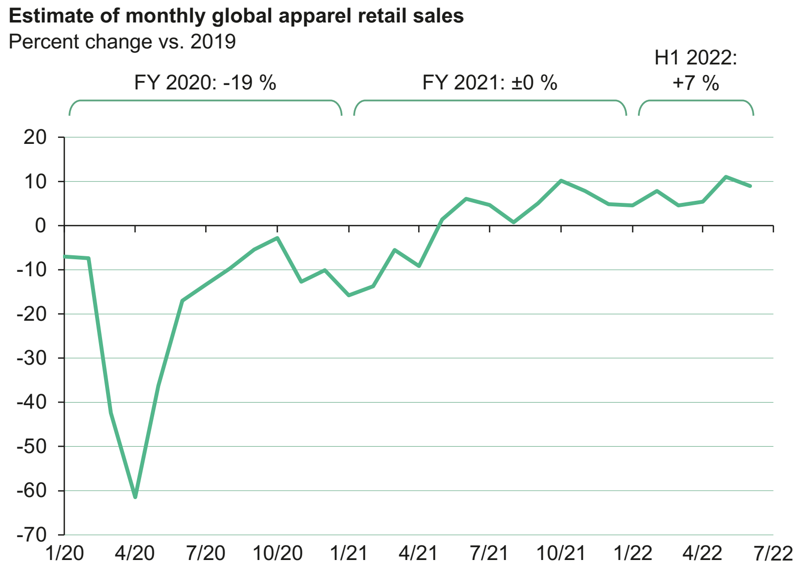

Figure 2: *Estimate of weighted average global apparel retail sales*

Corresponding demand for fibers declined from approximately 113 million tons in 2019 to below 99 million tons in 2020 (a -12% YoY decline) and increased again to more than 113 million tons in 2021 – roughly +1% above the level of 2019 (see Figure 3) [5]. It is appropriate to say the global fiber market lost two years of growth.

This article tries to explore the outlook for the global fiber market until 2030, both in terms of top-line demand as well as in terms of the composition of supply from different fiber types.

Overall fiber demand growth until 2030

Similar to historical fiber market growth, we can dissect future growth into population growth and per-capita fiber consumption. We can also assume fiber demand to continue to closely follow volume growth in the underlying apparel, footwear, home textiles, technical textiles, and hygiene markets.

In terms of population growth, the UN [6] expects 0.9% annual growth from 2021 to 2030. Given its high latency, we take this rate as granted as a structural growth driver.

Euromonitor [7] expects main fiber end markets to grow at 2.5-3.0% p.a. at constant prices (a good proxy for volumes) from 2021 to 2026. According to the source, the apparel and footwear market is set to grow at 2.9% p.a., home textiles at 2.7% p.a., and retail hygiene (wipes, sanitary protection, adult incontinence, and diapers) at 2.8%. Since no forecast is available until 2030, we extrapolate the available forecast for 2026 further into the future.

Many global trends support a further growth in per-capita fiber consumption. The number of middle class households (defined by their disposable income of USD 15,000–45,000) which constitute the bulk of consumer spending in most countries, is expected to grow by 60% from 2020 to 2040, "accounting for more than one in three households globally" [8]. Similarly, through optimization of value chains and a move towards low-cost manufacturing locations, textile products have become much more affordable. While clothing accounted for 11.5% of US household expenditure in 1950 [9] it was only 3.0% in 2019 (even 2.3% in 2020) [10]. In hygiene applications, certain pandemic-induced behaviors are expected to remain sticky – particularly increased hygiene awareness –, but that effect is expected to wane over time. Particularly the adult incontinence market is expected to experience support by an ageing population, with the worldwide absolute population >65 years more than doubling from 728 million in 2020 to 1,549 million in 2050 [11], as well as products slowly shedding their associated stigma.

On the other hand, certain trends, which might lead to a slowdown in per-capita fiber consumption, are on the rise. For example, trends such as frugality, degrowth, conscious spending, and keeping long-life products start to gain popularity, but so far remain somewhat limited to certain population groups in most mature markets. Hence, we do not expect them to be a major inhibitor to growth in per-capita consumption.

Large regional differences in growth exist. Textile and nonwovens end markets in North America and most of Europe are mature and relatively saturated. They exhibit limited (and partly even negative) population growth and already high per-capita consumption. On the other hand, in many Asian, Middle Eastern, and African countries, both population and per-capita GDP (historically good proxies for rising per-capita fiber consumption) are forecasted to grow above world average [12]. Therefore, we can expect much of the growth in fiber demand to come from those regions.

Overall, we expect global fiber demand to continue annual growth at a rate of 2-3% through 2030, broken down to roughly 1% population growth and 1-2% growth in per-capita consumption. Such a growth would lead to total fiber demand of close to 142 million tons in 2030 (see Figure 3). This growth rate is in a similar range as other recently published estimates, such as 3.0% by Textile Exchange for 2020-30 [13], 2.4% by Hawkins Wright for 2019-26 [14], and 2.2% by Tecnon OrbiChem for 2020-30 [15].

Of course, unforeseeable "black swan events" hold the power to derail consumer spending and, as a consequence, also fiber demand. Examples include the Global Financial Crisis of 2007-08, as well as the Covid-19 pandemic starting 2020, with the latter cost-

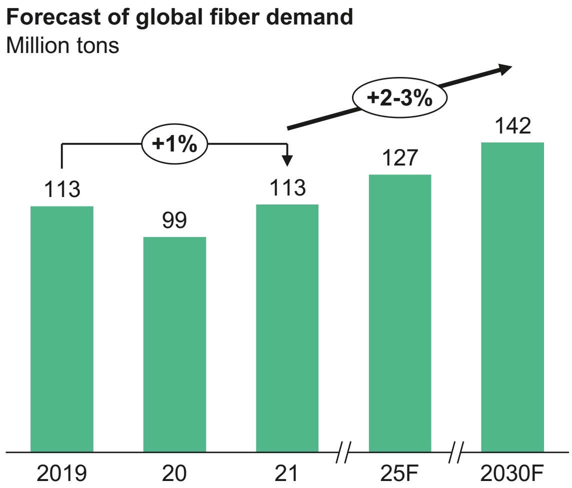

Figure 3: *Forecast of global fiber demand, 2019-2030*

ing the global fiber market two years of growth. The Russia-Ukraine conflict is likely another such event, fueling inflation and leading to low consumer confidence in European markets and potentially limited appetite for discretionary purchases such as apparel. In addition, the conflict holds the potential to influence fiber supply. Disrupted grain exports might lead to acreage being diverted away from cotton towards food crops in other parts of the world. Rising energy prices and fertilizer costs make growing cotton less economical.

Composition of future fiber supply

The aforementioned 142 million tons of fiber demand in 2030 correspond to an incremental demand of almost 30 million tons per year compared to 2021. We will take a look at which fiber types are most likely to capture this growth (see Figure 4), based on consumers' demand for comfortable and aesthetic, yet affordable clothes. When doing so, two different perspectives are of particular relevance: first, which fiber types are able to scale their output that rapidly, and second, which fiber types satisfy the increasing demand from consumers for higher sustainability standards.

There have been multiple efforts in the past to forecast the fiber mix in terms of volume, including by Hämmerle [16] and Eichinger [17]. Some of those earlier assumptions for future fiber supply remain valid. As outlined by Eichinger, "Future fiber demand … can only be met by man-made fibers in the light of the stagnant or shrinking production of natural fibers."

Production of the most prevalent natural fiber, cotton, has been relatively stagnant for almost 20 years – of course with seasonal fluctuations [18]. Cotton harvest

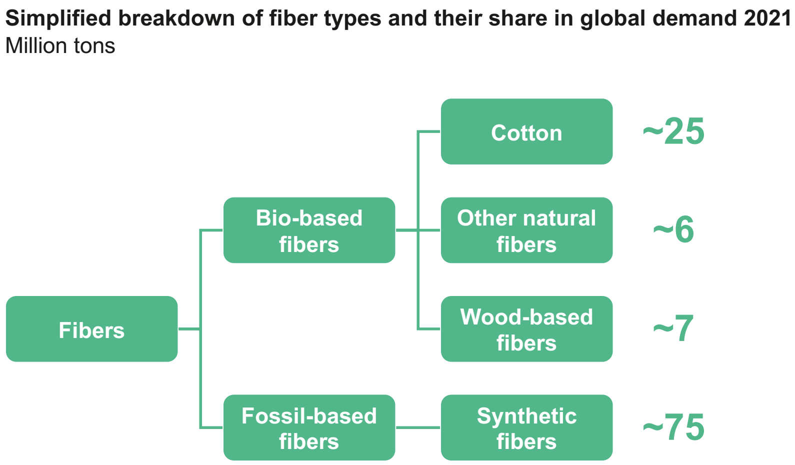

***Figure 4:** Simplified breakdown of fiber types*

can be analyzed as a function of planted area and yield. Historically, since the 1950s the global cotton planted area was relatively stable in the range of 30 to 36 million hectares. Global average cotton yield grew gradually over time with improving agricultural practices, then jumping in the 2000s to ~800 kg/ha with the widespread adoption of genetically modified (GMO) cotton (see Figure 5). Combined, this resulted in recent seasonal cotton harvests in the 25 to 28 million tons range.

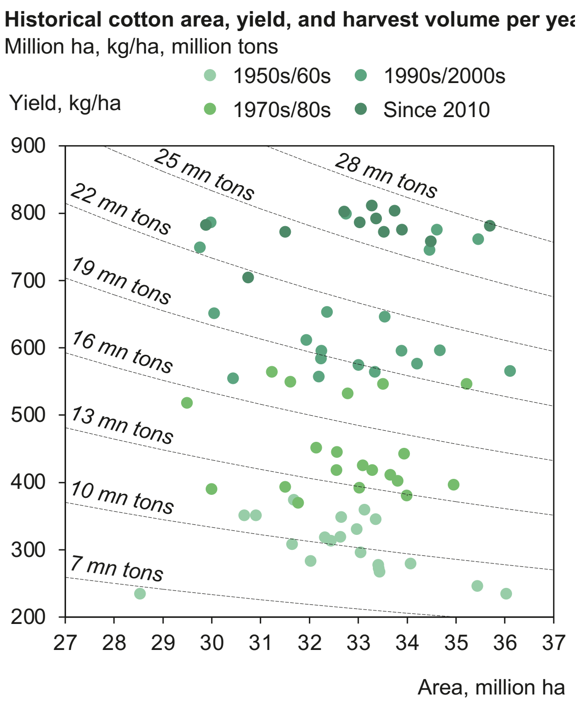

***Figure 5:** Historical cotton area, yield, and harvest volume 1950-2021*

Cotton cultivation in several world regions is criticized for high water and pesticide consumption, as well as labor issues, e.g., in China's Xinjiang province. Only a fraction of the global cotton harvest is produced to higher standards with the market share of the most sustainable option organic cotton equaling less than 1% [19].

Going forward, cotton harvest can be expected to remain in the 25-30 million tons range. In its latest publication, the International Cotton Advisory Committee (ICAC) expects global cotton production to reach 27.9 million tons by the 2026/27 season [20] while the latest OECD-FAO outlook expects 30.1 million tons by 2030 [21]. Further improvements in farming practices and an ever-increasing share of GMO cotton in some countries could lead to an increase in yields. On the other hand, a higher share of (lower-yield) organic cotton, scarcity of irrigation water, and fertilizer shortages or cost increases have the potential to counterbalance this development. Therefore, yields are expected to stay relatively stable or grow only incrementally. Short-term, the cotton planted area will continue to fluctuate with term planting decisions based on expected economics compared to competing crops, such as soybeans or corn. Additional volumes might come from mechanically recycled cotton, a stream so far limited in scale <0.3 million tons produced in 2020 [22], but with great potential. Long-term, the acreage is somewhat limited upwards given the decline of arable land globally [23], increase in population, and therefore competition with food crops. Cotton-growing is also exposed to risks caused by climate change. As a recent report warns, "by 2040 half of global cotton growing regions will face high or very high climate risk exposure to at least one climate hazard" [24]. This development could eventually lead to both a smaller cotton-growing area and crop failure; developments already witnessed, e.g., as a result of the 2010/11 flooding in Pakistan, 2019 Australian wildfires, and repeated hurricanes and drought in Texas.

Other plant-based natural fibers such bast, flax, and hemp have recently gained popularity. However, similar to cotton, they compete with other crops and are therefore somewhat limited in their potential to grow further. Animal-based fibers are equally supply-constrained. Wool production declined from 1.5 million tons in 1995 to just above 1.0 million tons in 2021 [25], and no reversal of the trend is expected.

To summarize, while cotton and other natural fibers offer many benefits in being of renewable origin, friendly to the skin, and biodegradable at the end of their useful life, they are limited in their ability to help satisfy the additional 29 million tons of demand until 2030.

Another important aspect of cotton and other natural fibers is their price. To simply keep their 2021 combined ~28% share in the total fiber market, an output increase of 8 million tons until 2030 would be required, which – based on the above supply constraints – is unrealistic. Assuming consumers continue to ask for these fibers, and based on typical economies of supply and demand, one would expect their price to increase significantly.

Contrary to cotton and other natural fibers, the supply of synthetic fibers has grown disproportionately. While they accounted for only 18% of global fiber demand in 1970, their share increased to 66% by 2021 [26], reaching a total of close to 75 million tons. Several advantages have enabled this growth. They can be engineered to meet sought-after functional properties such as stretch or abrasion resistance. Polyester staple fibers and filament yarn – with 84% of production volume the most widely used synthetics – are particularly versatile and relatively inexpensive [27]. However, the use of synthetics has recently come under scrutiny from NGOs including Changing Markets [28, 29], the Ellen MacArthur Foundation [30], and the WWF [31]. Main points of criticism include their fossil origin and therefore depletion of finite resources, high emissions in their production process, lack of true fiber-to-fiber recycling, and release of polluting microfibers throughout their life. In response to this criticism from NGOs, but also encouraged by growing demand from consumers and in anticipation of potential future regulation, many apparel brands such as Levi Strauss [32], Reformation [33], and Patagonia [34] have committed to cutting their use of petroleum-based materials, or in a first step at least using more recycled rather than virgin synthetic fibers.

While their high strength and hydrophobic nature make synthetic fibers a good fit for applications such as sportswear and functional wear, they are not suitable for all applications. As outlined by Hämmerle [35], "The physiological performance of cellulose fibres – cotton or man-made – is unmatched by any other man-made fibre. They are hydrophilic and stand for absorbency and breathability." This is where wood-based cellulosic fibers (WBCF) such as viscose, modal, and lyocell can play a critical role in closing the so-called "Cellulose Gap" [36]. "Similar properties … make them the best substitute for cotton" [37] – not to compete, but to complement cotton and compensate for demand that cotton is unable to meet due to the above-mentioned supply constraints.

Wood-based cellulosic fibers have another major advantage, particularly when compared to synthetic fibers: their superior sustainability credentials in areas such as resource consumption, land use, and biodegradability – just to name a few. Wood-based cellulosic fibers – as their name suggests – are made of wood, which is rain-fed and does not require additional irrigation. While cotton in some countries is produced without irrigation, the "world average blue water used to produce a kilogram of lint was 1931 litres", summing up to a worldwide "estimated 48,338 trillion litres (…) used for cotton production in 2018-2019" [38]. Based on global average cotton yields, cotton requires 1.31 hectares to produce one ton of fiber. In the most productive countries Australia and China, that value is only 0.52 hectares per ton of fiber [39]. In comparison, lyocell produced from eucalyptus plantations requires only 0.2 hectares to produce one ton of fiber [40]. "It should also be noted that unless the cotton is certified organic, there will be high levels of pesticides, herbicides and fertilizers used in cotton production also. Note that the land use for cotton growing is of agricultural quality, whereas the land used for growing of the trees is marginal land, generally unsuitable for growing agricultural crops" [41]. At the end of their life, clothes made of synthetic fibers take up to 450 years to decompose into microfibers [42], while those made of wood-based fibers are fully biodegradable under soil, freshwater and marine environment, achieving "full biodegradation within a couple of months" [43]. Based on those considerations, products made of truly sustainable fibers – such as organic cotton, lyocell, and ecologically produced viscose – are in high demand, both by apparel brands as well as consumers.

Wood-based cellulosic fibers are not only produced from virgin wood pulp, but also recycled content such as pre- and post-consumer textile waste, that is processed into pulp [44]. At its launch in 2017, Lenzing's TENCEL™ Lyocell fiber with REFIBRA™ technology was the "first cellulose fiber featuring recycled material on a commercial scale" [45]. By 2025, fibers with REFIBRA™ technology are planned to include up to 50% recycled content – an important step towards a more circular textile industry.

Based on the above-mentioned advantages in fiber properties and sustainability, we expect wood-based cellulosic fibers to continue their growth above the 2-3% market average, at a rate of 4-6% until 2030. Among WBCF, similar absolute growth of around 2 million tons each is expected from viscose fibers and lyocell fibers (see Figure 6). Lyocell fibers – the latest generation of wood-based fibers with superior sustainability credentials and a closed-loop production process – are expected to show the highest rate of growth with 20-30% p.a., starting from a lower base of fewer than 0.4 million tons in 2021.

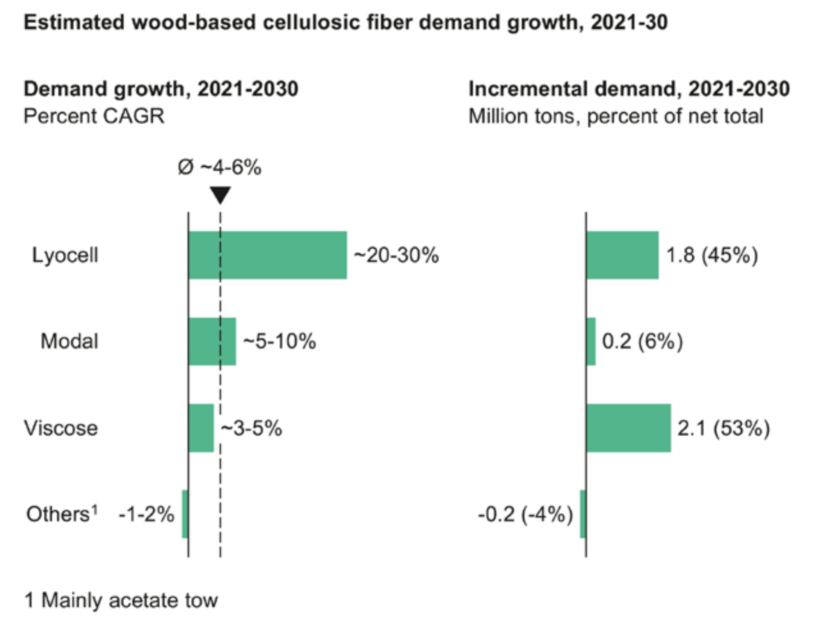

Figure 6: *Estimated wood-based cellulosic fiber demand growth, 2021-2030*

Not all wood-based cellulosic fibers are equally sustainable. Differences can be observed in areas such as wood sourcing or a plant's steam and electricity generation. Canopy's annual "Hot Button Report" aims at assessing the wood sourcing efforts and risks of viscose manufacturers. Its last edition for 2021 found "49.5% of all global supply of MMCF [man-made cellulosic fibers] is produced by producers who have attained a green shirt … with Birla and Lenzing retaining their dark green shirt status" [46] as leaders in the industry. On the other hand, many producers are criticized for "high risk sourcing" of wood pulp from ancient and endangered forests. A similar situation can be observed in utility generation of lyocell plants: while Lenzing's lyocell plants primarily utilize bio-based energy or natural gas to generate their steam and electricity demand, almost all Chinese lyocell plants exclusively run on coal. This difference in steam and electricity generation and utilization influences the carbon footprint of assets and products directly. Data for Life Cycle Assessment (LCA) comparisons between MMCF producers and products can be found via the Sustainable Apparel Coalition's Higg "Material Sustainability Index" (Higg MSI) tool [47]. Lenzing shares and periodically updates its LCA data with Higg MSI, while other lyocell producers are summarized under "Lyocell (generic)". Clearly, TENCEL™ Lyocell and LENZING™ ECOVERO™ fibers display a more favorable sustainability footprint than their generic equivalents (see Figure 7). In addition, Lenzing has set an ambitious science-based target (SBT) of a 50% reduction in CO_2 emissions (Scope 1, 2 and 3) per ton of product by 2030 compared to a 2017 baseline, which will help foster this leading position.

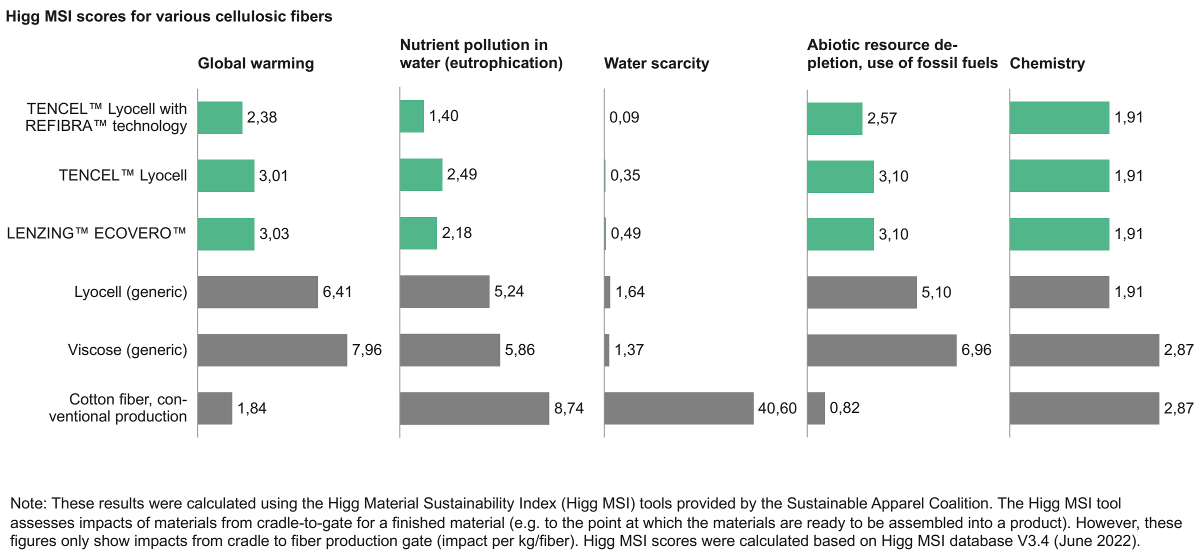

Figure 7: *Higg MSI scores for various cellulosic fibers*

In addition to the well-known viscose, modal, and lyocell fibers, numerous additional technologies and processes for producing cellulosic fibers are under development. The most commonly mentioned ones are the carbamate process, ionic liquid-based process, and direct spinning using micro-fibrillated cellulose [48]. Many start-ups, particularly in Nordic countries work on commercializing those technologies, often with investment by pulp and established fiber manufacturers. While not all of their ambitious growth plans might eventually materialize, those developments can hopefully add to the supply of sustainable fibers in the future.

Conclusions

- Fiber demand continues to increase at 2-3% p.a., driven mainly by per-capita consumption
- Growth in fiber consumption comes with a significant environmental cost, CO_2 footprint, water and pesticide consumption, microplastic release, and products being landfilled at the end of their useful life
- Oil-based synthetic fibers, which have historically captured most of the growth, increasingly come under scrutiny for their fossil origin, high emissions in their production process, lack of true fiber-to-fiber recycling, and release of polluting microfibers into the ocean
- Cellulosic fibers meet the need of consumers in many applications of aesthetics and moisture management, which will gain in importance as climate change heats our planet
- Cotton, the main category of cellulosic fibers, is expected to remain supply constrained. Increasing concerns are voiced due to the significant use of water and pesticides, but also due to competing land use for food crops
- Among sustainable fibers, wood-based cellulosic fibers have the biggest potential for growth. Their properties are close to natural cellulosic fibers and they come with superior sustainability credentials in areas such as resource consumption, land use, and biodegradability
- Going forward, WBCF also provide a perfect base for a circular business opportunity for all cellulosic products, reducing the need for wood while giving a new life to cotton and other cellulosic fiber products
- Even among WBCF, differences in sustainability are significant, primarily based on their wood source as well as energy usage

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