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Executive Summary

'Alps capital' stands out as a beacon of innovation, renowned for its vibrant economy driven by high-tech research and development. Grenoble has early on recognised the importance of transitioning to a circular economy and laid out ambitious roadmaps to foster sustainable development in the region with a dedicated focus on textiles reuse and repair.

Circular textile services in Grenoble are primarily concentrated in the central commune. Only 39% of the population can reach reuse, recycling, or repair service points within a 10-minute walk, though this increases to 95% when considering a 10-minute drive. This centralisation limits accessibility for residents in northern and southern communes, who may not have the same ease of access to circular services as those living closer to the city center.

The wholesale and retail sectors account for two-thirds of all jobs in the textile value chain within Grenoble. However, second-hand retail represents only 11% of retail jobs, indicating a limited presence of circular economy practices in the sector. Employment data for textile manufacturing, repair/upcycling, and textile waste management sectors is incomplete, which makes it difficult to assess the full scale of the circular economy's potential in the region. The 'use and repair' category, which mainly includes washing and dry cleaning services, does not contribute significantly to circular economy efforts. Additionally, employment figures for textile waste collection and sorting should be interpreted with caution, as textile recycling activities are not yet established in the region.

The city exhibits a diverse range of consumer profiles, from students and low-income families focused on affordability to high-income groups who prioritise quality, ethical, and locally-produced goods. These diverse consumption patterns reflect varying attitudes toward sustainability and fashion, with affordability often driving purchase decisions in lower-income areas and quality and ethics taking precedence in higher-income areas. In 2020, average annual fashion expenditure for French households was €430, below the EU average of €490.[1]

Grenoble collects one-third of its textile waste separately, which is significantly higher than the EU average of 15% and just below the national average in France (39%[2]). Despite this relatively strong performance, the remaining textile waste is disposed of in mixed waste and incinerated with energy recovery. The collection system is well-organised, with a diversified network of collection points and methods. However, the circular pathways for reuse, repair, and recycling are largely underutilised in Grenoble, with textiles mainly being exported for further processing or disposal outside of France.

The estimated climate impact from post-consumer textile flows in Grenoble is 37 thousand tonnes of CO2e per year. Environmental impacts vary across materials and

[1] https://fashionunited.com/statistics/global-fashion-industry-statistics/france

[2] https://www.cbi.eu/market-information/apparel/recycled-fashion/market-potential

categories, but reducing unnecessary consumption emerges as a critical strategy for mitigating these effects. Although microplastic impacts and other environmental consequences are not yet fully integrated into available scientific models, the data highlights the significant potential for impact reduction through circular strategies like reuse, repair, and recycling.

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1. Introduction to the territory profile

1.1 Context setting

The global textile industry is 0.3% circular: of the 3.25 billion tonnes of materials it consumes each year, over 99% come from virgin sources.[3] In part, this metric is bogged down by high virgin material consumption, with per capita fibre consumption rising significantly over the decades: from 8.3 kilograms in 1975 to 14.6 kilograms in 2022. This is expected to grow by a further 7.4% per year up to 2030. At the same time, textile recycling is lagging—the strong majority (61.4%) of discarded textiles are landfilled or incinerated. Just 8% is reused or exported, 6.3% ends up in cascading recycling, and 2.2% is lost during collection or sorting.

The current scale of textile consumption is linked to numerous impacts: from climate change to water eutrophication and water scarcity. Social impacts, including labour rights violations, health hazards and threats to livelihoods in producing communities, are also pronounced. The circular economy offers a means to address these challenges, through various R-strategies such as **Reduce, Reuse, Repair, Repurpose,** and **Recycle.**

1.2 SOLSTICE: 5R solutions for textile integrated circular economy

The SOLSTICE project aims to address the key social, environmental and technical challenges posed by the textile industry through a circular economy lens. Funded by the European Union's Horizon Europe research and innovation programme under grant agreement No. 101134989, SOLSTICE is taking steps towards a circular textile industry through the implementation of pilot projects in four territories: Berlin, Grenoble, Catalonia, and Prato. The project will showcase how circular economy practices can be tailored to and implemented across the textile industry.

1.3 Territory profile: goal, methodology and structure

In collaboration with the four territories studied, Circle Economy led a current state analysis of the textile ecosystem, including current circular practices. This analysis provides insight into areas where immediate action is needed and informs the selection of relevant circular practices in each of the four territories. A mixed-methods approach was used to analyse this current state: first, describing the national and local textile industry context; giving an overview of relevant national and regional textile policies; and conducting a detailed analysis for the territories in focus. This includes a material flow analysis to map textile flows across the value chain, a baseline analysis of employment in the territory's textile value chain, a consumer behaviour analysis vis a vis textile consumption and circular solutions, and an environmental impact assessment to determine the current consequences of the

[3] Circle Economy. (2024). *The circularity gap report textiles*. Amsterdam: Circle Economy. Retrieved from: CGR Website

textile value chain in each territory. The final chapter for each territory profile extracts key findings to formulate recommendations for the design of the circular textile pilot project.

2. The current state of the circular textile landscape

2.1 National industry context

France holds a prominent position as one of Europe's leading textile producers.[4] In 2022 alone, an astonishing nine million textile items were sold daily across the country, culminating in an annual total of 3.3 billion items—or 827 thousand tonnes.[5] These figures highlight the significant scale of France's textile industry in terms of both volume and value, encompassing a diverse range of product types.

To manage the lifecycle of these textiles, France has established an extensive infrastructure for textile waste collection. As of 2021, there were 44,000 collection points strategically located throughout the country. These include convenient spots such as supermarkets, shopping malls, private parking areas, charitable organisations, and on-street containers. Consumers can also locate nearby collection points using an online interactive map. Once collected and sorted, textiles follow multiple pathways: they are resold, exported for reuse and recycling, or processed at local recycling facilities.[6]

However, challenges remain. A key concern is ensuring that the majority of collected textiles are efficiently sorted and recycled through authorised channels. Additionally, gaps in monitoring the volume of textiles sold via online platforms present another obstacle to achieving a fully transparent and circular system. Addressing these issues will be critical to advancing circularity within France's textile sector.

2.2 Local industry context

Grenoble stands out as a beacon of innovation, renowned for its vibrant economy driven by high-tech industries and cutting-edge research. Often referred to as the 'Alps capital' due to its prominence in the region, Grenoble thrives in key sectors such as nanotechnology, information technology, and biotechnology. A high concentration of research institutions and research and development (R&D) jobs solidifies its reputation as an innovation hub, attracting talent and fostering breakthroughs in science and technology.[7] Nestled amidst mountainous terrain, Grenoble's geography limits urban sprawl, making it the third densest city in France with 8,861 inhabitants per square kilometre. This constraint has pushed the city toward urban regeneration, focusing on rehabilitating existing spaces and prioritising

[4] https://single-market-economy.ec.europa.eu/sectors/textiles-ecosystem_en

[5] https://globalmeasure.org/epr-3-textiles-france/#:~:text=The%20French%20EPR%20scheme%20emphasizes,(Circular%20Online%2C%202023).

[6] https://globalmeasure.org/epr-3-textiles-france/#:~:text=The%20French%20EPR%20scheme%20emphasizes,(Circular%20Online%2C%202023).

[7] https://futurehubs.eu/discover-the-pioneering-spirit-of-grenoble-alpes-a-thriving-metropolis-at-the-crossroads-of-nature-innovation-and-culture/

public transport, sustainable development, and quality public spaces. A prime example is the transformation of former industrial brownfields into vibrant eco-neighborhoods, reflecting Grenoble's commitment to sustainable urban living.[8]

In 2022, Grenoble earned the title of European Green Capital, thanks to a range of forward-thinking initiatives. The city has implemented an ambitious urban planning protocol, enhanced its green spaces, initiated a comprehensive tree-planting programme, and embraced urban gardening.[9] [10] These efforts align with its long-standing climate plan, first adopted in 2005,[11] and a bold goal to reduce greenhouse gas (GHG) emissions by 50% by 2030. Notably, Grenoble already achieved a 25% reduction in emissions between 2005 and 2016.

Grenoble has recognised the importance of transitioning to a circular economy in response to an energy crisis and a global shortage of raw materials, which are significantly impacting local businesses.[12] The metropolitan area is rethinking its reliance on the linear economic model—characterised by extracting, producing, consuming, and disposing—toward a circular system that emphasises reuse, repurposing, repair, and recycling.[13] To support this shift, the city administration has initiated several pilot projects across multiple departments,[14] including the creation of four new waste disposal centres where residents can donate repairable items to extend their lifecycle. Additionally, businesses that enable the reuse of textiles are playing an integral role in advancing Grenoble's circular economy efforts.

One standout example is the work of Emmaus Grenoble, a French community organisation that recently launched a work integration scheme focused on sorting, reusing, and recycling donated textiles.[15] While many actors collect textiles in the region, no textile recycling currently takes place locally. Nevertheless, Grenoble boasts more second-hand shops than other territories, reflecting a growing culture of sustainability. Anecdotally, its population is said to be more sustainability-oriented, though data to confirm this trend is still emerging.

Grenoble's circular economy initiatives extend to academia and industry. Known as 'France's Silicon Valley,'[16] the city is home to four universities, numerous research hubs, and

[8] https://environment.ec.europa.eu/topics/urban-environment/european-green-capital-award/winning-cities/grenoble-2022_en

[9] https://mayorsofeurope.eu/news/grenobles-transition-towards-circular-economy/

[10] https://www.sustaineurope.com/grenoble-european-green-capital-2022-20230110.html

[11] https://environment.ec.europa.eu/news/grenoble-starts-year-2022-new-european-green-capital-2022-01-14_en#:~:text=Grenoble%20was%20the%20first%20French,carbon%2C%20zero%2Dnuclear%20energy

[12] https://circularcitiesdeclaration.eu/cities/grenoble

[13] Stratégie Économie Circulaire en direction des entreprises

[14] https://circularcitiesdeclaration.eu/fileadmin/user_upload/CCD-Report-2022.pdf

[15] https://emmaus-europe.org/language/en/emmaus-grenoble-creates-its-own-work-integration-scheme-the-lucie-coutaz-workshop/

[16] https://www.investingrenoblealpes.com/en/why-grenoble/our-economy/electronics-digital-technologies/

a high concentration of researchers, particularly in science, engineering, and technology. This strong research and innovation ecosystem creates many opportunities in R&D,[17] including in circular economy fields. Grenoble offers courses on circular economy topics like remanufacturing,[18] and the Circular initiative at Université Grenoble Alpes focuses on designing circular industrial systems,[19] aiming to innovate and educate for a sustainable future.

3. Governance & policy overview

3.1 National overview

France's circular economy strategy outlines ambitious objectives to transition towards sustainable resource use and waste management. By 2030, the strategy aims to reduce natural resource use tied to French consumption by 30% relative to GDP. By 2025, it targets a 50% reduction in non-hazardous waste landfilled, 100% recycling of plastics, and a reduction in GHG emissions by eight million tonnes annually through improved plastic recycling. Furthermore, it seeks to create approximately 300 thousand circular jobs, demonstrating a commitment to economic and environmental sustainability.[20] [21]

The strategy includes 50 actions across four key areas: enhanced waste management, improved manufacturing, better consumption practices, and stakeholder engagement. Specific initiatives focus on fostering eco-design, promoting repair and reuse, increasing recycling rates, and reducing waste generation.[22] A significant milestone was reached in April 2021, when France published an updated document consolidating indicators for monitoring circular economy progress. Additionally, the French Fashion Pact unites fashion and textile businesses to address climate, biodiversity, and ocean sustainability challenges collaboratively. In alignment with the EPR Roadmap (2023-2028), €1 billion is allocated to five projects enhancing garment recycling.

France's legislative framework reinforces its circular strategy. The *Anti-Waste for a Circular Economy Law* (AGEC, 2020) transforms production, distribution, and consumption systems into a circular model.[23] Key provisions include promoting product repairability, mandating Producer Responsibility Organisations to support repair funds, banning the destruction of unsold new products like clothes and shoes, and requiring manufacturers to disclose environmental product characteristics. Complementing the AGEC, the *Climate and Resilience Law* (2023) introduces measures such as environmental labelling, greenwashing

[17] https://sifted.eu/articles/how-grenoble-became-europes-deeptech-hotspot

[18] https://eit-campus.eu/course/manufacturing/msc-in-zero-defect-manufacturing-for-a-circular-economy

[19] https://circular.univ-grenoble-alpes.fr/circular-project

[20] https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-products/etc-ce-report-5-2022-country-profiles-on-circular-economy/france-ce-country-profile-2022_for-publication.pdf

[21] https://www.ecologie.gouv.fr/sites/default/files/documents/FREC%20-%20EN.pdf

[22] https://hollandcircularhotspot.nl/france-2/

[23] https://www.ellenmacarthurfoundation.org/circular-examples/frances-anti-waste-and-circular-economy-law

regulations, sustainable public procurement, and frameworks for carbon compensation claims.[24]

France also pioneered the EU's first Extended Producer Responsibility (EPR) system for textiles in 2007.[25] This initiative sets clear objectives: the collection and treatment of 50% of marketed textiles annually and achieving 70% recycling, material recovery, or reuse of sorted waste. The EPR scheme is managed by Refashion, a producer responsibility organisation accredited by French authorities and governed by a consortium of 29 manufacturers and three industry federations.[26] Producers can choose to comply with EPR requirements individually or collectively. While some brands operate their own take-back systems, 95% of the French market relies on Refashion's collective compliance scheme, which has over 4,000 registered members. Refashion incentivises sustainable practices by offering reduced tariffs for products made with recycled fibres. To qualify for these discounts, producers must provide documentation verifying the type, origin, and proportion of recycled materials in their products. The scheme specifically rewards the use of post-consumer clothing, household linen, and footwear (CHF) waste collected through approved systems, with higher bonuses for fibres sourced from closed-loop recycling compared to open-loop recycling.[27]

3.2 City-level overview

The Grenoble Alpes Métropole has laid out an ambitious roadmap to advance the circular economy and foster sustainable development across the region. At the heart of this effort is the *Master Plan for Repair and Reuse* (2020–2030), which introduces a comprehensive strategy to divert 7.5 thousand tonnes of waste annually towards reuse or repair.[28] This initiative also aims to generate jobs within the social and solidarity economy (that which prioritises social over financial profits) by expanding the variety of objects collected, diversifying collection points, and scaling up repair and reuse activities to an industrial level. To support these efforts, the Metropole is focused on creating appealing outlets for second-hand goods and encouraging their purchase, reshaping perceptions of used items as valuable resources. Innovative projects such as the *'donneries'*, the *Préaux des matériaux*, and the *Pôle R*—a dedicated hub for circular economy activities—further exemplify this transformation.

[24] https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-products/etc-ce-report-5-2022-country-profiles-on-circular-economy/france-ce-country-profile-2022_for-publication.pdf

[25] https://www.eionet.europa.eu/etcs/etc-ce/products/country-profiles-on-the-management-of-municipal-waste-1/france_msw_2016.pdf

[26] https://globalmeasure.org/epr-3-textiles-france/#:~:text=The%20French%20EPR%20scheme%20emphasizes,(Circular%20Online%2C%202023).

[27] https://refashion.fr/pro/sites/default/files/fichiers/BAREME_ECO_MODULATIONS_2024_REFASHION_MAI2024_EN_Vdef.pdf

[28] https://www.grenoblealpesmetropole.fr/305-le-schema-directeur-des-dechets.htm

In 2022, the *Circular Economy Action Plan* built on these efforts by targeting specific sectors including electronics, food and agriculture, packaging, and textiles. The Grenoble Métropole has committed to reducing resource consumption and waste generation through a range of innovative systems, with the *Pôle R* serving as a key location for companies focused on reuse and repair, such as the Fabricanova cooperative.[29] To foster a thriving circular economy, the Metropole emphasises the importance of raising public awareness about circular practices, facilitating cooperation among stakeholders, and supporting the emergence of new circular economy activities.

The Grenoble Alpes Métropole has a long history of leadership in sustainability. In 2005, it became the first French municipality to adopt a *Climate-Air-Energy Plan* (PAEC).[30] This initiative achieved significant reductions in GHG emissions between 2005 and 2016, largely due to a 27% decrease in energy consumption among the region's 20 largest manufacturers. While these reductions were partly influenced by changes in industrial operations and employment levels, the plan also underscored the critical role of addressing indirect, consumption-related emissions (scope 3) alongside direct emissions.

Building on its legacy of climate action, the Metropole has committed to an ambitious *2030 Waste Master Plan*, which emphasises waste reduction and resource recovery.[31] This initiative includes the development of a framework for integrating circular economy principles into public procurement processes in alignment with the national SPASER scheme.

4. City-level analysis

4.1 Textile ecosystem

4.1.1 Methodology

Approach

This spatial analysis examines the distribution of key locations within Grenoble's circular textile ecosystem and their accessibility to residents. Accessibility refers to the ease with which people can reach a location or 'point of interest' (POI). The analysis follows a structured approach, beginning with the compilation of an inventory of POIs related to the circular textile ecosystem. This is followed by the calculation of travel times to these POIs using open-source road data, considering both walking and driving. Finally, the analysis assesses how many people have good access to these POIs based on population and socioeconomic data, exploring potential links between accessibility and socioeconomic

[29] https://www.grenoblealpesmetropole.fr/327-le-soutien-a-l-economie-circulaire.htm

[30] https://www.climate-chance.org/wp-content/uploads/2020/04/synthesis-report-2019-local-action-book-case-grenoble_france-p70.pdf

[31] https://www.grenoblealpesmetropole.fr/305-le-schema-directeur-des-dechets.htm

profiles. A more detailed explanation of the methodology is available in the Methodology Document.

Territory and socioeconomic inputs

This spatial analysis focuses on Grenoble-Alpes Métropole, an intermunicipality comprising 49 communes in Isère, referred to as 'Grenoble' for simplicity. In the absence of survey data on acceptable travel times, the analysis applies a threshold of ten minutes for both walking and driving as the maximum acceptable travel time to reach a POI. To examine whether accessibility varies across population strata, we employed data on the standard of living, estimated by the average household disposable income per commune.[32]

POI collection

To compile an inventory of POIs within Grenoble's circular textile ecosystem, publicly available bottom-up sources were collected. Additionally, establishments related to secondhand clothing shops and textile and apparel repair services were identified through queries to the Google Places API.[33] The analysis focuses on four 'R-categories' of POIs: reuse, repair, rental, and recycle. Reuse locations facilitate textile reuse through selling, exchanging, or giving away used textiles, including secondhand shops, donation points, and clothing swap initiatives. Repair services extend the lifespan of textile products and include clothing and shoe repair shops, repair cafés, and cleaning services. Rental providers offer textile rental services such as clothing and costume rental businesses. Recycling locations involve textile waste management and recycling, including textile collection bins and stores with take-back services.

This analysis is limited to consumer-oriented POIs, considering only locations accessible to the general public. Facilities primarily serving industrial or business purposes within the circular textile value chain, such as sorting facilities, are excluded. Furthermore, the study does not differentiate between specific textile-related products, such as shoes, carpets, clothing, or bags. Depending on the data source, a POI may be classified under multiple categories. For example, a vintage store offering repair workshops is categorised under both reuse and repair, while a collection bin supplying secondhand stores contributes to both reuse and recycling.

POI inventory

A total of 404 POIs were identified for Grenoble (see Table 1). Most are related to reuse and recycling, with a smaller number focused on repair and none on rental. The bottom-up data draws from several key sources. One dataset maps POIs related to selling and acquiring second hand goods, as well as repair services, based on OpenStreetMap (OSM) and filtered

[32] Institut national de la statistique et des études économiques (Insee). (2021). Statistiques locales. Retrieved from: Insee website.

[33] Google. (n.d.). Places API. Retrieved from Google Maps Platform.

specifically for textile items.[34] Another dataset focuses on textile waste collection points, including drop-off locations, public and private bins, and waste disposal sites, also sourced from OSM.[35] Additionally, a list of establishments across different points in the textile value chain was filtered to highlight repair-related locations.[36] Some textile collection points are linked to stores that offer take-back schemes.[37] The remaining POIs were sourced from the Google Places API.

	Reuse	Recycle	Repair	Rental	Total
count	288	227	115	0	404

Table 1: Overview of the bottom-up collected points of interest in Grenoble.

4.1.2 Results

Accessibility

The analysis reveals distinct spatial patterns in the accessibility of circular textile services across the Grenoble-Alpes Métropole. Given a maximum driving time of ten minutes (Figure 1), accessibility appears to be more strongly influenced by proximity to the commune of Grenoble than by population density. The highest levels of accessibility are observed within and around the commune of Grenoble, which forms the centre of the metropolitan area. While these areas are among the most populated, the data suggests that population alone does not determine accessibility. For instance, communes with approximately 10,000 residents near Grenoble have access to 40–60 POIs, whereas similarly populated communes located farther away experience significantly lower accessibility. Driving accessibility declines as distance from the commune of Grenoble increases, a trend that is particularly evident for reuse and repair POIs.

When considering a maximum walking time of ten minutes (Figure 1), accessibility patterns differ from those observed for driving. Reuse and repair POIs tend to be more concentrated in densely populated communes, suggesting a stronger correlation between population and accessibility. However, for recycling, accessibility is more evenly distributed across the territory, with little apparent relationship to population density. Overall, accessibility gaps are most pronounced in the Northern and Southwestern parts of the metropolitan area, where some communes lack access to any POIs within both the ten-minute driving and walking thresholds.

[34] OpenStreetMap France (OSM-Fr). (n.d.). RE-EMPLOYMENT ADDRESSES IN THE GRENOBLE METROPOLIS. Retrieved from: uMap.

[35] OSM-Fr. (n.d.). Collecte des textiles. Retrieved from: uMap.

[36] Institut national de la statistique et des études économiques (Insee). (n.d.). Constituer une liste. Retrieved from: Sirene website.

[37] Refashion. (n.d.). Je dépose. Retrieved from: Refashion website.

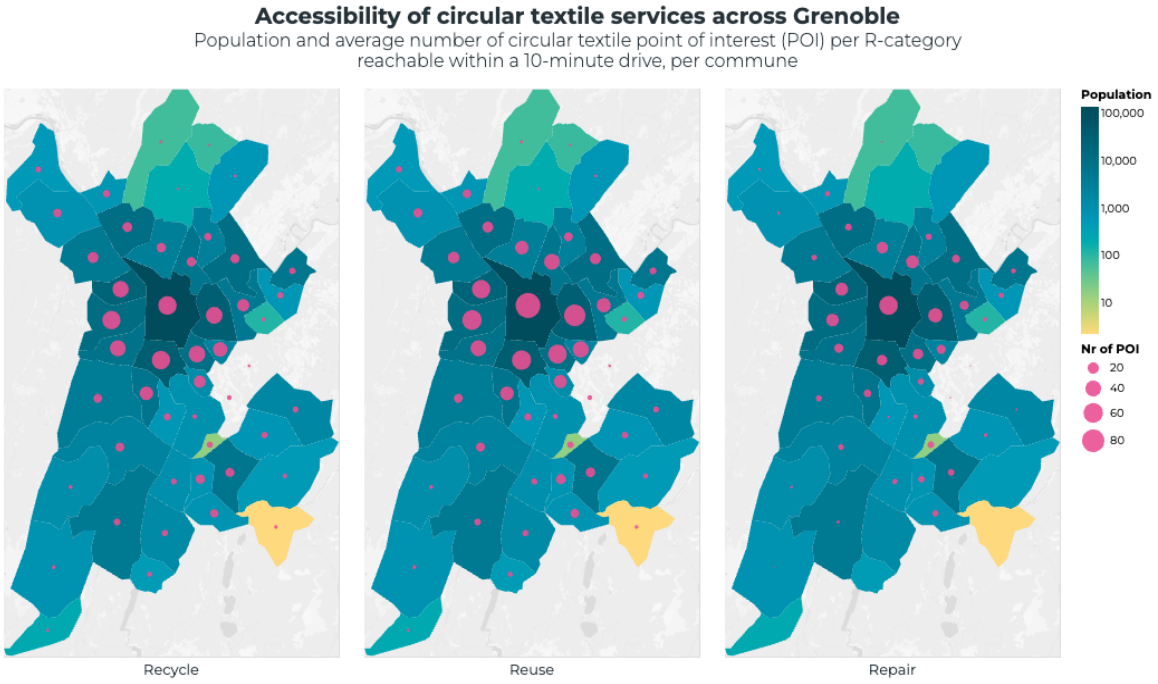


Figure 1: The accessibility maps show the average number of recycle, reuse, and repair (3R) POIs reachable within a ten-minute drive for residents in each commune of Grenoble. Larger bubbles indicate greater accessibility, while darker shades represent higher population density. The plot compares population and accessibility levels across communes to highlight spatial patterns or disparities.

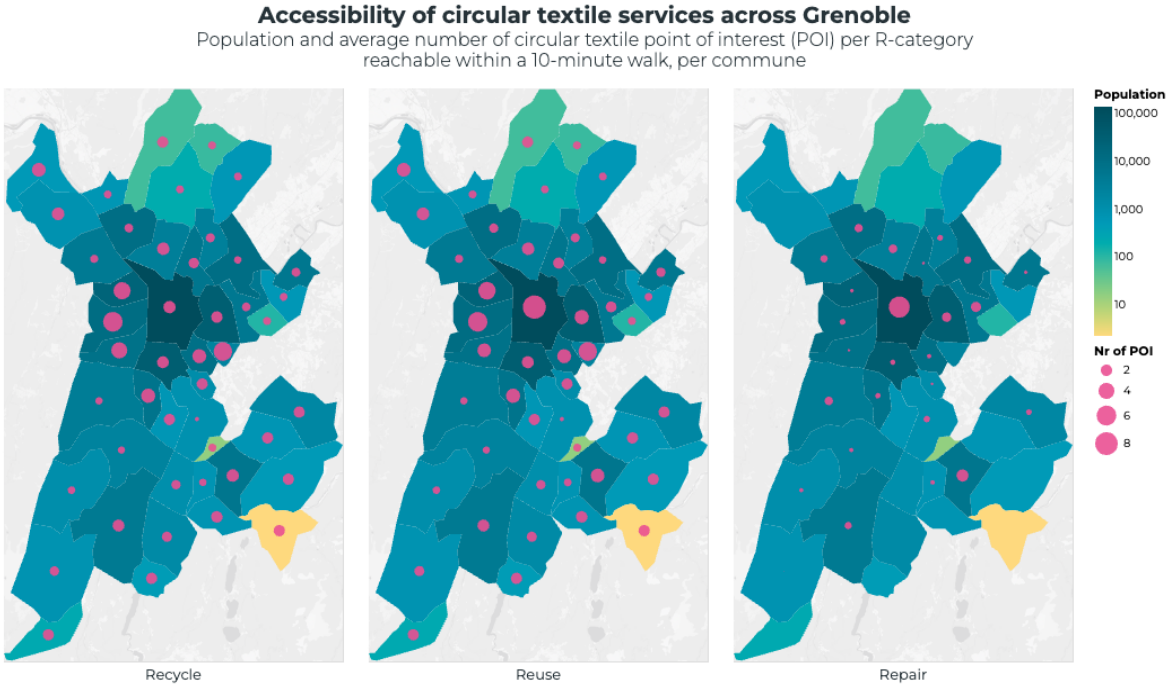


Figure 2: The accessibility maps show the average number of recycle, reuse, and repair (3R) POIs reachable within a ten-minute walk for residents in each commune of Grenoble. Larger bubbles indicate greater accessibility, while darker shades represent higher population density. The plot compares population and accessibility levels across communes to highlight spatial patterns or disparities.

Travel time

The analysis shows that 50% of Grenoble's population can reach at least one POI within ten minutes and 12 seconds on foot or three minutes and 12 seconds by car (Figure 2). However, accessibility varies, with some residents facing significantly longer travel times—the longest distance to the nearest POI is one hour and 12 minutes by walking and 22 minutes by driving.

When considering access to all three R-categories (recycle, reuse, and repair), 39% of the population (172,625 people) can reach POIs from all categories within a ten-minute walk, whereas 95% (423,930 people) have access to all three categories within a ten-minute drive. This highlights the significant role of driving in ensuring comprehensive access to circular services in Grenoble.

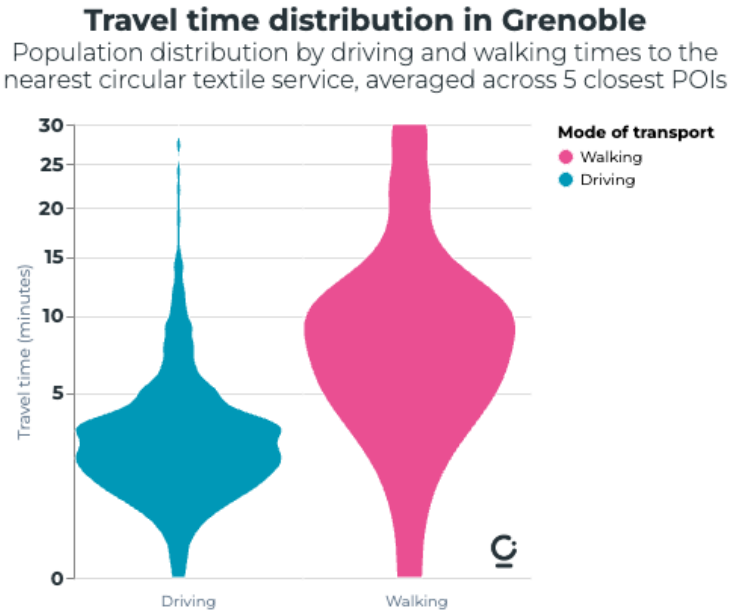


Figure 3: The chart shows the distribution of travel times for Grenoble's population to reach a circular textile POI, by driving (blue) and walking (pink).

Socioeconomic factors

The analysis suggests that living standards are not a key determinant of accessibility to circular textile services in Grenoble. Communes with higher median incomes (above €30,000) generally have access to fewer than 20 POIs within a 10-minute walk, while higher accessibility is predominantly found in communes with comparatively lower incomes. As shown in Figure 4, many of these communes are also among the most populated in the territory. Instead, accessibility appears to be more closely linked to population density, with less densely populated communes tending to have higher incomes but fewer POIs within walking distance.

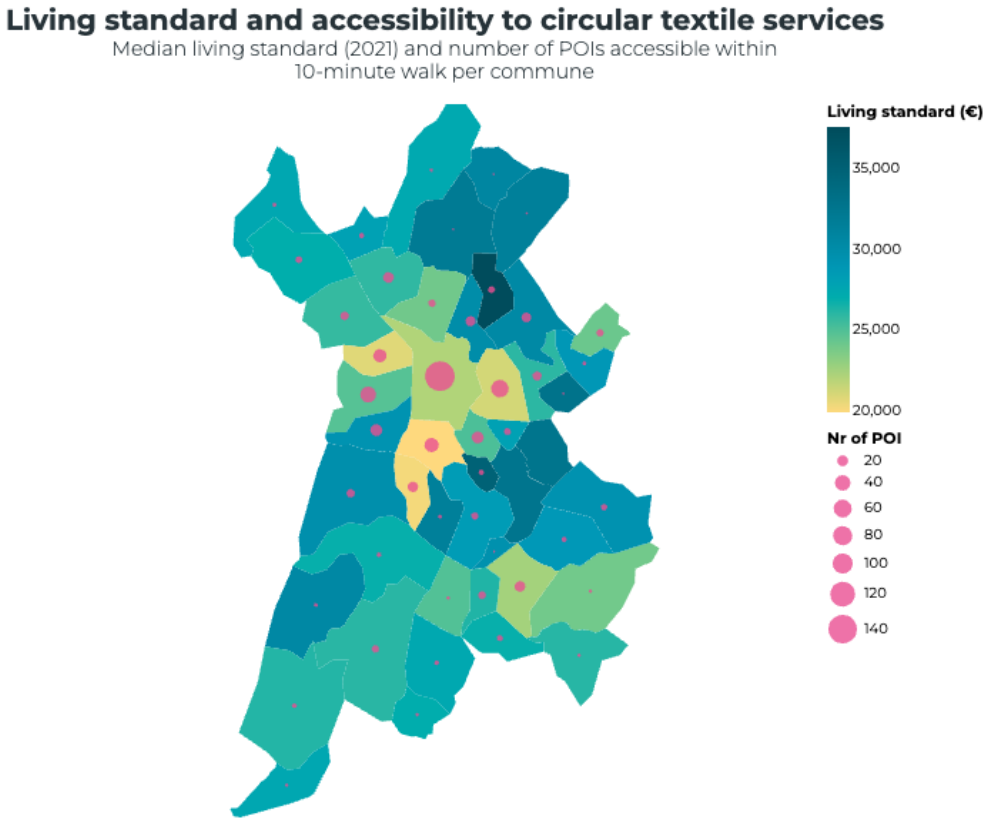


Figure 4: Choropleth and density bubble map showing that lighter shades (lower income) are in central areas with higher accessibility, while darker shades (higher income) are in periphery areas with limited access. Accessibility is more influenced by population density than socioeconomic factors.

4.2 Material Flow Analysis

4.2.1 Methodology

In Grenoble, the life cycle of textiles unfolds through five interconnected stages: fibre production, textile manufacturing, distribution and retail, use and repair, and waste management. To provide a detailed view of these stages, a Material Flow Analysis (MFA) was conducted, offering valuable insights into the region's textile flows in 2023. The analysis focused on clothing and footwear, home textiles, and technical textiles. Data on fibre production, textile manufacturing, and repair activities were retrieved using NACE classification codes.

At the beginning of the value chain—covering fibre production, textile manufacturing, and distribution and retail—data for Grenoble Métropole was very limited. As a result, this data was downscaled from national figures. National data on textile manufacturing and trade was sourced from Eurostat's Statistics on the Production of Manufactured Goods

(Prodcom).[38] To estimate production for Grenoble Métropole, the proportion of full-time jobs in Grenoble[39] relative to the national total[40] was used as a scaling factor.

For the distribution and retail stage, apparent consumption served as the key metric. This was calculated based on Huygens et al. (2023):[41]

$$Use = Import_{fin.prod} + Production_{fin.prod} - Exports_{fin.prod}$$

Where 'Import$_{fin.prod}$ ', 'Production$_{fin.prod}$' and 'Export$_{fin.prod}$' refer to the import, domestic production and export of finished textile products. To benchmark results, data was compared to the European average of 23 kilograms per person.[42]

Exports for Grenoble were not calculated, as downscaling national trade data without additional region-specific information cannot accurately reflect the complex trading patterns of the textile sector in the area. Data on waste generation and treatment was obtained at the regional level from Grenoble Métropole, providing additional insights into the end-of-life stage of textiles. For more information, see the Methodology Document.

4.2.2 Results

Fibre production in Grenoble is nonexistent, with no local output recorded. Regional manufacturing contributes a modest 0.2 thousand tonnes of finished textiles annually.[43] The apparent consumption calculated for France—and assumed for Grenoble—was 17.7 kilograms per person.[44] While this figure is higher than the number reported by Refashion,[45] the Prodcom-based estimate of 17.7 kilograms per capita aligns more closely with the European benchmark of 23 kilograms per capita.[46]

Repair activities remain limited, with only 0.05 thousand tonnes of textiles repaired annually.[47] Post-consumer textile collection amounts to 4.2 thousand tonnes each year (9.3

[38] Eurostat (2023) Statistics on the production of manufactured goods .Retrieved from Eurostat website

[39] Besnard, C., Reffet-Rochas, A. (2024). Des spécialités qui s'appuient sur un ancrage territorial fort. Retrieved from Insee website

[40] Eurostat (2023) .Enterprises by NUTS 2 region and NACE Rev.2 activity. Retrieved from Eurostat website

[41] Eurostat (2023) .Enterprises by NUTS 2 region and NACE Rev.2 activity. Retrieved from Eurostat website

[42] European Environment Agency (2022). EU-27 apparent consumption of clothing, footwear and household textiles. Retrieved from EEA website. Value based on the same NACE codes considered in this analysis, further explained in the Methodology document

[43] Result from the MFA model, see Methodology Document, Section 3.2 for details

[44] Result from the MFA model, see Methodology Document, Section 3.3 for details

[45] Refashion (2024). 2023 Activity report. Retrieved from Refashion website

[46] European Environment Agency (2022). EU-27 apparent consumption of clothing, footwear and household textiles. Retrieved from EEA website. Value based on the same NACE codes considered in this analysis, further explained in the Methodology document

[47] Result from the MFA model, see Methodology Document, Section 3.4 for details

kilograms per capita),[48] while pre-consumer textile volumes are negligible at just 23.8 tonnes due to the region's low levels of textile production.[49]

Out of the total textile waste generated, 35% (equivalent to 1.52 thousand tonnes) was separately collected and sorted, including 1.5 thousand tonnes from municipal waste and 0.02 thousand tonnes from industrial waste.[50] Despite these efforts, a significant volume of textiles—approximately 2.7 thousand tonnes (6 kilograms per capita)—remains within mixed municipal waste streams.[51] The treatment of textiles within mixed municipal waste is straightforward: 100% is incinerated with energy recovery,[52] as Grenoble does not utilise landfills. For separately collected post-consumer textiles, the treatment pathways are more varied: approximately 40% is exported for recycling, 48% is exported for reuse, 6% is reused locally, and the remaining 5% is incinerated.[53] Only 100 tonnes of textiles are reused locally each year, highlighting the need for greater capacity and focus on local reuse and recycling initiatives.

[48] Grenoble Métropole (2023). SYNTHÈSE DU RAPPORT SUR LE PRIX ET LA QUALITÉ DU SERVICE DÉCHETS MÉNAGERS ET ASSIMILÉS.. Retrieved from Grenoble Métropole website

[49] Result from the MFA model, see Methodology Document, Section 3.5 for details

[50] Result from the MFA model, see Methodology Document, Section 3.6 and 3.7 for details

[51] Grenoble Métropole (2023). SYNTHÈSE DU RAPPORT SUR LE PRIX ET LA QUALITÉ DU SERVICE DÉCHETS MÉNAGERS ET ASSIMILÉS. Retrieved from Grenoble Métropole website

[52] Grenoble Métropole (2023). SYNTHÈSE DU RAPPORT SUR LE PRIX ET LA QUALITÉ DU SERVICE DÉCHETS MÉNAGERS ET ASSIMILÉS. Retrieved from Grenoble Métropole website

[53] Data shared by Grenoble Metropole from Refashion (not available online)

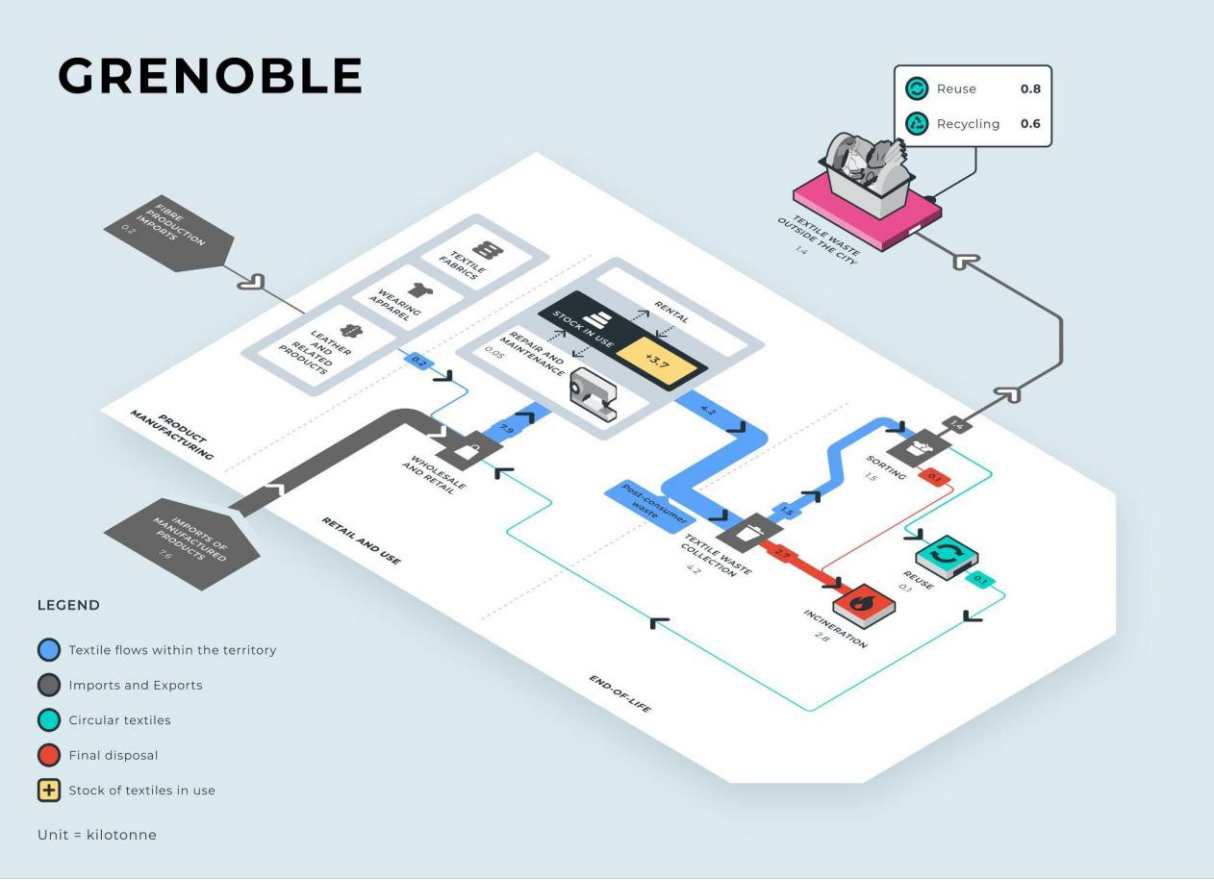


Figure 5: Material Flow Analysis results

4.3 Employment baseline

4.3.1 Methodology

Both full-time equivalent (FTE) and 'job' counts are used in this analysis, but they should not be interpreted as identical measures. Where available, FTE data is used; when FTE figures are not available, employment is referenced more broadly as 'jobs'. A reported count of zero jobs does not necessarily indicate the absence of employment but rather reflects a lack of reliable data sources.

The baseline analysis is informed by a mix of sources. When available, city-level data is prioritised, such as figures provided directly by Grenoble Métropole for manufacturing, wholesale, distribution, and retail in 2024. National statistics, such as those from INSEE, supplement the analysis, particularly for manufacturing, though this data is from 2021. In cases where no direct figures exist, employment estimates are derived from interviews and contextual knowledge. For example, employment in collection and sorting was estimated based on reported textile volumes, as no comprehensive employment data was available. These estimates were not verified by companies operating in the sector and should be treated with caution. Overall, the reported employment figures primarily reflect data from 2024.

4.3.2 Results

The textile value chain in Grenoble Métropole employs an estimated 1,320 people across various stages, from manufacturing and retail to repair and waste management. Each segment of the value chain varies in employment levels, with some sectors lacking available data or showing low reliability due to limited reporting.

Fibre production

Fibre production does not account for any jobs in Grenoble Métropole.

Textile manufacturing

In the manufacturing sector, there are an estimated 99 FTE jobs. This figure is based on two datasets: one from the national statistical agency, INSEE, for 2021[54] and another from data reported by the Métropole for 2024. The INSEE data reported 42 FTEs in textile manufacturing, 20 FTEs in the manufacture of wearing apparel, and 37 FTEs in the manufacturing of leather, leather products, and footwear. The 2024 data, based on the number of businesses operating in each sector and their reported employment figures, suggests lower estimates. However, fewer than 10% of businesses in the manufacturing sector provided employment figures, making the data highly unreliable. For textile manufacturing, five of the 93 businesses reported an average of 3.2 employees, leading to an estimate of 16 FTEs for those who reported. In the manufacturing of wearing apparel, 13 of the 210 businesses reported an average of 1.2 employees, also leading to an estimate of 16 FTEs. In the manufacture of leather, leather products, and footwear, three of the 29 businesses reported an average of three employees, resulting in an estimate of nine FTEs. Given the significant limitations in the 2024 data, the employment figures from INSEE for 2021 were used as the primary source.

Research and innovation

Despite Grenoble Métropole being located inside a wider regional hub for research and innovation, the research team could not estimate R&D employment pertaining to the textile value chain specifically. Nevertheless, there are 23,000 jobs in research within the Grenoble-Alpes area, which is the highest density of jobs dedicated to R&D in the country overall.[55]

Distribution and retail

The wholesale, distribution, and retail sector employs an estimated 865 FTEs, with 54 in wholesale and 811 in retail, based on 2024 data provided by the Métropole. These figures were derived from reported averages from a subset of companies rather than comprehensive data, which affects their reliability. In the wholesale sector, between 17% and 37% of businesses reported employment figures, while in the retail sector, the reporting rateranged from just 2% to 56%. Within wholesale, the wholesale of textiles employs an

[54] INSEE (2021) https://www.insee.fr/fr/statistiques/7755601#tableau-figure1

[55] Grenoble Alpes

estimated 16 FTEs, based on an average of 2.6 FTEs reported by six of the 16 companies in the sector. The wholesale of clothing and footwear employs 38 FTEs, with an average of 3.8 FTEs reported by ten of the 58 companies. In the retail sector, the sale of textiles in specialised stores employs 16 FTEs, based on an average of two FTEs per store reported by eight of the 20 businesses in this sector. The retail sale of clothing in specialised stores employs 658 FTEs, based on an average of 2.8 FTEs reported by 227 of the 521 companies. The retail sale of footwear and leather goods in specialised stores employs 122 FTEs, with an average of 2.3 FTEs reported by 52 of the 92 businesses. The retail sale via stalls and markets of textiles, clothing, and footwear employs 15 FTEs, based on an average of five FTEs reported by three of the 171 businesses.

Second-hand retail

The second-hand retail sector employs an estimated 96 people in Grenoble. This figure was obtained by scaling down a national estimate to the local population and accounts for all reuse activities,[56] not just those related to textiles. As a result, the estimate likely overstates textile-related employment.

Use and repair

Rental

No data was available on employment in the rental sector, so it is assumed that there are no jobs in this segment.

Repair, upcycling and maintenance

The repair sector employs an estimated 127 FTEs, based on 2024 data provided by the Métropole. These figures were derived from a subset of businesses reporting employment numbers, with reporting rates ranging from 22% to 41%, significantly limiting the reliability of the data. The sector includes both footwear and leather repair and the washing and dry cleaning of textile and fur products. Repair of footwear and leather goods employs an estimated nine FTEs, based on an average of 0.9 FTEs reported by ten companies. The washing and dry cleaning of textiles and fur products employ an estimated 118 FTEs, based on an average of 5.3 FTEs reported by 22 businesses.

Waste management

Collection and sorting

The collection and sorting sector employs an estimated 133 people. Due to the lack of direct employment data, this estimate was calculated based on textile waste volumes and average employment per tonne collected or sorted. Collection activities are assumed to require 0.0075 FTEs per tonne, resulting in an estimate of 32 FTEs. Sorting activities are assumed to require 0.0675 FTEs per tonne, leading to an estimate of 101 FTEs. Anecdotally,

[56] Ordif (2018) https://www.ordif.fr/fileadmin/NewEtudes/000pack3/Etude_2905/Figure_complementaire_Economie_circulaire.pdf

La Remise, one of the largest collectors in the region, collects approximately 800 tonnes of material annually, half of which consists of textiles. The organisation reports employing an estimated 50 people for textile-related activities, with a workforce primarily composed of women, including 14 men and 40 women.

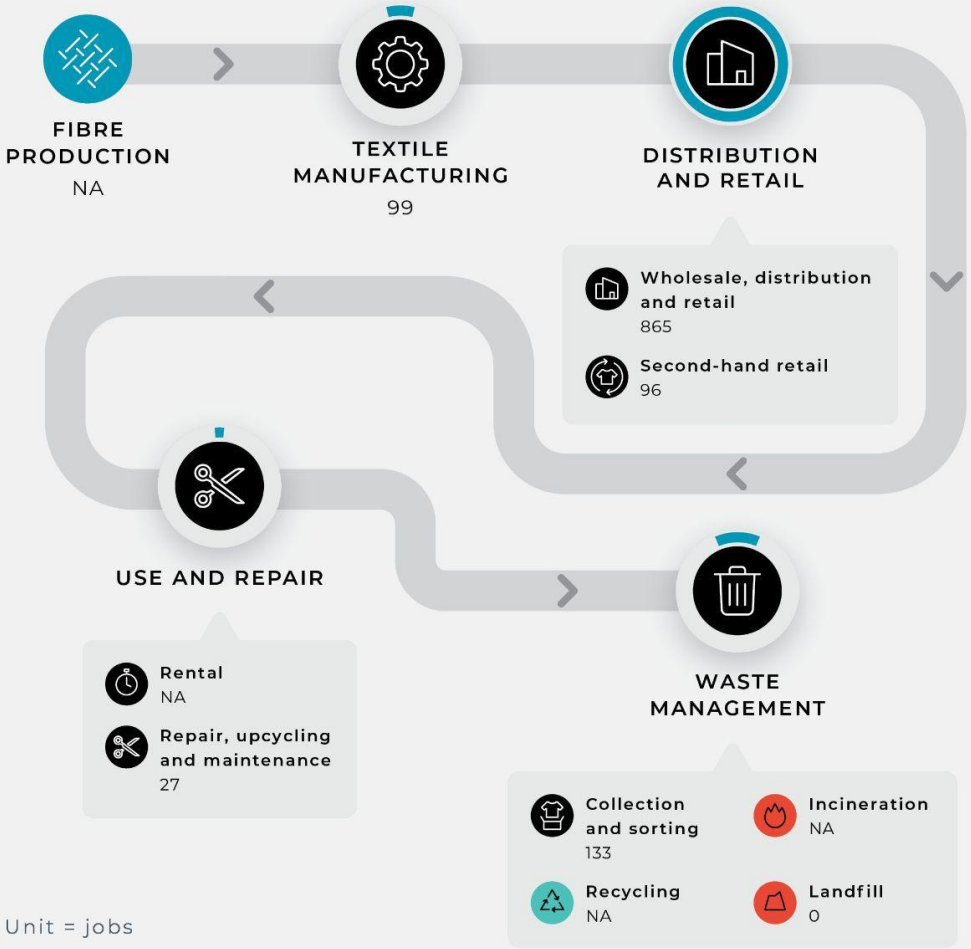
Incineration, landfill and recycling

There are no available employment figures for textile-related waste management activities in Grenoble Métropole. One of the city's incineration plants employs 46.47 FTEs in total, but no data is available to determine how many of these jobs are linked specifically to textile waste. The region does not have landfill facilities for textile disposal. Finally, there are no known recycling activities for textiles in Grenoble Métropole, meaning this sector does not contribute to employment figures.

OVERVIEW OF **EMPLOYMENT** IN THE **TEXTILE SECTOR** IN GRENOBLE (2024)

This infrographic presents the number of employed people in the textile sector in Grenoble. Some activities could not be retrieved. A value of NA does not indicate the absence of jobs but rather that the data was unavailable. Data sources vary, so please refer to the methodological section in the main text for further details.

TOTAL
1,320



4.4 Consumer behaviour

4.4.1 Methodology

Consumer behaviour in Grenoble was investigated with focus groups that employed a multi-layered approach to data collection to better understand consumer behaviour regarding circular textiles in Grenoble. Two focus groups were conducted with 12 participants, with each group designed to be relatively representative of the city's inhabitants. This ensured that insights captured reflected a broad spectrum of consumer perspectives, from different demographics and lifestyle backgrounds. A combination of qualitative methods was used to identify behavioural trends and key motivators. Group discussions provided an open forum for participants to share their understanding of attitudes and preferences toward circular textiles, while persona creation exercises helped map out distinct consumer profiles and purchasing behaviours. The focus groups explored four key themes: purchase drivers (price, brand loyalty, and sustainability); awareness and barriers (understanding of circular solutions and obstacles to adoption); and opportunities for circular textiles.

Prior to this, an initial assessment was conducted to map existing consumer behaviour trends in both Grenoble and France more broadly. Building on these insights, an iterative process guided the focus group design and execution.[57] Key findings included:

- **Stable purchasing habits:** According to the Kantar Division World Panel and the French Fashion Institute, the average number of clothing items purchased per person remained steady between 2009 and 2019 at around 46 items per year.[58] This compared to the EU average of 42 items in 2023. **Frequent shopping among younger consumers:** Young people are major drivers of textile consumption in France, with frequent clothing purchases shaping market demand. In line with broader consumer trends, 46% of younger shoppers buy clothing at least once every three months, making them one of the most active consumer groups.[59]
- **Shifting consumer habits:** A study by the French PRO found that 78% of respondents have changed their consumption habits, and additional research indicates that many individuals are actively trying to reduce their clothing purchases and move away from fast fashion.[60] [61] Additionally, More individuals are exploring second-hand shops and repair services, signalling a shift toward reuse.[62]

[57] The initial approach included a survey on consumer behaviour in order to gather insights directly from consumers, in light of time and resource constraints a focus group was selected as a sufficient method to gather consumer insights.

[58] Dix ans de consommation d'habillement en France

[59] Les habitudes de consommation vestimentaire en France

[60] Les habitudes des français en matière de consommation, de tri et de recyclage des textiles d'habillement, du linge de maison et des chaussures (Refashion)

[61] La Mode et les Français·es : chiffres et Statistiques 2022-2023

[62] Les habitudes des français en matière de consommation, de tri et de recyclage des textiles d'habillement, du linge de maison et des chaussures (Refashion)

- **Preference for locally made products:** Since the covid-19 pandemic, there has been a surge in consumers who are prioritising items produced within France due to lower prices, and to support local economies.[63]
- **Most young consumers are not knowledgeable about textile impacts**: 60% of respondents in a study examining young people's textile consumption habits were not aware of the environmental harm caused by the textile industry. 53% did not know any eco-labels. Those that are aware cite four main eco-responsible brands.[64]
- **Low prioritisation of carbon footprint reduction:** While sustainability is gaining traction, reducing carbon emissions is not yet a top priority for individual consumers, with only 27% of consumers stating environmental impact to be of importance in purchase decisions[65]
- **Barriers to sustainable consumption:** Cost concerns and scepticism about brands' sustainability claims remain major obstacles.[66]
- **Limited awareness of sustainable brands and labels:** Many consumers lack knowledge about the environmental effects of textile production and the availability of local, responsible brands and labels.[67]

4.4.2 Insights and key results

Consumer motivations and profiles

Consumer motivations and purchasing behaviours in Grenoble reflect a diverse range of priorities influenced by income, age, and personal values. Students and low-income families prioritise affordability, making second-hand shopping an attractive and practical choice. In contrast, middle-aged and high-income consumers emphasise brand loyalty, quality, and convenience, often opting for well-known retailers. Retirees and younger eco-conscious consumers take a more deliberate approach, embracing minimalism and ethical purchasing practices.

Barriers to circular practices

Despite growing interest in sustainability, several persistent barriers hinder the adoption of circular textile practices. Reducing consumption remains a challenge due to social pressures to keep up with trends and the widespread availability of inexpensive fast fashion. When it comes to sustainable purchasing, high prices, limited access to responsible brands, and time constraints deter consumers from making more eco-friendly choices. Repairing clothing is similarly challenging, with high costs and a lack of accessible, affordable repair services acting as key deterrents. Finally, second-hand shopping faces cultural resistance,

[63] Étude sur les habitudes de consommation et le made in France. Marques de France

[64] Les habitudes de consommation vestimentaire en France

[65] La Mode et les Français·es : chiffres et Statistiques 2022-2023

[66] https://www.ipsos.com/fr-fr/les-francais-et-la-mode-durable

[67] Les habitudes de consommation vestimentaire en France

with many consumers associating pre-owned clothing with hygiene concerns and a preference for new items.

This continued prevalence of fast fashion, alongside its aggressive promotion, presents a significant obstacle to reducing textile consumption. To address this challenge, there is a need to expand alternatives to purchasing new products, such as rental, bartering, and exchange platforms. These alternatives were identified as key opportunities to integrate into the proposed circular pilot project, ensuring that consumers have practical and appealing options beyond conventional retail.

Opportunities for circular textiles

The focus groups in Grenoble identified several key opportunities to advance circular textile practices and engage the local community. One promising approach is the creation of multifunctional spaces that combine repair workshops, vintage sales, and educational activities. These hubs could serve as accessible, community-driven spaces where consumers can learn about circular solutions while actively participating in them. Additionally, immersive and playful events, such as circular fashion festivals, were highlighted as effective ways to build awareness and encourage behaviour change by making sustainability engaging and enjoyable.

Targeting younger consumers through awareness campaigns and interactive workshops could help shift perceptions and encourage more sustainable shopping habits. Increasing the visibility and accessibility of second-hand stores and repair services would make circular options more convenient and appealing to a wider audience. Furthermore, participants emphasised the need for government subsidies for repair and upcycling initiatives, which could help lower financial barriers and make sustainable options more viable. Legislative, economic, and educational measures are seen as essential drivers of change, along with making information and resources easily accessible to consumers.

4.5 Environmental assessment

4.5.1. Methodology

This chapter estimates the environmental effects of Grenoble's textile flows. Using a life cycle assessment (LCA) approach, the method builds on the results of the MFA, connecting the identified quantities of material flows to their associated environmental impacts. The goal of this assessment is to highlight key priority impact areas within the textiles value chain and lay the foundation for estimating the impact reductions as a consequence of the potential circular pilot solutions. These pilots are co-designed, tested, and evaluated per territory in WP3.

The proposed methodology for this baseline environmental assessment of the current textile flows in each region consists of the following steps (see Figure 6): (1) desk research on the environmental impacts of textiles (2) identifying relevant MFA data (selecting the textile flows in scope for the assessment) (3) approximate the composition of the textile

flows (4) apply the LCA method to estimate the textile flows' relevant impacts (5) present quantitative estimations on the environmental effect of the to-be-introduced pilots.

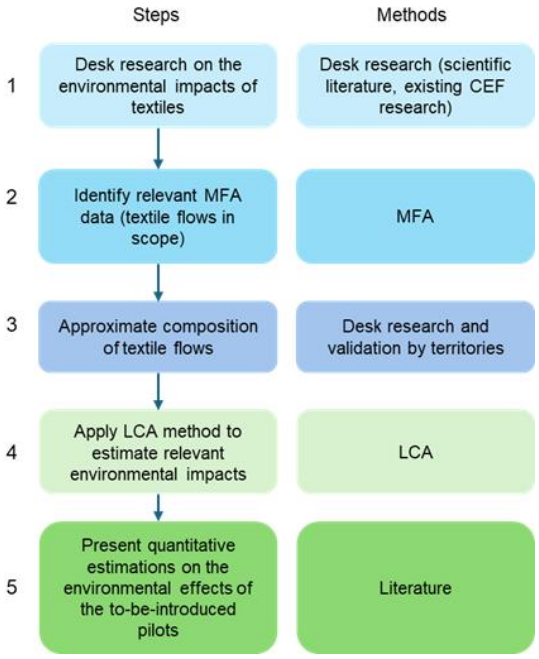


Figure 6: Description of the methodology steps for the baseline environmental assessment

Step 1: An introduction to the environmental impact of textiles

The global textile industry is largely linear: of the 3.25 billion tonnes of textile materials consumed each year, over 99% come from virgin sources, making it only 0.3% circular (Circle Economy, 2024). The textile industry also has a high environmental impact, in particular with high demand for water, land and energy required to produce fibres and textile products: around 4-6 % of the EU's environmental footprint across a range of impact categories is caused by the consumption of textiles, with the large majority of those impacts occurring elsewhere in the world (Köhler et al., 2021). Key impact categories to look at when assessing the environmental impact of textiles are global warming, water consumption, land use change, water and air pollution, and the release of microplastics into terrestrial and aquatic environments.

The textile life cycle stages - not including the use phase - with the highest environmental footprint are typically material extraction, processing, and product manufacturing (Circle Economy, 2024). At the same time, textiles' end-of-life stage is also problematic, as post-consumer textile waste is still largely characterised by incineration and landfilling instead of reuse, repair or recycling pathways. In fact, a large share of used textiles separately collected in the EU and sorted for recycling ends up being traded and exported to Africa and Asia with a highly uncertain fate (EEA, 2024).

Textiles are a heterogeneous group of materials. Clothing and household textile items are composed of a variety of materials, each with highly distinct origins and manufacturing processes, and therefore different environmental impacts.

The origin of textile fiber can be natural (cotton, wool, linen, silk), synthetic (polyester, nylon), or semi-synthetic (rayon), with many textiles being composed of blends between different natural and synthetic fibers. Additives and colouring agents cause additional material complexity. The textile industry is increasingly using fossil-fuel-derived synthetic fibres like polyester, currently making up 63% of the raw materials used in textile production (Circle Economy, 2024).

There are multiple scientific methods to calculate materials' environmental impacts. One of the most widely used is life cycle assessment (LCA), which allows to evaluate the environmental impacts of a product, process, or service throughout its life cycle, from 'cradle to grave' (such as, from raw material extraction through manufacturing, use, and end-of-life disposal or recycling). The LCA process is typically carried out by (1) setting the goal and scope, (2) inventorying data on resource inputs (energy, materials) at each stage of product life cycle, (3) assessing the product's impacts, often expressing them in midpoint indicators[68] such as global warming potential (GWP), measured in CO2 equivalents, and (4) interpreting the results.

LCA results are often complex to interpret, as most conventional impact assessment methods report on many midpoint impact categories[69]. To produce results that are understandable and in line with policy makers' goals, we propose to select a limited number of impact categories, based on which impact categories are most relevant to the domain of focus. Several existing methodologies and references are available to do so (see Higg MSI tool or Quantis report), and previous work by Circle Economy will be used to align the selected impact areas with (CGR Textiles, CGR Quebec). The selected impact categories on which we present the general impact results for the material types are:

- **Global Warming Potential, expressed in kg CO2e/kg material**
    - The industry contributes almost 3.5% of global greenhouse gas (GHG) emissions linked to climate change, with material production, including fabric and trim manufacturing and finishing, accounting for 55% of the industry's GHG emissions, largely due to energy-intensive wet processing.

[68] Midpoint indicators measure environmental impacts in specific categories, such as climate change (GWP), ozone depletion, resource depletion, and others. Midpoint indicators are useful for assessing the relative contribution of different stages of a product's life cycle to specific environmental issues. The midpoint method looks at the environmental impact earlier along the cause-effect chain before the endpoint is reached. For example, the midpoint method might look at the global warming impact, which later on may relate to different endpoint impacts, such as damage to human health or ecosystems.

[69] The ReCiPe midpoint method, for instance, presents results for 18 midpoint categories.

- **Energy Use, expressed in non-renewable energy consumption MJ/kg material**
    - As expressed above, various steps of the textiles value chain, in particular fibre production, and product manufacturing and finishing are quite energy-intensive, and to a large degree still rely on fossil energy sources.
- **Water consumption, in m3 water/kg material**
    - Additionally, the industry accounts for 3.5% of the total water scarcity impact caused by all global manufacturing activities, often operating in regions already facing water shortages. Factors such as geographical constraints, population growth, and competing industrial and domestic demands worsen water scarcity. The dyeing and finishing stages of the textile value chain are especially water-intensive, consuming approximately 93 billion cubic metres of water annually (Circle Economy, 2024).
- **Land use change, m2a crop/kg material, and microplastics emissions**
    - Land use change concerns the clearing of native vegetation to establish new agricultural grounds, for example for the production of cotton. Such changes lead to various interlinked environmental issues, such as increased GHG emissions through soil degradation and biodiversity loss. Cotton is also linked to deforestation (Solidaridad, 2023).
        - For synthetic materials, land use change issues are less material, but emissions from microplastics become relevant. While research to include quantifiable midpoint-indicator results for microplastics in the LCA method is very new (TNO, 2024), it is clear that the textile industry significantly contributes to microplastic pollution through materials and embellishments used in garments, such as prints, coatings, buttons, and glitter. Synthetic plastics, including those in textiles, take decades to degrade, particularly in marine environments (Circle Economy, 2024).
    - **Marine and freshwater eutrophication, in kg P and N/kg material**
        - Textiles contribute to over 5% of marine eutrophication and over 4% of global freshwater eutrophication, primarily due to fertilizer runoff from cotton farming and the chemicals used in dyeing processes (Circle Economy, 2024).

The impact factors for 1 kg of each fibre type for the different impact categories mentioned above were retrieved using the LCA software SimaPro and the ecoinvent database. For all impact indicators, the ReCiPe 2016 midpoint (H) method was used, except for Energy Use, for which the Cumulative Energy Demand V1.11 method was used. The impact factors are summarised in Table 2 below.

Impact Categories per kg of fibre	Global Warming Potential (kg CO2e/kg)	Energy Use (non-renewable, fossil, MJ/kg)	Water Consumption (m3/kg)	Land Use (m2a crop eq/kg)	Freshwater eutrophication (kg P eq/kg)	Marine eutrophication (kg N eq/kg)
Cotton	12	111	5.52	7.32	0.0093	0.0534
Polyester	5.78	104	0.0389	0.201	0.002	0.000276
Polyamide	9.82	114	0.069	0.00199	0.000294	0.000313
Wool	52.2	N/A	0.851	58.2	0.0126	0.0443
Polypropylene	3.15	87.2	0.011	0.0371	0.000711	0.0000615
Viscose	3.33	36.4	0.0636	0.996	0.00132	0.000123
Acrylic	3.73	81.2	0.0469	0.0342	0.00111	0.00315
Other fibres	N/A	N/A	N/A	N/A	N/A	N/A
Non-textile material	N/A	N/A	N/A	N/A	N/A	N/A

Table 2: Summary of environmental impact factors per kg of textile fibre, per type of textile fibre

Step 2: Identifying the relevant MFA data

The collected MFA data contains estimated textile flows for each region. Several stages of the textile value chain are included, from fibre production, textile manufacturing, distribution, and retail to repair/rental/secondhand and, finally, waste management. The granularity of this MFA data—i.e., its availability for different value chain stages—allows quantifying textile flows that are most relevant to Grenoble. To combine MFA results with the life cycle impact assessment, we decided to use the post-consumer stage as a reference value chain step, therefore the baseline environmental impact factors are multiplied by the total amount of textile waste collected (in mass), which in Grenoble amounts to a total of 4.2 thousand tonnes (all considered as local post-consumer textile waste).

Step 3: Approximate composition of textile flows

Virtually no country-level information is available on the composition of textiles. Often, estimations are complicated by different definitions and scopes. Several reports and studies conducted in recent years present different estimations of the composition of textiles in Europe, distinguishing between production, import, and exports of fibres, yarn and textile products. A common finding is that there seems to be a relatively large uncertainty with regards to the exact composition of textiles at these stages (Köhler et al. 2021),[70] possibly due to the fact that textile products are made of blends of different fibres. In recent research by Circle Economy for the JRC[71], 18 tonnes of textile waste across 3 countries (Czech

[70] More than 50 % of production, imports and exports of fabrics are undefined with respect to fibre composition.

[71] BAKOWSKA, O., MORA, I., WALSH, S., VAN DUIJN, H., NOVAK, M., CHERUBINI, G., JOSHI, R., MORBIATO, A., VISILEANU, E., VESELÁ, A., RYŠAVÁ, E. and HOLICKY, M., Fate and Composition of Textile Waste from Italy, the Czech Republic and Romania, HUYGENS, D. editor(s), Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/3332076, JRC141441.

Republic, Romania and Italy) were sampled, it was found that 28.7% consisted of "other blends", with many other composition categories also consisting of textile blends (such as 80-99% Cotton and 40-95% Polyester).

Despite these limitations, the decision was made to use recent data presented in the JRC report by Huygens et al. 2023, as it appeared to be the most robust fibre composition estimation available at the time of the assessment, and it was required to establish a baseline composition estimation. The composition breakdown and absolute figures for Grenoble are summarised in Table 3 below, and cover over 82% of all post-consumer textile waste collected (in mass), and at least 90% of all fibre types used in the production of textile products used in the EU.[72]

Fiber type	Fibre composition of new products	Fibre composition of post-consumer waste	Breakdown of textile waste by type of fibre in Grenoble (in tonnes)
Cotton	33.3%	33.7%	1,415
Polyester	29.3%	29%	1,218
Polyamide	7.3%	7.1%	298
Wool	3.9%	3.9%	164
Polypropylene	3.1%	3.2%	134
Viscose	3.1%	3.1%	130
Acrylic	2.8%	2.7%	113
Other fibres	6%	5.9%	248
Non-textile material	11%	11.5%	483

Table 3: Summary of the fibre composition in post-consumer textile waste in Grenoble

4.5.2. Results

Step 4: Estimation of environmental impacts in Grenoble

To produce quantitative results, the MFA data (tons of textile flows) for post-consumer textile waste in Grenoble will be used as reference mass inputs to the LCIA, providing insights into the life-cycle impacts of the textile flows relevant to the End-of-Life stage. The reason for selecting this particular stage (instead of production, manufacturing or textiles put on the market) is to be able to conduct some scenarios regarding different post-

[72] The fibre composition of pre and post-consumer textile waste in the EU is assumed to be representative for the fibre composition in Grenoble

consumer textile treatments and fates (repair, reuse, recycling, etc.) at a later stage of the project.[73]

The preliminary results of the baseline environmental impact assessment of post-consumer textile flows in Grenoble are summarised in Table 4 below. Note that "other fibres" and "non-textile material" are missing more granular information to estimate their respective contributions to different environmental impacts, which is why they were left out of the baseline calculation.

Impact by fibre	Global Warming Potential (kt CO2e)	Energy Use (non-renewable, fossil, GWh)	Water Consumption (hm3)	Land Use (hectares crop eq)	Freshwater eutrophication (tonnes P eq)	Marine eutrophication (tonnes N eq)
Cotton	16.98	43.64	7.81	1036.07	13.16	75.58
Polyester	7.04	35.19	0.05	24.48	2.44	0.34
Polyamide	2.93	9.44	0.02	0.06	0.09	0.09
Wool	8.55	NA	0.14	953.32	2.06	7.26
Polypropylene	0.42	3.26	0.00	0.50	0.10	0.01
Viscose	0.43	1.32	0.01	12.97	0.17	0.02
Acrylic	0.42	2.56	0.01	0.39	0.13	0.36
Other fibres	NA	NA	NA	NA	NA	NA
Non-textile material	NA	NA	NA	NA	NA	NA
Total	**36.78**	**95.40**	**8.04**	**2028**	**18.14**	**83.65**

Table 4: Baseline environmental impact assessment of post-consumer textile flows in Grenoble

While the table above provides quantitative estimates of the life-cycle footprint of different textile fibres, it is worth reviewing what the scientific literature tells us about key environmental hotspots across the textile value chain.

The largest sources of impact occur at the earlier stages of the value chain.[74] [75]

[73] An example of this type of result: based on the literature review and LCA, it is estimated that the secondhand activities in Grenoble would lead to a reduced consumption of new textiles products, reducing GHG emissions by X tons CO2e, water consumption by X m3, and land use by X m2a.

[74] InvestNL. (2024). Towards a Dutch Circular Textile Industry: Exploring the common thread. Retrieved from: InvestNL website

[75] Gözet, B., & Wilts, H. (2022). The circular economy as a new narrative for the textile industry: An analysis of the textile value chain with a focus on Germany's transformation to a circular economy (Zukunftsimpuls no. 23). Wuppertal Institute

- **Raw material extraction and production** is a major impact hotspot, especially for natural fibres like cotton and wool. At this stage, the main environmental impacts occur in the impact categories of land use and water consumption, but also in the form of pollution like eutrophication due to irrigation runoff and pesticide use. For synthetic fibres, this stage is also an important contributor to fossil fuel extraction and energy consumption (with important associated greenhouse gas emissions) during polymerization processes.
- **Fibre production and garment manufacturing** stages are one the largest sources of impact. At these stages, energy and chemical-intensive processes like spinning and dyeing contribute substantially to GHG emissions, eutrophication. Some waste is already generated at these stages, in particular during garment manufacturing, and is accounted for as "pre-consumer" waste in the MFAs.

Wholesale and retail are responsible for a smaller fraction of the environmental impacts, which at these stages consist mainly of energy consumption and associated emissions, mainly from transport, or during operational phases of retail (e.g. electricity consumption in stores).

Although the **consumption and product-use phases** are outside of the scope of the environmental impact results show in in the table above, it must be noted that, over the long run, they can be responsible for a significant share of water and energy use due to washing/drying processes, and also for the release of microplastics for synthetic fabrics.[76] It is also a step of the value chain which is characterised by short lifespans induced by fast-fashion, which therefore contributes to amplifying the absolute environmental impact of textiles production (as product turnover cycles occur more rapidly, leading to more demand for new products).

Finally, it appears that the environmental impacts associated with **textile waste End-of-Life processes** are relatively small compared to the full life cycle impacts of textiles (largely influenced by production and manufacturing processes).[77] However, due to the large volumes of textile waste and poor End-of-Life management systems, it remains crucial to find circular solutions, like reuse or repair, that aim at minimising new consumption (and therefore, new production).[78] This is the focus of the following step (*Step 5*).

Step 5: Impact reductions as a result of the to-be-implemented circular solutions (pilots)

In WP3, we will utilise the baseline environmental impact results as a reference to conduct a comprehensive Life Cycle Assessment (LCA)-based modelling of the estimated impact reductions that would result from the hypothetical changes in the value chain, tested in

[76] Huygens, D., Foschi, J., Caro, D., Caldeira, C., Faraca, G., Foster, G., ... & Tonini, D. (2023). *Techno-scientific assessment of the management options for used and waste textiles in the European Union: JRC Science for Policy Report*. Publications Office of the European Union.

[77] InvestNL. (2024). Towards a Dutch Circular Textile Industry: Exploring the common thread. Retrieved from: InvestNL website

[78] EuRIC (2023). LCA-based assessment of the management of European used textiles. Retrieved from: EuRIC website

Grenoble's selected pilot project. This analysis will focus on either of the following R-strategies:

- **Refuse:** Refusing unnecessary consumption is arguably the most effective strategy for reducing environmental impacts. However, this approach involves complex considerations, such as Rebound effects (e.g. reduced consumption may lead to increased spending in other areas), or behavioural change challenges in shifting consumer habits.
- **Reuse**: Reuse strategies offer significant potential for impact reduction, but assessing their true additionality is challenging. As highlighted in a CE Delft report:[79] "It is very uncertain how much less new textiles consumers will buy if they buy more second-hand.
- **Repair**: Extending product lifespans through repair can substantially reduce environmental impacts by delaying the need for new product manufacturing.
- **(Optional) Recycling and other End-of-Life treatment:** While not a primary focus of the pilots, our analysis may touch upon recycling and end-of-life strategies. For instance, we will consider how these approaches can help avoid high-impact disposal methods like incineration, potentially leading to significant environmental benefits.

Work Package 3 will aim to provide quantitative assessments and detailed analyses of these strategies, offering valuable insights into their potential for reducing environmental impacts across various product lifecycles.

5. Key findings and recommendations

Grenoble's textile industry is known for its focus on developing smart textiles, technical fibers, and advanced manufacturing techniques, often linked to Grenoble's reputation as a center for research and technology. While traditional textile manufacturing has declined, the industry now thrives through collaborations with universities and research institutions, contributing to Grenoble's position as a hub for technological innovation in the textile sector.

1. Consumption

Average fashion spending in France has dropped post-COVID to €430 per household annually, falling below the EU average of €490.[80] Grenoble Metropole hosts a wide spectrum of consumer profiles, from low-income residents prioritising affordability to higher-income groups seeking ethical, local products. Yet social norms, fast fashion availability, and cultural resistance still hinder widespread adoption of sustainable consumption habits.

[79] https://open.overheid.nl/documenten/ronl-e02e486cdb962a2280987b7f5456c0ab94c4b3da/pdf

[80] https://fashionunited.com/statistics/global-fashion-industry-statistics/france

Recommendations:

- Launch tailored communication strategies that address specific barriers across income, age, and demographic groups.
- Expand access to affordable and attractive circular options, such as rental, second-hand, and repair services.
- Foster community-driven initiatives—like workshops, swap events, and vintage sales—in multifunctional hubs to encourage behaviour change through hands-on engagement.
- Provide tailored coaching and awareness-raising programmes to help local businesses transition to circular services and adopt sustainable materials at scale, while maintaining or increasing competitiveness.

2. Waste collection and infrastructure

Grenoble Metropole collects one-third of its textile waste separately—a rate significantly above the EU average (15%) and just below the French national average (39%[81]). The remainder is disposed of in mixed waste, and consequently incinerated with energy recovery. This achievement is driven by a diverse and accessible collection network. However, the circular potential of these collected textiles remains largely untapped locally. Most post-consumer textiles are exported beyond the metropole—and often beyond France—for sorting, recycling, or disposal, limiting local value creation and transparency over downstream impacts.

Recommendations:

- Integrate the needs of local collectors and sorters—many of which are social enterprises—into ongoing reforms of the Extended Producer Responsibility (EPR) system.
- Strengthen the traceability of textile waste flows to assess the environmental and economic impacts of exports and identify opportunities for local value capture.
- Support public education efforts to improve disposal habits among new generations, using locally appropriate languages and communication channels.
- Improve access to capital investment for circular businesses and service providers.
- Advocate for favourable tax, trade, and policy incentives to give circular service providers a competitive advantage over linear models and competing EU textile regions.

3. Public awareness of circular services

Circular service providers are highly centralised in and around the city of Grenoble, leaving northern and southern communes underserved. While 95% of residents can reach all key circular service points (reuse, recycle, repair) within a 10-minute drive, only 39% can access

[81] https://www.cbi.eu/market-information/apparel/recycled-fashion/market-potential

the same within a 10-minute walk—highlighting a dependency on car travel for equitable access.

Recommendations:

- Promote broad education and awareness-raising efforts towards general public, youth, as well as industry and marketing professionals, alongside public-private support, to encourage lower textile consumption—arguably the most effective way to reduce environmental impact.
- Expand service coverage to peripheral communes through decentralised infrastructure such as mobile collection units and micro-hubs.
- Prioritise walkable, localised access to reuse, repair, and recycling services to reduce transport barriers and improve engagement.
- Create community spaces where residents can resell, reuse or repair textiles, promoting skill-building and sustainability. In order to design them, a design-thinking led process[82] can be applied including outreach to service users and service providers, including surveys and polls on diverse platforms that enable deepening the understanding of specific and localised habits, words, values and practices that make repair in Grenoble unique and essential part of the ecosystem.
- Learn from existing best practice in piloting community led repair projects, that build on human-centered design[83].

4. Employment and labour dynamics

Wholesale and retail sectors account for two-thirds of all textile-related jobs in Grenoble Metropole, yet second-hand retail comprises only 11% of these, highlighting an underdeveloped circular economy. Meanwhile, limited employment data for manufacturing, repair/upcycling, and waste management obstructs effective planning for circular transition strategies. Notably, reported 'use and repair' jobs are dominated by laundry services, which have minimal circular impact, while textile waste-related employment is constrained by the absence of local recycling activities.

Recommendations:

- Develop robust employment data tracking across circular segments—repair, upcycling, waste management—to inform future workforce and upskilling strategies.
- Support genuine circular employment opportunities through training and incentives, especially in reuse, repair, and local processing.

[82] To access The Circular Toolbox that guides users through a tried and tested circular innovation process and provides the resources you'll need along the way towards the launch of a circular business model that is financially competitive, impact-driven and delights and engages the user. Access here: link

[83] Innovate UK (2025) Next Door Repairs in Hackney. Access here

- Invest in regional recycling infrastructure to unlock job creation potential and reduce dependence on external treatment systems.

5. Reducing environmental impact

Refusing unnecessary textile consumption remains the most effective strategy to reduce environmental impact. While the environmental burden of textiles varies widely by material and impact category—and some, like microplastics, are not yet fully accounted for—early estimates place the climate impact of Grenoble's post-consumer textile flows at 37 thousand tonnes of CO2e annually.

Recommendation:

- Maximise adoption of R-strategies (refuse, reduce, reuse, repair, recycle) through infrastructure, education, and incentive mechanisms to meaningfully cut emissions and reduce the city's textile footprint.

These considerations will guide the effective design and rollout of circular textile 4R pilots, ensuring that they meet the needs of Grenoble's diverse communities and drive progress towards a more sustainable, circular textile economy.

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