

Post-Consumer Textile Recycling: Challenges and Opportunities, Northern Periphery and Arctic Communities' Perspective

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Abstract – The study explores the circularity of textiles with a focus on reuse and recycling within the Northern Periphery and Arctic (NPA) communities. With a need to delimit the study, the Northern regions of Finland, Norway, Sweden, and Ireland were chosen as the areas of focus due to their proximity to one another and their shared demographical and geographical characteristics. As a result of the conducted research, the current textile waste recycling landscape in the NPA within the public sectors of the regions and technologies that would be commercially viable for the areas were identified and discussed. The current recycling landscape among the regions highlights the challenges the industry faces, the factors to consider when choosing a potentially viable textile waste recycling technology, and the current stance and updates regarding the Extended Producers Responsibility on textiles. Based on this data, the researchers suggest that mechanical recycling technologies would technically be suitable for the areas, but due to the lower-than-average textile waste volume generated per area, it may be recommended to have a shared or centralized recycling facility for these northern regions.

Keywords: textile collection, textile sorting, textile waste recycling, circularity of textile

1. Introduction

Textiles are fundamental materials in our society due to their wide range of use. In Europe, it is estimated that an average individual purchases 26 kg of textile [1] and throws away 12 kg of textiles every year [2]. Hence, the European Union (EU) set various strategies and regulations for sustainable and circular textiles. Some of these strategies include setting design requirements for producers, restricting the export of textile waste, and incentivizing circular business models [3]. This is in line with the 2018 EU directive set that by 2025, EU member states must separately collect at least 50% of textile waste as a measure of high-quality recycling [4]. There are no fine or penalties in place should a member state fail to adhere to the directive on time. Instead, extended deadlines are provided with respective targets to meet in case these extensions are used [5].

One of the most compelling reasons for these plans and actions is because textiles have the fourth highest impact on the environment and climate change in Europe [6]. In fact, consumers' improper handling of discarded textiles accounts for approximately 85% of textile waste [7]. Hence, consumers themselves demand sustainability in the textile industry [8]. An approach toward circular textiles involves the management of textile waste, an area that is still in its early stages of research [9]. As a result, within this study, specific attention was dedicated to examining this subset of textile waste management – recycling.

This study explores the current landscape of recycling technologies in the textile industry and the state of textile waste recycling within the public sectors of Northern Finland, Norway, Sweden, and Ireland. As an output, the research aims to contribute to textile waste management and development in NPA region.

2. Methodology

Aside from existing literature, interviews with industry experts in the NPA area serve as a mean to gather data. This qualitative research method aids in exploring the current practices, challenges, and potentials of the recycling landscape within the public sector, specifically, within the municipalities of the NPA area. Subsequently, following the identification of the best available technologies (BAT), analysis of their maturity level, and interviews with the experts, the available alternative methods for textile recycling were considered from the perspective of regional challenges. A conceptual framework illustrates the variables used in research and maps out how they interconnect to form cohesive conclusions [10].

In this research, the framework outlines the variables such as the textile waste recycling technologies, employing the BAT and the Technology Readiness Level (TRL) scale. The BAT serves as a representation of the technological solutions available for textile waste recycling, and the TRL serves as a scale of measurement to evaluate the development stages of the technologies. The framework establishes the borders for the suitability of different technologies based on their readiness levels and effectiveness in addressing specific challenges.

3. Discussion

3.1. EU perspective

Generally, in the EU, 12.6 million tons of textile waste is generated [11]. As of 2023, approximately 22% of post-consumer textile waste is recycled [12]. Further, an estimate of only 1% of the collected waste is recycled fiber-to-fiber. Approximately 10% of these 22% are recycled via other technologies, and the remaining “recycled waste” is either reused or exported [13]. Annually, the EU exports 1.35-1.85 million metric tons of used textiles, mostly to Asian and African countries. These textiles are either processed locally in Asia for industrial use or re-exported to other African nations after sorting [14]. With these numbers, it is apparent that a huge percentage of 65-75% of textile waste is unaccounted for, regardless of if these were collected or not [13]. Therefore, the EU aims to improve the sustainability and circularity of textiles not just by recycling textile waste, but by enumerating the key actions that would address several issues in the value chain.

These initiatives include several key actions such as mandatory Ecodesign requirements, the limitations of the destruction and/or incineration of unsold textiles, the introduction of a Digital Product Passport for textiles. In relation to the latter, the key actions are the amendment of the Unfair Commercial Practices Directive and Consumer Rights Directive. Lastly is the proposal of a harmonized Extended Producer Responsibility (EPR) on textiles that aims to create a system supporting the collection, sorting, reuse, and recycling of textiles while motivating companies to design products that follow circular economy principles [3]. The scheme outlines that the producer’s responsibility would entail covering the costs associated with collecting textiles, shoes, and textile-related products for reuse or recycling. These schemes are expected to encompass transport, sorting, and support for research and development to enhance the efficiency of sorting and recycling processes. The impact assessment for these proposals, informed by stakeholder consultations and scientific input from the Joint Research Centre, emphasizes the need for concerted action within the textile value chain to prioritize reuse and fiber-to-fiber recycling.

3.2. Nordic countries

In the Nordic countries, there is minimal variation among the textile consumption per person per year [15]. In 2019, it was reported that textile consumption, at least for Finland, has remained consistent for the past 10 years (East Cham, 2019). Hence, if the same can be assumed for other Nordic countries, based on these values, it is apparent that textile consumption in the Nordics is significantly lower than the average European consumer’s 26 kg/year textile consumption. Although Nordic countries have a lower textile consumption rate than the general EU, this does not imply that there is no need for action to address textile consumption and waste for these countries. Hence, the Nordic Council of Ministers has mapped the initiatives in the countries to identify the next steps required. With a focus on collaborative projects from both public and private actors that aim to drive innovation across the entire textile sector towards a more circular approach, 148 projects were mapped [17].

This research was focused on collection, sorting, and specifically recycling in NPA region. The activities here include the collection and production of municipal best practices, exploring and discovering sorting techniques and recycling technologies, and running of pilot plants and processing facilities.

Northern Finland. In Finland, the goal is to become a carbon-neutral circular society by 2035. The EU waste directive mandates that the collection and segregation of textile should be started by 2025, but as a potential forerunner, Finland has officially started this movement at the start of 2023. Local networks have set up textile collecting and sorting facilities [3].

Since 2021, two companies have trailblazed the textile waste recycling movement and invested in end-of-life textile refinement facilities: Rester Oy and Lounais-Suomen Jätehuolto (LSJH). These are located in the Green Field Hub in Paimio in Southwestern Finland. Rester Oy processes end-of-life textiles from businesses while LSJH creates local solutions for households [18]. In August of 2023, LSJH is known to be selling its plant to Rester Oy [19].

Currently, LSJH, in cooperation with local municipalities around Finland, is developing a national end-of-life textile collection network. Pre-sorting is and should be completed before sending the collected textile to LSJH's refinement facilities. This helps avoid the unnecessary transport of textiles that are beyond recycling [20]. In 2022, 741 tons of textile have been received and treated nationally, among which, 300 tons of sorted textile materials have been sold (Pokela, 2023).

Simultaneously, LSJH is also planning to build what is supposed to be the Northern Europe's largest end-of-life textile recycling plant in Topinpuisto, Turku, Finland. However, its implementation is put on hold as discussions on Extended Producer Responsibility (EPR) continuously arise [21]. According to the OECD, EPR is a market-based tool that extends the manufacturer's responsibilities to various stages of the textile's life cycle, particularly the take-back, recovery, and final disposal. EPR is used to promote total life cycle environmental improvements of product systems. This financial obligation manifests itself as a charge that is included in the product's market price [22].

At the time of publication, there has been no decision yet regarding EPR. If the directive is implemented, there might not be a need for the large-scale end-of-life textile recycling plant as producers or companies may opt to manage their textile waste by sending them to countries that are willing to take these with the cheapest fees. In practice, these countries may be from Asia or Africa, which then act like dumpsites for textile waste. This possibility may wreck years of effort and research on waste management for textiles in Finland [21].

Northern Norway. Currently, there is no municipal collection system, and all textiles collected are donations to non-profits like Fretex and UFF. The textile consumption volume per capita for Norway stands out (22 kg) in comparison with other Nordic countries. The NORUS report states that in its original source, a wider scope of textile was used for Norway, hence, the value may not be directly comparable to that of others. Specific data on textile waste in Northern Norway is scarce. However, in 2021, NORSUS provided an overview of textile waste across Norway, which can generally be extrapolated to Northern Norway. They found that Norwegian consumers purchase about 15kg of new textiles per person per year, a figure that has remained stable over the last decade. With approximately 500,000 people living in Northern Norway, this translates to 7,500 tons of textile waste generated in the region annually. The NORSUS report (2023) further examines the disposal of textiles and the fate of those collected by non-profits. In 2019, Nordnorge constitutes about 9% of the entire Norwegian population [23], which may be similar to that of Finland's, as it has a smaller national population. Furthermore, the country has not also implemented EPR yet, but the clothing research group at Consumption Research Norway (SIFO) expresses their support for the EPR scheme [24].

According to the Nordic Council of Ministers (2023), Miljødirektoratet or the Norwegian Environment Agency recommends the implementation of the separate textile waste collection to start in 2025, which follows EU's mandates [17]. This will be a mandatory duty for municipalities to collect textiles. Currently, charities and private companies volunteer to collect reusable textile waste. Further, some municipalities have been collecting via a drop-off scheme both reusable and waste textiles for recycling. Nonetheless, Miljødirektoratet allows municipalities to decide between a pick-up or drop-off scheme to collect textile waste. To date, there is no reported volume of textile waste collected as there are no national procedures in place yet.

Northern Sweden. Textile waste management, collection, and recycling in Sweden have undergone significant transformations in recent years, driven by a combination of legislative changes, industry initiatives, and public awareness campaigns. Since the enactment of legislation on April 1, 2020, textile waste management has been firmly integrated into Sweden's legal framework, with only rare exceptions allowing for deviation from this mandate. This legal imperative underscores Sweden's commitment to foster sustainable waste management practices and safeguard the environment, assigning the responsibility for waste management squarely to the jurisdictions of individual municipalities.

Each local administrative body is tasked with formulating and executing comprehensive waste management strategies that correspond to the specific needs and resources of their respective communities, underscoring Sweden's decentralized approach to governance and environmental stewardship.

Comparably with northern Finland's, Norrland's population also constitutes to approximately 12% of the country's population. [25]. Sweden's estimated textile consumption per person per year does not appear immensely larger than Finland's – considering its national population to be almost twice that of Finland (15 kg). As for textile waste recycling, only 5% of collected waste is reported to be recycled. [26]

Since 2021, there are various sources indicating that Sweden will be implementing the EPR by January of 2022, although companies and Producer Responsibility Organizations' (PROs) obligations would primarily start in January of 2024 [27]. As explained above, this would mean extended textile waste management responsibilities for producers and private companies. Hence, a large-scale recycling facility that would need expansive recycling technologies would not be essential. Still, the need for feasible and appropriate recycling technologies remains and could still provide substantial information for those responsible for textile waste management, on either a larger or smaller scale.

Similarly based on the Nordic Council of Ministers (2023), it explains that the EPR has been suggested but the implementation was on hold at the time of writing. Under the ambit of the EPR framework, which is being progressively phased in over a series of years commencing in January 2024, producers are obligated to ensure that a 90% of textile waste is gathered and repurposed by the year 2028. This target serves as a testament to Sweden's dedication to curbing waste production and propelling the principles of a circular economy, wherein resources are efficiently utilized, and waste generation is minimized through recycling and reuse initiatives.

As for waste and reusable textile collections, there are municipalities who already collect and sort and there are also charities and private companies who collect reusable textiles in a separate stream. No official data has been reported yet regarding the volume of textile waste collected.

Ireland. According to the Community Resources Network Ireland, about 68 ktonnes of textiles are discarded every year by householders and commercial users. Ireland is one of the biggest per capita consumers of textiles in Europe. Per capita generation of post-consumer textiles in Ireland is estimated at 35 kg per person per year, which is higher than the reported EU average of 26 kg per person per year (Environment Protection Agency, 2021). Per capita consumption of new textiles is estimated at 53 kg per person per year. Moreover, an increase in textile consumption is projected in the future. Thus, in 2019 over 300 ktonnes of textiles was consumed in Ireland alone. The largest source of post-consumer textiles is the household bin, with approximately 64 ktonnes per year, of which around 42 ktonnes are clothing. Commercial textile recyclers collect an estimated 40 ktonnes per year through textile banks, community, and club collections. The Irish charity sector collects an estimated 17,500 tonnes per year, with around 8,5 ktonnes sold in charity shops and 9,000 tonnes sold to commercial textile recyclers for export or recycling. Approximately 18 ktonnes per year of post-consumer textiles come from the non-domestic sector, including commercial and industrial facilities via kerbside waste collections. Other sources of post-consumer textiles include textile packaging waste, vintage and online sales, the textile industry sector, and litter.

3.3. Mutual Needs

Although these areas are known to have sparse populations, as seen above, the population within the northern regions of Finland, Sweden, and Norway varies. Moreover, the population in Ireland is significantly different from other NPA countries. The biggest commonality among Finland, Sweden and Norway is the geographical conditions that are mostly characterized by the Arctic climate.

The most apparent effect of these areas' similar geographical conditions – specifically weather – is that textiles, especially clothing, that inhabitants dispose of may have similar compositions. It is also essential to remember that textile waste recycling relies on initial stages or processes such as waste collection, sorting, and delivery to recycling facilities. Possibly the biggest impact would be the need for specialized equipment and additional materials that deplete natural resources faster. From a business perspective, these specialized assets would mean greater costs. Harsh weather conditions such as extreme winters in these areas would entail the need for heating systems in waste collection, sorting, and recycling facilities, and may impact the quality of textiles that can lead to faster degradation.

Furthermore, according to McKinsey and Company (2022), generally, the European textile recycling industry would require 6-7 billion EUR to invest in collection sites, sorting, and recycling facilities. Based on their analysis,

profit would be generated for every step of the value chain, if recycled products have the same quality as virgin materials. However, this investment decision remains unclear due to the proposal of the EPR which will affect the entire textile waste management industry. There is an apparent need to identify suitable and commercially viable textile waste recycling technologies applicable to the NPA region.

4. Conclusion

The average European consumer disposes 12 kilograms of textiles every year. The European Union set out a directive that textiles should be collected separately by 2025; with the urgency stemming from the growing amount of textile waste and ranking fourth in environmental impact in Europe.

Research on the circularity of textiles and the textile waste management industry is still considered to be in its early stages. This research has been conducted as part of the preparation of the regular project proposal, aimed at developing sustainable practices in textile consumption and waste management in the NPA region.

The evolving textile waste management sector significantly depends on the specifics of the Extended Producer Responsibility (EPR) and its implementation. The outcome of this policy framework will undoubtedly shape the trajectory of waste management strategies in the coming years. Furthermore, the imminent implementation of the EU waste directive for collecting textile waste next year (2025) introduces a crucial turning point. As the actual volume of textile waste collected for each area will be reported, it will open avenues for further research and a more precise analysis. This forthcoming data will enable a deeper understanding of the local dynamics, facilitating informed decisions, and targeted interventions to optimize waste management practices not just in the NPA region, but for all EU member states.

The research reveals that reduction of textile consumption and fostering consumers' behaviour change shall be the focus areas in promoting sustainability and circularity in the textile sector. Developing business models involving textile reuse, repair, repurpose could be the first steps towards the transition to the sustainable textile sector.

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