

# Textiles – from waste to resource by 2030

A sector report from the IVA project  
Resource Effectiveness and the  
Circular Economy (ReCE)

THEME :  
CLIMATE-RESOURCES

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# Contents

<b>Foreword</b>	4
<b>The subproject's summarised conclusions</b>	8
Design for sustainability, resource effectiveness and circularity	9
Business models based on sustainability, resource effectiveness and circularity	10
Recycling and industrial symbiosis to create the conditions for sustainability, resource effectiveness and circularity	11
Innovative environments that support development of sustainability, resource effectiveness and circularity	12
The role of the financial sector	12
<b>The subproject's vision and objective</b>	14
<b>Analysis of the subproject's focus area</b>	20
<b>Design</b>	28
<b>Business models</b>	34
Business models for resource effectiveness and circularity	35
What needs to happen in the public sector	40
<b>Recycling and industrial symbiosis</b>	42
Recycling and synergies to close the cycle	44
Business models	44
Innovation	45
Synergies	45
<b>Innovative environments</b>	48
Innovative environments that support resource effectiveness and circularity	50
Business models	51
<b>The financial sector</b>	52
<b>Appendix: Action plans</b>	58
Design for sustainability	59
Business models based on sustainability, resource effectiveness and circularity	60
Recycling and industrial symbiosis	61
Innovative environments	64
<b>References</b>	66



## **Foreword: Resource Effectiveness and the Circular Economy**

»The purpose of the project is to strengthen Sweden's competitiveness in a future with finite resources in line with the UN's Sustainable Development Goals.«

The Royal Swedish Academy of Engineering Sciences' project *Resource Effectiveness and the Circular Economy* has assembled more than 50 companies, organisations and public authorities around the **vision** of Sweden being the leading nation as a resource-effective, circular society. The **purpose** is to strengthen Sweden's competitiveness in a future with finite resources in line with the UN's Sustainable Development Goals.

The project's **goals** are: to create a platform for resource effectiveness and circularity; to draw conclusions on Sweden's resource options in public policy, research and industry based on initiatives that are under way, and to create collaboration and forward motion.

*Resource Effectiveness and the Circular Economy* builds on the IVA project *Resource Efficient Business Models – Greater Competitiveness* from 2014–2016. That project presented the significant potential that exists to make society considerably more resource efficient and to generate new commercial opportunities and business models. It defined five material flows (biomass from wood, steel, concrete, food and textiles) to show where flows are “leaking” and thus where commercial opportunities exist through more effective resource management.

This project continues the work of the previous one, using the same sector breakdown and exploring the commercial opportunities that were identified. It is divided into five subprojects: mobility, facilities, food, textiles and plastics. This report will present analysis and observations from the Mobility subproject. The most important conclusions from all of the subprojects will be compiled and presented as the project's recommendations for a broader societal transformation in a joint synthesis report.

The five subprojects have gathered representatives from the entire value chain to participate in individual work groups. They come from the private and public sectors and from the research community. IVA's work is based on a scientific approach and draws from relevant research,

but also involves critical analysis of other issues of relevance. Source references are included where appropriate. The project's results come out of an intense programme of workshops and work group meetings involving a large number of people.

The reason for this initiative from IVA is that resource effectiveness and circularity are both crucial for a future with greater global prosperity. One particularly important aspect is ensuring that we successfully improve efficiency in material management and advance material development. To support this, we also need to design new business models and identify commercial opportunities that will stay relevant many years into the future, meet the UN's Sustainable Development Goals and allow us to remain within the planetary boundaries.

We need sustainable systems that can deliver resources to meet the real needs of society. To achieve this we need a long-term system perspective and an overall understanding of, and system of managing, society's resource flows. We need to take a holistic approach in which all aspects in the production chain are included – from material extraction and raw materials, the design phase, manufacturing, business models and financing, through the user phase to the recycler and back to a new producer. This requires cooperation between all actors, as well as clear rules to create the right incentives and market conditions. We also need to accelerate, and better understand the benefits of, digitalisation, innovation and new business models that focus on resource effectiveness.

A lot is already happening – both internationally and around Sweden – with numerous initiatives and projects examining how resource effectiveness and circularity can be introduced in various sectors. But there is no unifying arena to show the need for a systemic change and where different perspectives can come together. IVA believes that a platform for cooperation between the private sector, the research community, the political sphere and the public sector is essential in order to achieve a resource-effective

and circular society. Actors within such a platform are also the project's overall **target group**.

*Resource Effectiveness and the Circular Economy* was launched at the beginning of 2018 and will continue until mid-2020.

## The project's definition of resource effectiveness and the circular economy

Resource effectiveness<sup>1</sup> and circular economy<sup>2</sup> are two distinct concepts under the same umbrella. A measure that supports the circular economy often also supports resource effectiveness. In this project we regard resource use within the planetary boundaries as the overarching goal. In order to manage any conflicting objectives in future development it is important for there to be clarity and an understanding of systems.

The primary focus of this report is more effective management of the value of society's and nature's resources beyond, for example, mere volumes or mass. Unless otherwise stated, this also includes the concept of a circular economy. In cases where conflicting objectives between the concepts are identified, they are described.

Geissdoerfer et al, for example, define circular economy below mainly in terms of the circulation of materials:

*A regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.*<sup>3</sup>

The project's premise is that resource effectiveness takes priority over the circulation of materials. We believe that it is important to include the user phase in the definition – not just the production phase; to include business models and services – not just physical products:

*A performance economy goes a step further by selling goods (or molecules) as services through rent, lease and share business models. ... In addition to design and reuse, the performance economy focuses on solutions instead of products, and makes its profits from sufficiency, such as waste prevention.*<sup>4</sup>

The project believes that this perspective is missing in some circular economy definitions, even if it is sometimes considered an implicit aspect. One example is the average car which is parked 95 percent of the time. We do not improve the efficient use of resources by merely recirculating the materials the car is made from – no matter how good we get at it. The effective use of resources ("resource effectiveness" = using resources as efficiently as possible while also avoiding negative environmental impact) must be improved.

As Florian Lüdeke-Freund et al. wrote in their article entitled "A review and typology of circular economy business model patterns":

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1 *Europa 2020 – A strategy for smart, sustainable and inclusive growth COM (2010)*, and *A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy COM (2011)*. There is unfortunately no actual definition of resource effectiveness.

2 Kirchherr, J., Reike, D., Hekkert, M., 2017, "Conceptualizing the circular economy: An analysis of 114 definitions", in *Resources, Conservation and Recycling* 127, pp. 221–232.

3 Geissdoerfer, M., Savaget, P., Bocken, N. and Hultink, E., 2017, "The circular economy – A new sustainability paradigm?" in *Journal of Cleaner Production* 143 (1), p. 759.

4 Stahel, W., "The circular economy", 23 Mars 2016, in *Nature* 531, pp. 435–438 (<https://www.nature.com/news/the-circular-economy-1.19594>; accessed 10 December 2019).



*The circular economy may not be a final goal, but rather part of an ongoing process to achieve greater resource efficiency and effectiveness.<sup>5</sup>*

This is a theory the project is happy to endorse.

For the project:

**Åke Svensson**, Chair

**Caroline Ankarcrona**, Project Manager

**Jan Nordling**, Project Manager

## Textiles work group

Chair: **Cecilia Tall**, TEKO

Project Manager: **Elin Larsson**, Elco

Project Manager: **Caroline Hofvenstam**, About Future

**Maria Sandow**, Swedish Trade Federation

**Yvonne Augustsson**, Swedish Environmental Protection Agency

**Gunnela Hahn**, Church of Sweden

**Maria Ström**, Wargön Innovation

**Åsa Östlund**, RISE

**Jonas Aspling**, RISE

**Lisa Schwartz Bour**, RISE

**Susanne Nejderås**, Smart Textiles,  
Swedish School of Textiles

**Lena-Marie Jensen**, Smart Textiles,  
Swedish School of Textiles

**Anett Aldman**, Smart Textiles, Swedish School of Textiles

**Adrian Zethraeus**, Smart Textiles,  
Swedish School of Textiles

**Jonas Larsson**, Swedish School of Textiles

**Felicia Reuterswaerd**, H&M

**Harald Cavalli-Björkman**, Re:Newcell

**Gustav Hedström**, Houdini

**Rickard Lindqvist**, Atacac

**Eva Karlsson**, Houdini

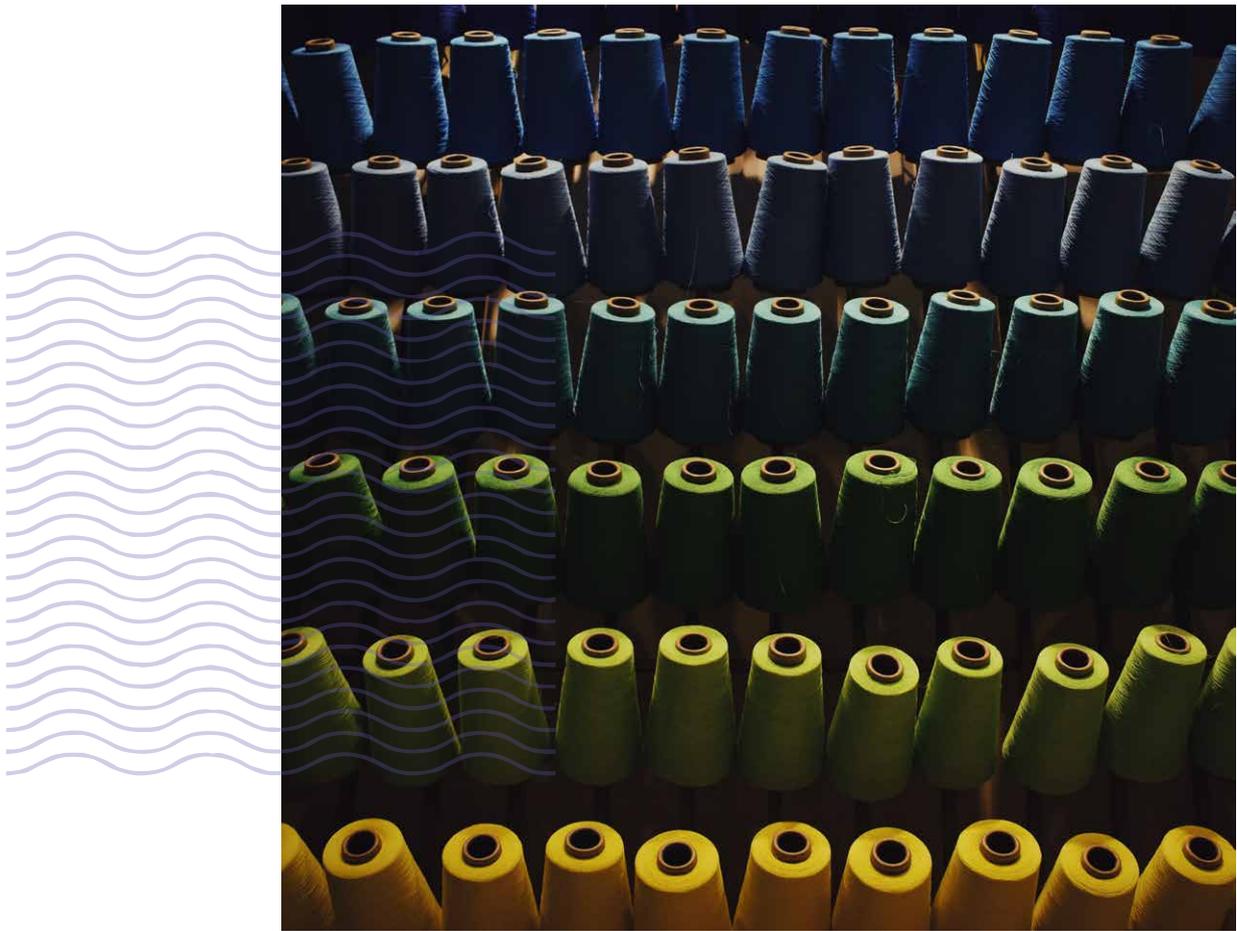
**Eliina Brinkberg**, Nudie Jeans

**Sigrid Barnekow**, TreeToTextile (formerly Mistra Future Fashion)

**Annica Karlsson**, IKEA

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<sup>5</sup> Lüdeke Freund, F., Gold, S. and Bocken, N., 2018, "A Review and Typology of Circular Economy Business Model Patterns", in *Journal of Industrial Ecology*, Volume 23, Issue1, February 2019, pp. 36-61.



## The subproject's summarised conclusions

»To bring about the transformation we want to see, we need to rethink, redesign and rebuild many of our processes and structures in everything from design, materials, production and business models to traceability, investments and control mechanisms.«

The members of the work group have worked together during the course of the project to prepare proposals and action plans. Project management has then reviewed these materials and produced final versions of the proposals and action plans for submission to appropriate bodies that have a mandate to implement them. It is of utmost importance for the Government to be a participant in this process in order to provide the best possible support to the work being done to make *Sweden the leading nation for a value-creating textile industry that is sustainable, resource-effective, circular and profitable* (the project's vision). Among other things, it is vital for the Government, as well as the financial sector, to find effective financing solutions for enterprises that support development, investments and upscaling.

It is important to go beyond individual initiatives and ensure that sustainability, circularity and resource effectiveness are natural aspects of business and behaviour. These aspects therefore need to be elevated to the highest level in all parts of society and in particular in boards and executive management in the private sector. Public policy has a role to play here as it can establish rules for new arenas, which companies must comply with. A Swedish circular strategy that also addresses commercial opportunities and sustainable growth is therefore a top priority in order to encourage all actors to join in the transition.

## Design for sustainability, resource effectiveness and circularity

There are several parts of this sector's ecosystem that need to be reviewed and renewed in order to close the textile cy-

cle. To bring about transformative change, designing for a sustainable value chain should be required. Traceability is needed throughout the value chain in order to monitor this. Information and traceability are important components to bring about circular flows. With the help of platforms etc. we can create general standards to ensure that information is comparable and validated.

### Design

- Companies and researchers need to produce design strategies that encourage the production of sustainable products for sustainable use that can easily be recirculated.
- Methods and tools based on life cycle data need to be developed to provide better support for circular design. Clothes and textiles need to be adapted as early as the design phase so that they can be recirculated, i.e. reused and recycled.

### Education

- Develop education and training programmes for companies and the public sector to enable them to make better decisions, create better standards and make better purchases.
- Clear communication to the public is also an important aspect to create awareness and thus impact purchasing behaviour.

## Policies and regulations

- A clear definition and an international standard will be needed for sustainable textiles and circularity to ensure we have a common framework.
- The industry needs to develop a national framework for how different materials and products are to be managed in the final phase of the life cycle.
- Information and traceability are important components in bringing about circular flows. They create consumer understanding and “price understanding”, and put a premium on better products.
- Customers should have access to relevant information at the time of purchase. This could potentially be regulated by legislation and for this, a common labelling system is required.
- Manufacturing new products using recycled materials should be rewarded through, for example, tax relief. Economic mechanisms could be used to increase supply and demand for materials based on residual flows.
- European chemical legislation should be reviewed to guarantee reliable circular flows.

Users are playing an important role in the transition that is needed but in order for customers to change their behaviours, support is needed from both the private and public sectors. We have therefore conducted an extra study to look more closely at what is needed to promote changed consumer behaviour. The study “Sustainability in textiles from a consumer perspective” was carried out by Mistra Future Fashion and Rise.

## Business models based on sustainability, resource effectiveness and circularity

New business models are needed to stimulate sustainable and circular products and services. Companies would be able to earn money from a function or service instead of the physical attributes of a product. New solutions and new technology can help to support the system transformation

that needs to happen. Through economic incentives and legislation, the Government can drive development in the right direction.

## Business models

- New business models based on sustainable circular products and that offer customers the opportunity to update their wardrobe in a more sustainable way, through reuse, renting, subscription, re-design etc.
- Buying precision, i.e. not producing more than is needed or will sell, will play an important role and could be facilitated through digitalised and faster production using AI through automation, on-site production and better forecasting, as well as slower purchasing processes that are based on customised solutions and pre-orders.

## Innovation

- If more local production options were established this would allow potential new business models involving updating and redesigning clothes to be used.
- Increasing customisation and the digital shopping experience will be crucial to reduce ecommerce return rates.
- With the help of AI it is possible to reduce over-production and surplus stocks through data analysis, customer feedback apps etc.

## Policies and regulations

- Reuse, renting and subscriptions for clothes and textiles could be tax deductible to kick-start the transition.

- Encourage solutions that are circular, i.e. resource-efficient, good for the environment and fully recyclable.
- Public, tax-funded actors that support industry should be tasked with promoting circular business models.
- Remove subsidies on products or solutions that work against circularity.
- The public sector could take the lead to support change. One example is an updated guide for procurement that includes circular criteria and purchasing of functions, tailored for different products based on resource consumption, quality and cost. Another is put a premium on more innovation and function procurement.

## Recycling and industrial symbiosis to create the conditions for sustainability, resource effectiveness and circularity

Recycling of textiles goes beyond recycling of worn out clothes, it also involves making use of the waste fractions that exist throughout the production chain – from fibre manufacturing to cutting waste when garments are made. Collection and sorting of worn out textiles has a key role in efficient textile recycling and is it therefore important to have good collection systems that guarantee the materials are in a hygienic and dry environment and that sorting is as automated as possible.

### Innovation

- Technical innovation in material sorting using digital labelling is crucial in order for the sorting process to be reasonably profitable. There are various technologies for traceability using, for example, QR codes, RFID labels or DNA woven into yarn.

- Development and upscaling of chemical processes for material recycling and to create alternatives to mechanical recycling.

### Symbioses

- A greater exchange of materials between different industries and sectors is needed. Analysis is needed to identify important and relevant flows and new streams – both industrial flows and post-consumer flows. Potential industry partnerships could be formed between the forest industry, agriculture and the food, engineering, construction and automotive industries. In the future there may be a need for material brokers who connect sellers and buyers.

#### Potential resource flows for textiles:

- From agriculture to food – e.g. vegetable waste products become fibres that are made into fabric or used in imitation leather etc. Large and stable resource flows are needed for this to be successful.
- Forest companies – a natural and established connection already exists.
- From plastics – today, for example, PET bottles become polyester, but there are also large flows from other industries to explore.
- Items collected from laundries and in public sector contexts could be used to make new textile fibres.

#### Potential resource flows from textiles:

- Large volumes of composites become new materials for other industries, such as the automotive and aviation industries. Another material is glass fibre which is moulded with plastic. Instead of glass, it may be possible to use worn out fabric and thus find a recycling flow for this low-value material.

- b. Synthetic materials can be used for polyester products other than textiles.
- c. Reused clothes, fabric, sheets, towels etc., can become new products. Discarded sheets can be made into new carrier bags or sheets, towels can become rag mats and old clothes can be remade into new styles. There is potential for cooperation between charity organisations, the healthcare sector, the furniture industry and the automotive industry.
- Synergies need to be developed with actors from, for example, the public sector (to use the power of public procurement), the financial sector and engineering industry. Tools, standards, traceability and transparency are crucial to close the circle and achieve full-scale recycling..

## Innovative environments that support development of sustainability, resource effectiveness and circularity

To succeed in transforming the textile industry into a resource-effective and circular flow we need to redesign products, processes, relationships and business models. This requires innovation in all areas. In order for innovations to be developed, we need creative environments where they can be nurtured, tested and implemented. It is crucial to have good support from business leaders, the research community, the Government and testbeds, as well as financial support.

A welcome move from the Swedish Government is a commission to establish a national platform for sustainable fashion and textiles based on a need to coordinate industry initiatives.<sup>6</sup> Borås University has been tasked with managing the platform called Textile & Fashion 2030. The idea is to promote cooperation, collaboration and initiatives for an environmentally sound, sustainable value chain for textiles<sup>7</sup> with a focus on SMEs.

In Sweden we are in general good at creating the right climate and environment for research and innovation. But if Sweden wants to be at the forefront we also need initiatives to *upscale* innovations so that we can keep enterprises and industries within our borders.

## The role of the financial sector

Financing and investment in new technology and business models is a key success factor in the conversion to circular models. Several links in the chain are missing in the circular flow of textiles in Sweden, and bold entrepreneurs, driven individuals and investments are needed to put these in place and close the circular flow.

There is substantial public funding available for the research and pilot phases, but when actors want to take the next step and need bigger investments, they encounter a gap in the capital market. The capital requirements are often too large for government grants, too small for public investment banks and institutional investors, and too new and unknown for commercial banks. Private venture capital is not reaching these actors either. This is often referred to as the "valley of death", which refers to the difficulty in obtaining financing for new business models and innovations when it is time to scale them up to a commercial level.

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6 Government decision, Ministry of the Environment and Energy M2018/01095/Ke.

7 Textile & Fashion 2030, *Handlingsplan* (<https://textileandfashion2030.se/handlingsplan/>; accessed 25 October 2019).



There are some interesting alternatives worth looking at to circumvent the problem:

- Develop a national strategy for a circular economy that not only takes into account the environmental perspective, but also looks at profitability for society and industry.
- Produce a road map for sustainable investments in line with the national circular strategy.
- Invite investors to participate in developing new business models for mutual learning, increased understanding of new business models and an exchange of knowledge and ideas.
- Develop a credit committee for resource effectiveness that provides guarantees or beneficial loans and thus reduces the project risk, making it easier to attract private capital.
- Several companies coming together to form a consortium to jointly apply for investments.
- A hub for financing model innovation to include representatives from the various parts of the financial sector.
- The Government or regions provide support to develop industrial parks where infrastructure and co-financing is included.
- Shift the investment focus of government funding, such as Saminvest, towards initiatives for resource-efficient textiles in Sweden.
- Expand the EU's innovation fund to also support circular solutions, and not just focus on the climate as it is doing today.



## The subproject's vision and objective

»Sweden – the leading nation for a value-creating textile industry that is sustainable, resource-effective, circular and profitable.«

The subproject's vision: *Sweden – the leading nation for a value-creating textile industry that is sustainable, resource-effective, circular and profitable.* The subproject's objective is to carry out a system/gap analysis of the textile flow which will result in action plans to achieve the vision.

## System analysis of challenges and opportunities

A sustainable, circular and resource-effective fashion and textile industry needs a circular system characterised by maximum resource use and minimal unusable resources/residual products. Today most of our textiles are produced at low prices in countries far away from Sweden and are at best transported by boat and at worst by air. Sweden's capacity for manufacturing garments domestically is extremely limited and there are few solutions for on-demand production. Environmental and resource management in the textile and fashion industries therefore need to be radically changed. The industry is aware of this but there are many challenges involved in making it happen. Although there has been progress in recent years, setting clear and concrete goals is still a challenge for many companies. Another challenge is that the majority of production takes place outside Sweden's borders and there are essentially no brands that own their own factories. Also, 80 percent of a garment's climate impact<sup>8</sup> is in the production phase – the phase that companies today have little or no possibility of controlling. In most production countries the energy used is from fossil sources, most commonly coal. There is waste in every part of the value chain which today is rarely used optimally. In order for companies to be able to set concrete

goals and start to act they need to have a comprehensive picture of their operations and the products they design and sell. Making it easier to conduct life cycle assessments is therefore important so that companies can measure their progress and make improvements.

New business models are needed that support increased use, resource effectiveness and circularity. Recycling in this context is the last stage in a product's life cycle. According to Textile Exchange, a total of 105 million tonnes of textiles were produced in 2017, 24.5 percent of which were of cotton, while synthetic fibres from fossil raw materials<sup>9</sup> accounted for 62.1 percent. This is not sustainable in the long term as conventional cotton cultivation uses large amounts of water and chemicals and depletes the soil of salts, and as most of the synthetic materials used today come from crude oil. Bio-based fibres are also associated with challenges. According to an IPCC report<sup>10</sup> released in 2019, agriculture, forestry and other land use account for close to a quarter, 23 percent, of the greenhouse gas emissions caused by humans. At the same time nature can absorb carbon dioxide at a rate that is equivalent to a third of the emissions from fossil fuels and industries. IPCC thinks that we need to look at emissions from land use due to its significance for the entire climate system and for biological diversity. According to the OECD global land use is expected to more than double between the years 2011–2060. Furthermore, we will need a new palette of the fibres we use in the future because the demand for fibre is expected to increase by 150 percent by 2050. We need to focus on recycling of both synthetic and natural fabrics, find alternative raw materials, such as waste from other industries, and require the remaining cotton cultivation to be sustainable. But one of the most important parameters to focus on to reduce water and climate

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8 Sandin, G., Roos, S. and Johansson, M., 2019, *Environmental impact of textile fibres – what we know and what we don't know. The Fiber Bible Part 2* ([http://mistrafuturefashion.com/wp-content/uploads/2019/03/Sandin-D2.12.1-Fiber-Bibel-Part-2\\_Mistra-Future-Fashion-Report-2019.03.pdf](http://mistrafuturefashion.com/wp-content/uploads/2019/03/Sandin-D2.12.1-Fiber-Bibel-Part-2_Mistra-Future-Fashion-Report-2019.03.pdf); accessed 11 November 2019).

9 Textile Exchange, 2018, *Preferred fibers and materials market report* (<https://textileexchange.org/downloads/2018-preferred-fiber-and-materials-market-report/>; accessed 17 October 2019).

10 IPCC, 2019, *Climate Change and Land* (<https://www.ipcc.ch/report/srcccl/>; accessed 17 October 2019).

impact, as well as toxicity from consumption, is reducing the volume of textiles produced.

Measures to increase the life of garments – using the garments and textile products for longer instead of buying new ones – would probably be the most effective way to reduce climate impact. As 93 percent of all climate impact is linked to purchasing new products (only 3 percent to laundering and drying), doubling the life of all textile products would reduce climate impact by 47 percent, i.e. essentially cut it in half. Promoting a transition to renewable electricity production would have the second biggest effect (43 percent), followed by energy efficiency improvement in production (12 percent). It is not just climate impact that can be reduced by doubling the life of the products, but also the impact on water could be reduced by 48 percent as well.<sup>11</sup>

There are also challenges to closing the textile cycle as there is no organised collection process in Sweden today, and there is neither the infrastructure nor the technology for large-scale recycling to turn textile fibres into new fibres, even if some progress is being made. According to a new directive adopted by the EU, all textiles are to be separated from household waste by 1 January 2025 in member nations. Sweden and all the other member states must therefore have a solution in place for large-scale collection by then. This means that solutions for sorting and managing collected textiles and textile waste must also be available. Transparency and traceability are, however, lacking today, making this essential cycle difficult to achieve. It is therefore encouraging that the development of digital solutions is progressing at a rapid pace and that the industry has recognised the importance of traceability.

Digitalisation and new production technology will lead to disruptive change in the industry and could have a positive effect. It is important for Sweden to keep up with develop-

**Figure 1:** Climate benefits from combining interventions to reduce the effects, based on Swedish clothing consumption. Source: Roos, S., Sandin, G., Zamani, B. and Peters, G., 2019.



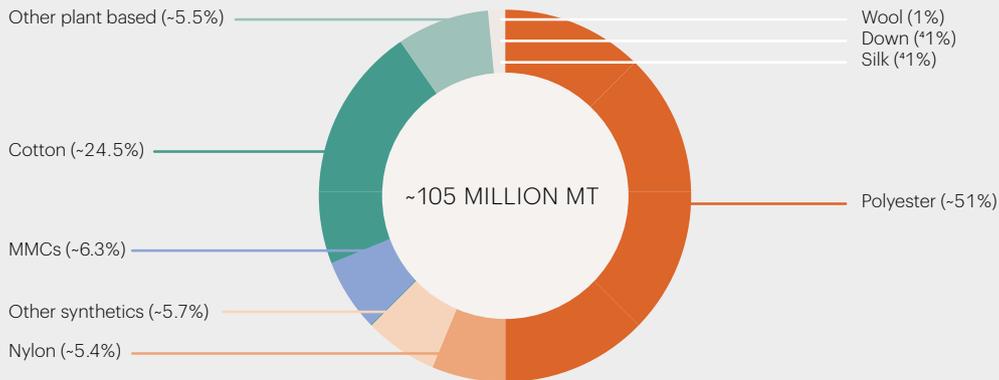
ment. Artificial intelligence (AI) has an important role to play here (see also the “Business models” section). AI is, however, weak in Sweden and even weaker in the fashion industry, which means there is room for much development in this area.<sup>12</sup> On the positive side: this is a creative industry with every opportunity to find new sustainable solutions and one that has an innate energy for change. It is also an industry where companies work together, share experiences and jointly exert pressure to accelerate sustainable development. Clothes and textiles are of interest to many people because they are a large part of everyone’s lives, a means of self-expression and things we have close to our bodies.

In an increasingly global world, domestic initiatives can be perceived as insufficient, as not all parts of the system are within a nation’s borders – a case in point is products being consumed in Sweden but not produced here. However, at the national level, a country can lead the way through invest-

11 Roos, S. and Larsson, M., 1 October 2018, *Klimatdata för textilier. Commission report 27402*, Swedish Environmental Protection Agency (<http://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/uppdelat-efter-omrade/hallbar-konsumtion/rapport-klimatdata-for-textilier-swerea-2018.pdf>; accessed 17 October 2019).

12 Based on a conversation with Professor Oskar Juhlin, Stockholm University.

**Figure 2:** Global production of textile fibres 2017. Source: Textile Exchange 2018.



ment in both research and industry as well as policy initiatives, and thus be a role model, specifier and active partner in dialogue at the global level with decision-makers as well as organisations and other nations.

In addition to the above, our work is not limited by current waste legislation, policies and control mechanisms.

## Boundaries

The subproject is not examining:

- Social sustainability
- The cost of environmental impact or lost biodiversity
- The final phase in the biological cycle, e.g. composting and energy recovery (incineration)
- The difference between the biological and technical cycles' functions in a circular economy
- Transportation of customers and products to stores as transportation is the topic for another IVA subproject.

## Background

### Resource effectiveness requires a system shift from linear to circular

A system shift is an important and complex imperative for the industry. The global fashion industry is huge with global net sales of USD 1.3 trillion and 300 million people employed, making it the seventh largest industry in the world with a turnover equivalent to 4 percent of all world trade. At the same time, according to a report from Quantis (an organisation of researchers, experts, strategists, innovators and visionaries working on sustainable solutions), global clothing and footwear production accounts for 8 percent

of the world's greenhouse gas emissions.<sup>13</sup> The industry also has a negative environmental impact due to its high consumption of water, energy and chemicals. Every year tonnes of textile waste end up in landfills or are incinerated and our global textile consumption has doubled over the past 15 years.

According to the Swedish Environmental Protection Agency, we purchase around 13.6 kilos of textiles/clothes per person and year in Sweden, more than 7.5 kg of which ends up as refuse or goes to waste. Random sample analysis shows that a large percentage of textiles are in excellent condition and could be put to further use.<sup>14</sup> The Swedish Environmental Protection Agency has recommended a goal of reducing textiles in household waste by 60 percent by 2025 (compared to the 2015 level). The Agency also recommends 90 percent of separately collected textiles/clothes going to reuse or recycling. According to calculations by the Ellen MacArthur Foundation's Circular Fibres Initiatives only 46 percent of collected garments were reused in 2015 (i.e. used clothes were used by someone else) and only 1 percent of all discarded clothes in the world were recycled and made into new textile fibres.<sup>15</sup> This is mainly due to the lack of infrastructure, technology and financial profitability in the sector for recycling.

There are currently 40 countries that have stopped importing used textile products, which means that we must find new, efficient ways to handle this resource. We need to establish more sustainable, circular and resource-effective systems where the products are used longer, repaired and better maintained, where sustainable and renewable fibre sources are used to a greater extent, production processes are more efficient and material recycling is better and more efficient.

## The transition has begun

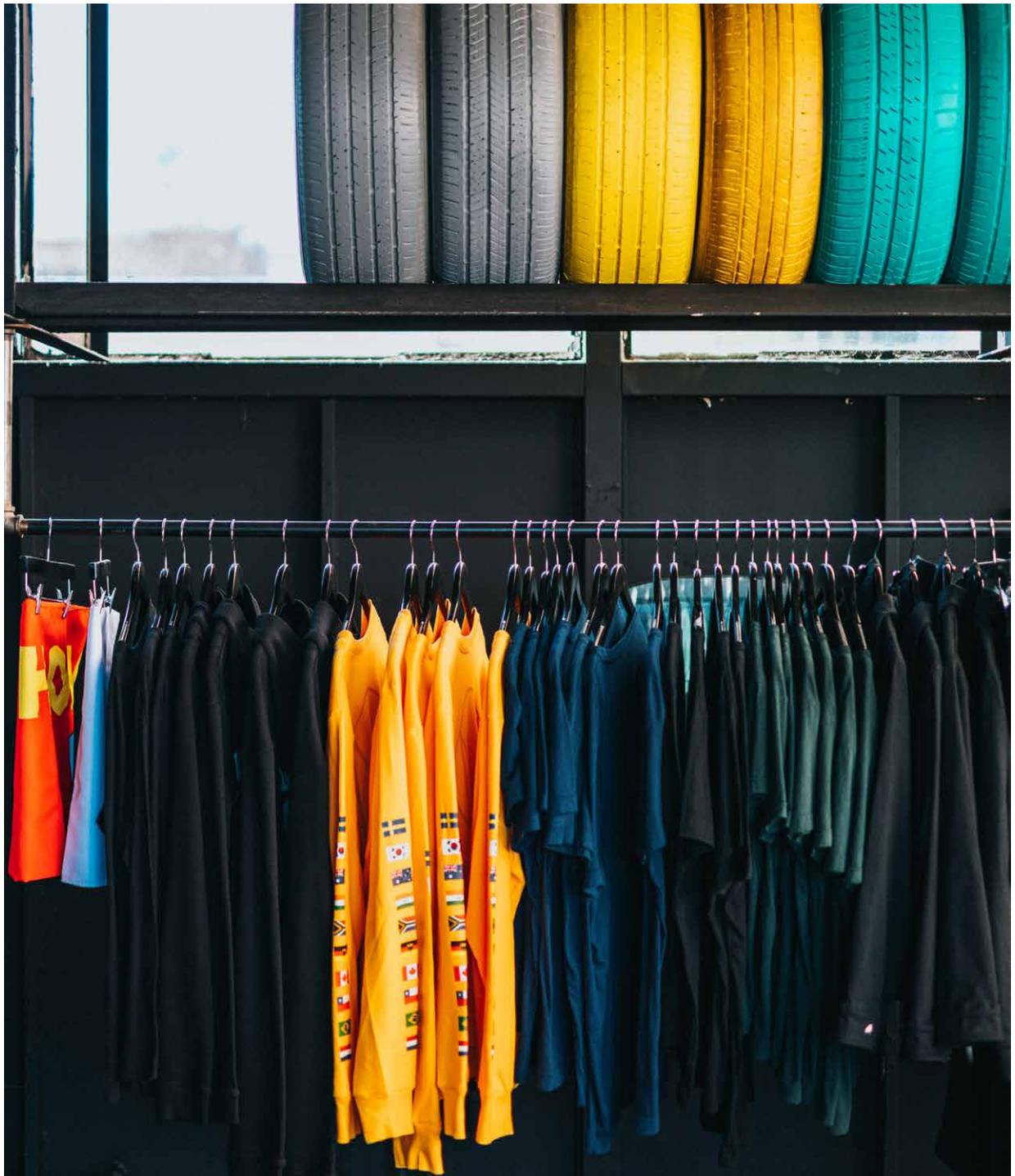
Although change is on the way, only a minority of today's fashion actors have started to act in earnest. New climate initiatives have emerged both globally and in Sweden. Other stakeholders such as politicians, recycling companies, technology developers, producers, the financial sector and users also have to play a role in the transition. The system today lacks policies that promote circularity, production innovation, sustainable fibre and process substitutes, infrastructure and technology for recycling, commercial incentives for a sharing economy etc. There are numerous organisations providing support, such as Cradle to Cradle, the Ellen MacArthur Foundation, Fashion for Good and Sustainable Apparel Coalition, initiatives such as the H&M Foundation's "Global Change Awards" as well as Textile & Fashion 2030, established by the Swedish Government in 2018 under the leadership of Smart Textiles, parts of Science Park Borås, and Borås University. Political actors are driving sustainable development both regionally and globally. Strong regions such as Västra Götaland are actively incentivising the textile industry with the objective of prioritising the circular economy transition. At the Nordic level, the Nordic Council of Ministers has its "Nordic Action Plan for Sustainable Fashion and Textiles" and there are sustainable development goals to work towards at the EU and UN level. To drive development in the right direction it is crucial to create the right commercial incentives; this is not about handouts but the ability to build successful enterprises.

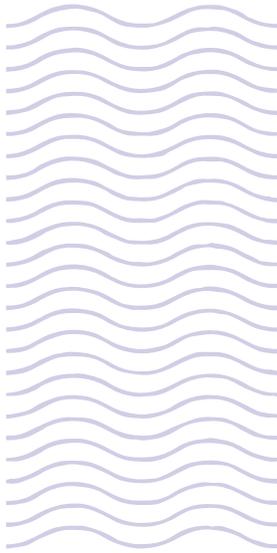
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13 Quantis/ClimateWorks Foundation, 2018, *Measuring fashion. Environmental Impact of the Global Apparel and Footwear Industries Study*.

14 Swedish Environmental Protection Agency, 24 May 2019, "Textilkonsumtion per person i Sverige" (<http://www.naturvardsverket.se/Sa-mar-miljon/Statistik-A-0/Textil/>; accessed 16 September 2019).

15 Ellen MacArthur Foundation and Circular Fibres Initiative, 2017, *A New Textiles Economy: Redesigning Fashion's Future* ([https://www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy\\_Full-Report.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy_Full-Report.pdf); accessed 17 October 2019).





## **Analysis of the subproject's focus area**

»It is currently cheaper and easier  
to make poor choices when it  
should be the exact opposite.«

In recent years a sustainable and circular economy and resource-efficient methods have come into sharper focus. Research and interest in sustainable textiles and fashion have in general increased over the past few years to reach an almost explosive level of focus in 2017. Examples highlighted in the analysis conducted by the project in 2018 represent only a small portion of all initiatives, but still show that there are many actors focusing on this area – both internationally and in Sweden. Over the course of a few years Sweden has come a long way thanks to the many research projects and active actors in the industry. The problem with system transformation is, however, that it is difficult to influence all of the relevant actors in a system (or multiple systems) and in a globalised world, such as producers in a complex supplier network outside Sweden as well as users. It is also important for legislation to keep up with and promote circular development, despite the fact that the majority of actors still operate linearly.

The many projects and initiatives that are under way provide a relatively positive picture indicating that we are moving in the right direction, even if the situation is still fragmented. The initiatives are relevant in increasing resource effectiveness but lack the potential for upscaling. It is relatively easy to securing financing to launch a project and during the lab phase, but it is harder to fund the upscaling phase when the time comes to commercialise the innovation.

The challenge for Sweden is being able to take advantage of and use all of the initiatives in this area and the knowledge that is now available. A quick assessment of the initiatives reveals their diversity and that they cover the entire value

chain – from new fibres, recycling, processes, services, mapping and analysis for new circular business models, recycling barriers, evaluation of potential control mechanisms and measuring tools, to communication projects and activism.

There are no dedicated resources to turn the insights, recommendations and new models that have now been generated into action. Change agents are needed to drive change and potentially benefit more groups, for example initiatives such as the F/ACT Movement<sup>16</sup> and the Swedish Environmental Protection Agency's government commission to inform users about sustainable consumption.<sup>17</sup> The research today is often aimed directly at actors who are perhaps not ready to take the next step as they require a supportive environment (both politically and from the market), and cannot act based on what needs to be in place five to ten years from now. There is thus a gap between research and direct system transformation, and there is no actor at this time to bridge the gap and monitor and encourage long-term progress. The recently concluded Mistra Future Fashion<sup>18</sup> research programme was the beginning of such a bridge. This is a role that Textile & Fashion 2030<sup>19</sup> can now take over.

Research is often conducted within one discipline but, thanks to these projects, has the ability to create interdisciplinary benefits across "boundaries". Designers are, for example, working directly with recyclers, and researchers from different disciplines are working in a cross-functional way. These projects, however, only run for a limited period and there are no plans to transfer insights and proposed measures that need to be further developed and shared with others.

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16 F/ACT Movement, a project at Science Park Borås (<https://www.factmovement.se>; accessed 16 September 2019).

17 Swedish Environmental Protection Agency (<https://textilsmart.hallakonsument.se>; accessed 17 October 2019).

18 Mistra Future Fashion (<http://mistrafuturefashion.se>; accessed 16 September 2019).

19 Textile and Fashion 2030 (<https://textileandfashion2030.se>; accessed 16 September 2019).

The current fragmented situation with an intense period when numerous simultaneous initiatives are under way is also a sign that there is a risk of competition rather than cooperation emerging. A coordinated strategy based on cooperation and a long-term research agenda could gather all actors and provide better benefits for Sweden and the world.

## Gap analysis and how to achieve a circular textile flow

### Design

It is currently cheaper and easier to make poor choices, especially when the price of more sustainable materials is higher. Accordingly, the majority of buyers are still choosing inferior and cheaper alternatives. The availability of more sustainable materials and more resource-efficient production processes is still limited, and making sustainable material choices is impeded by high minimum orders or in some cases lower quality. There are no available tools to educate designers and product developers to make better choices. A comprehensive education initiative is needed to create awareness and change ingrained behaviours and opinions.

### Fibre production

We need comprehensive live cycle assessments (LCA) of more fibres. Many of the tools available today are based on LCA data from raw materials for finished fabrics, which is only a small part of the whole material life cycle. The need for LCA data will increase as new bio-based and circular fibres come onto the market. It is a challenge to find substi-

tutes or supplements for the fibres we use the most – cotton and oil-based synthetic fibres (86.6 percent).<sup>20</sup>

Results from Mistra Future Fashion research shows that there is currently no fibre on the market or even in the lab that can match the technical properties or comfort of conventional cotton. The closest we can get is organic cotton or cotton from the Better Cotton Initiative. But if we can set aside traditional requirements and expectations, there are several fibres that in the future could replace and supplement cotton, which will not be available in sufficient quantities. These are fibres from regeneration processes, such as viscose, modal and Tencel, or natural fibres such as linen and hemp. Development today is focused on new processes that can produce fibres not only from cellulose but also from residual products from agriculture, food and the fishing industry.

There are some fully or partially bio-based alternatives (BioPET, PLA, PTT) to oil-based polyester that match conventional polyester in both comfort and technical properties. These are new in relation to conventional polyester, and have a higher price and lower availability (production capacity) than normal polyester. The challenge with respect to these and other bio-based fibres that are being developed is to increase their availability and thereby lower the price.

The vast majority of polyester is not recycled. There is therefore an untapped material resource – both of today's oil-based varieties and future bio-based polyester. Chemically recycled polyester has the benefit of having the same properties as virgin fibres because the material is depolymerised into its components and then built up again (polymerised) into polyester. Chemical recycling is being developed but the challenge is how to develop the processes and upscale the capacity.

There is no generic definition for "good" and "bad" fibres. A garment made from organic cotton or recycled material

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<sup>20</sup> Textile Exchange, 2018, *Preferred fibers and materials market report* (<https://textileexchange.org/downloads/2018-preferred-fiber-and-materials-market-report/>; accessed 17 October 2019).

is not necessarily sustainable; the way in which it was produced plays a crucial role in its sustainability.<sup>21</sup>

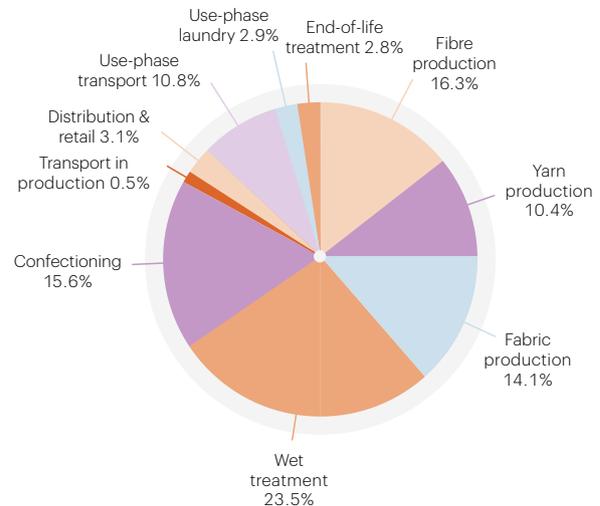
## Textile production

Textile production is an industry with widespread old-fashioned technology. It is not particularly resource-efficient and much of the volume production takes place in developing countries. The majority of the production processes consume a significant amount of resources such as water, energy and chemicals, and a large percentage of the energy supply comes from fossil sources. It is a low margin market with low product value, which makes it challenging to secure investment in new, expensive equipment. It is also an industry that still involves a lot of manual labour. As outlined above, a garment is not more sustainable or resource-efficient just because it is made from organic cotton. The key factors are instead which suppliers have manufactured the fabric and the garment and what their processes and environmental impact look like based, for example, on their choice of energy. Transparency throughout the production chain is therefore more important than the choice of fibre. It is important to know which suppliers have a good record in environmental management and resource efficiency. Here the industry has a long way to go as there is often a lack of both traceability and transparency. Producing garments using organic cotton is a good start, but it is more important to focus on the whole life cycle of the product.<sup>22</sup>

## Business models

Today the main focus is on optimising the existing system, i.e. the linear models. It is, however, a system that promotes

**Figure 3:** Climate impact from Swedish clothing consumption. Source: Sandin et al., 2019.



over-production models. We design and develop a collection over a six-month period. Orders are then placed based on speculation for products that take around three months to manufacture. Manufacturing often takes place far away from Sweden. Hopefully the finished products are sent here by cargo ship. This takes between three and five weeks. They normally end up in a central warehouse where products are packed for the respective stores. This takes about a week. Stores usually maintain inventory in various sizes depending on how well they have optimised their replenishment processes from the central warehouse to ensure that the particular style, colour and size the customer wants is available. Depending on how many collections a brand has, the products stay in store from two weeks to six months before they are put on sale and then culled and sold through

21 Sandin, G., Roos, S. and Johansson, M., 2019, *Environmental impact of textile fibres – what we know and what we don't know*. *The Fiber Bible Part 2*, Mistra Future Fashion report series.

22 Rex, D., Okcabol, S. and Roos, S., 2019, *Possible sustainable fibers on the market and their technical properties*. *The Fiber Bible Part 1* (<http://mistrafuturefashion.com/wp-content/uploads/2019/03/Reos-D2.1.1.1-Fiber-Bible-Part-1-Mistra-Future-Fashion-2019.02-1.pdf>; accessed 11 November 2019).

other channels, such as outlets or discount websites, to make space for a new collection. Companies can increase their profitability by constantly increasing production and sales of individual items. This makes it even more difficult for companies to break the trend.

The industry is working to speed up the process of getting products from concept to store, while fashion trends have ever-shorter cycles, guaranteeing a "race to the bottom".<sup>23</sup> Companies are producing more clothes than will be sold to optimise sales and because they are afraid of running out of something. This leads to surplus inventory which stores try to get rid of through discount prices and seasonal campaigns, and longer and more aggressive sales at the end of seasons, which happens at least twice a year. Customers get used to being able to find most items at bargain prices and therefore stop buying them at full price. This makes for a vicious circle that is difficult to break out of. We should also remember that clothes have become cheaper over the years in relation to other products. There is still low acceptance among customers for new consumption patterns and it is difficult to secure investment and financing for new business models as they do not meet traditional assessment criteria or risk and return requirements.

## Users

Although more and more people say they want to consume fashion more sustainably, we have a long way to go before words are turned into action. It is also difficult to make conscious choices today because it is impossible to compare what or which garment is better from an environmental perspective. As long as production processes remain the same, the greatest positive environmental impact will be gained from using clothes as long as possible. Doubling the life of all tex-

tile products would reduce environmental impact by 47 percent.<sup>24</sup> Users therefore need to learn about caring for clothes – laundering correctly, protecting and mending – so they last as long as possible. Today, despite the repair deduction in the Swedish tax code, it is often more expensive to have clothes repaired or have more complex alteration done than to buy new ones. Users in this case are not just private individuals but include professional customers, such as those working in public procurement for uniforms, hotel and hospital linens etc. where the products are often rented out by laundries. Today there are unfortunately no criteria for circularity or resource effectiveness in public procurement. If such criteria existed they would have a significantly positive impact.

## Reusing and recycling

There is currently no large-scale textile recycling flow and no large-scale system for collection and sorting. The value of collected materials is low, making it hard to make collection and sorting work from a financial perspective.

In a future resource-efficient textile management system the percentage of textile materials that go to incineration will have been significantly reduced through reuse and recycling.

Reuse is at the top of the waste hierarchy. Materials are recycled once the textiles cannot be sold in any market or are not suitable for reuse. An important factor in product reuse is ensuring that the problem is not shifted to another country where large volumes of materials may end up in landfill. If this risk exists, it is more sustainable to recycle the materials closer to the source.

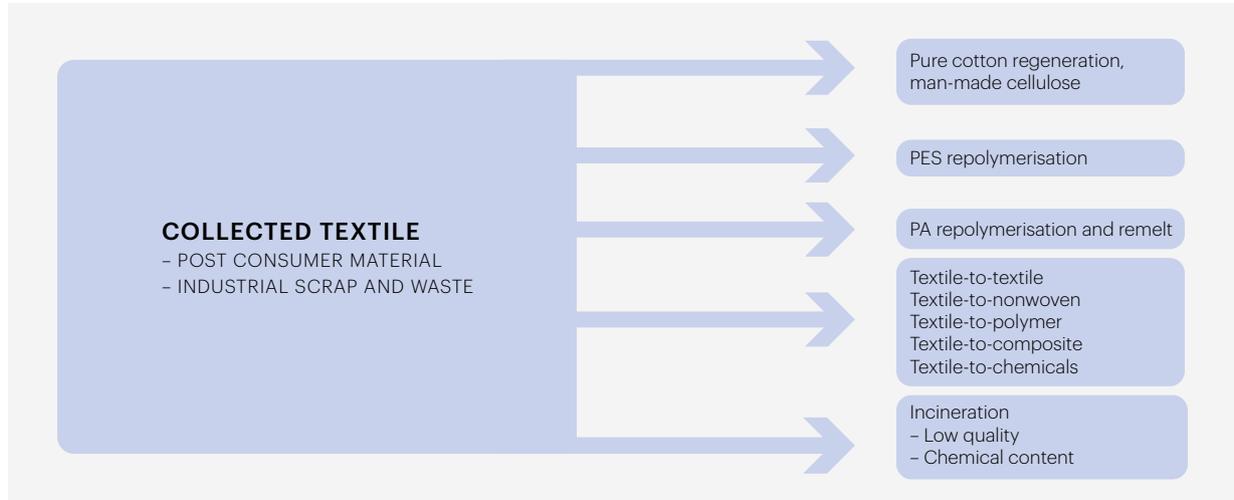
A future resource-effective material recycling system must be able to handle aspects such as the chemical profile of

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23 Investopedia, 2019, *Race to the Bottom* (<https://www.investopedia.com/terms/r/race-bottom.asp>; accessed 17 October 2019).

24 Sandin, G., Roos, S., Spak, B., Zamani, B. and Peters, G., 2019, *Environmental assessment of Swedish clothing consumption – six garments, sustainable futures* (<http://mistrafuturefashion.com/wp-content/uploads/2019/08/G.Sandin-Environmental-assessment-of-Swedish-clothing-consumption.MistraFutureFashionReport-2019.05.pdf>; accessed 17 October 2019).

**Figure 4:** Textiles collected and potential application areas. Graphic produced by RISE IVF.



materials, fibre composition, construction and fibre degradation in the user phase. These challenges have varying degrees of relevance depending on the type of material and which recycling processes are used. As we describe in more detail below, a future system must be able to include both chemical and mechanical processes, all of which must be both financially and environmentally sustainable.

One essential aspect for all material recycling is that there is oversight of the collection and sorting systems because textiles are sensitive to moisture and have a mix of fibres. Today's collection and sorting is not adapted for future resource-effective textile management systems and the importance of these parts of the value chain cannot be overemphasised.

It is important to have consumer confidence in recycled materials and to build trust through knowledge growth in the area. There are some garments, such as firefighter

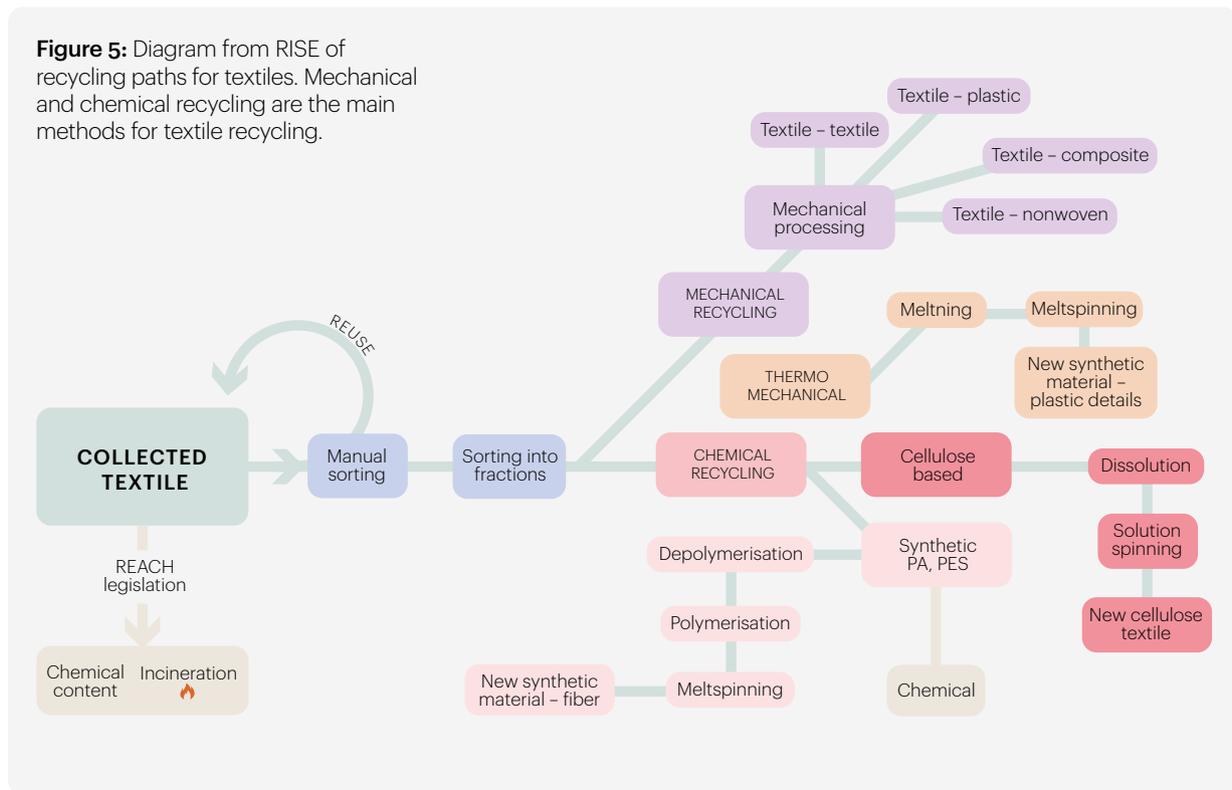
uniforms, that still need to be sorted into separate flows and not recycled.

Bearing in mind the complex composition of the textile material flow, it is not possible for a single process to meet the global textile recycling needs. Instead, a palette of different technologies will be needed to help exploit the full potential of textiles for recycling. It is also necessary to work across material and industry lines, with an exchange of materials between textile, plastic, composite and nonwoven applications as a natural aspect of that. Nonwoven fabrics are neither woven nor knitted to build the fabric; the fibres are instead usually bonded together.

The simplest and least energy-intensive recycling technology for both natural and synthetic fibres is *mechanical* recycling under today's conditions.<sup>25</sup> Globally, mechanical recycling is an established, commercial process for producing more

25 Roos, S., Sandin, G., Peters, G., Spak, B., Bour, L., Perzon, E. and Jönsson, C., 2019, *White paper on textile recycling* (<http://mistrafuturefashion.com/wp-content/uploads/2019/10/S.-Roos.-White-paper-on-textile-recycling.-Mistra-Future-Fashion.pdf>; accessed 26 November 2019).

**Figure 5:** Diagram from RISE of recycling paths for textiles. Mechanical and chemical recycling are the main methods for textile recycling.

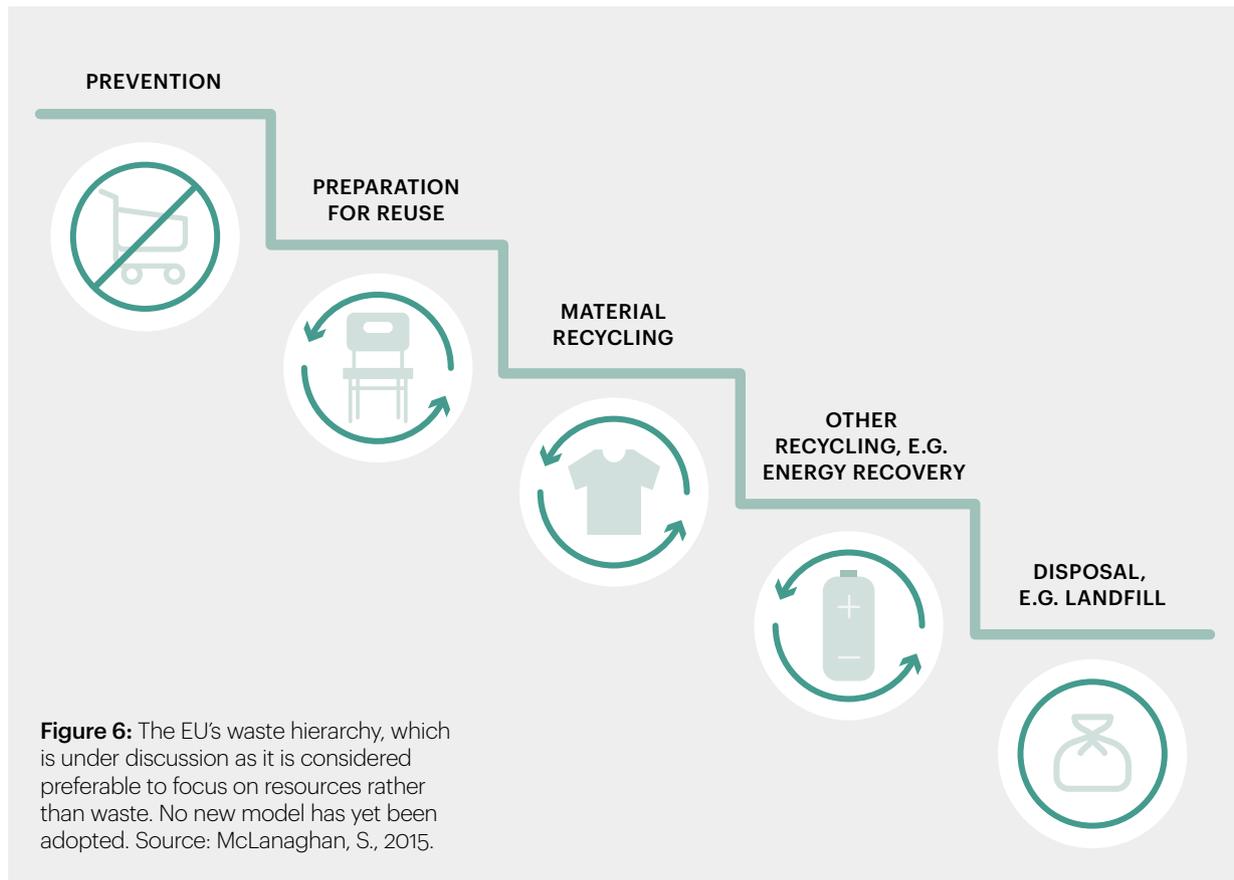


long-lasting end products. When we discuss mechanical recycling in Sweden, the objective is to achieve end products of significantly higher quality, including recycled yarn. The quality of the recycled fibres depends on the materials they contain, which makes the user phase impact important. It is also important to ensure that there are high standards for collection and sorting methods because handing them in the wrong way can significantly affect how well the subsequent processes will work. Even if we have very good control of production of fibre for textile applications, the materials produced may not necessarily be returned to the system in the same pure state. Textile materials actually consist largely of fabrics with a blend of fibres so that fossil-based and bio-based materials are mixed together.

As the textiles are used and subjected to wear and tear they are gradually broken down. This can make them unsuita-

ble for their original application but excellent for a different type of product. Development of new, innovative recycling methods where the greatest possible material value is extracted from the textile fractions collected is essential for optimised processing of textiles for recycling. The goal is to move from today's situation, which is marked by a low recycling level and low-value performance of the recycled products, to instead achieve a high recycling level and high-value secondary products.

Certain types of fibres can also be recycled in chemical processes. Chemical recycling involves a chemical process to transform the textile fibres at the molecular level into new textile fibres which can then become textiles of virgin quality. It is important to note that the processes that are relevant here are different for synthetic and natural fibres, and that, for example, the depolymerising process needs



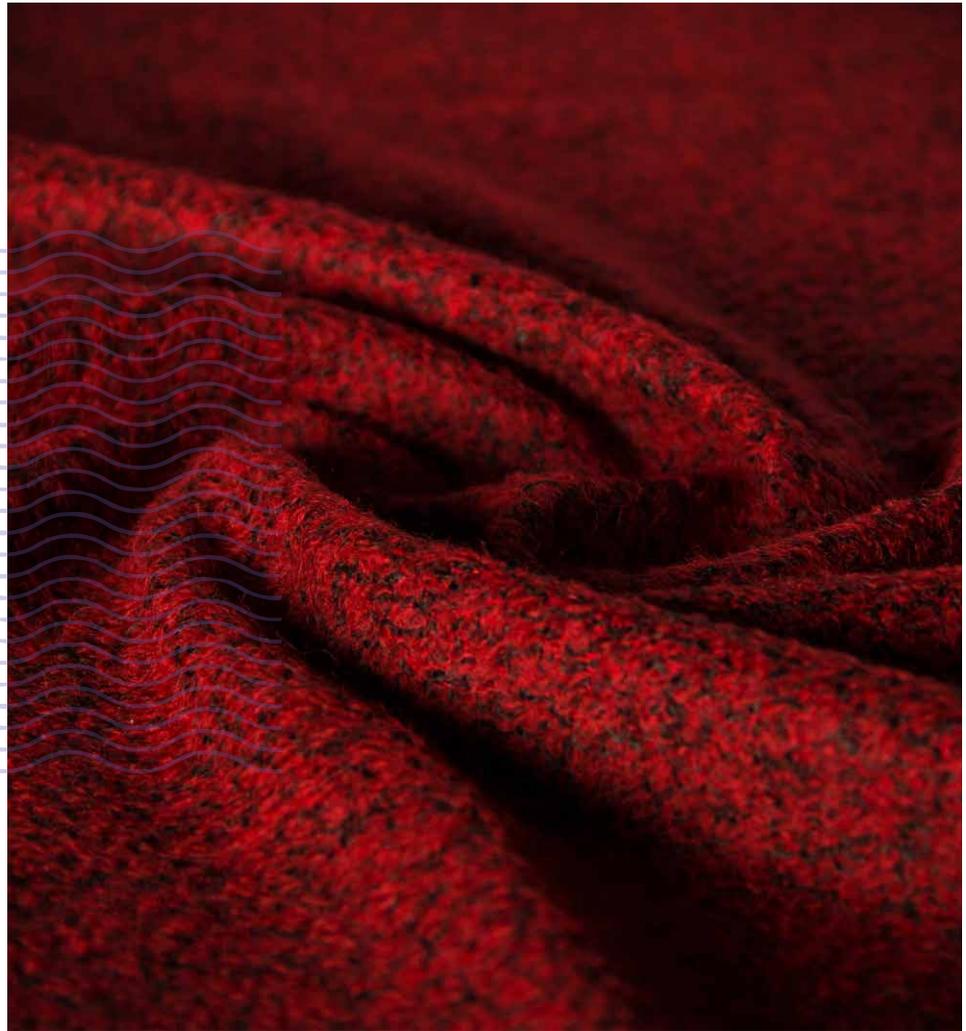
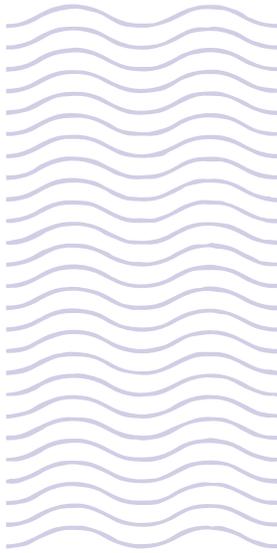
to be customised for the particular fibres. In chemical recycling of blended fabrics it is also important to take into consideration both components so that, for example, cotton or a cotton and polyester blend is not broken down in a process aimed at only the polyester component.

## Regulations

There is a lack of support today in the form of control mechanisms, incentives and laws to create more circular business models. There are no clear incentives for following the waste hierarchy and the industry is measured in terms of earnings rather than circularity. The waste hierarchy is the

order of priority for waste. Waste should first be prevented then reused and thirdly recycled etc. We are stuck in a conventional approach to the market economy and market expectations making it difficult to break away from traditional models. We have no standards for circularity. Such standards would enable us to develop a common approach to making judgements and choices.

Overall most circular flow initiatives are still small in scale. We have been focusing more on improving and optimising the linear system rather than converting to real circularity. There are few large-scale circular solutions in place and more innovation is needed. There is also an enormous need to increase the amounts being invested.



## Design

»Making the right choices in the design phase is crucial in order to create more resource-efficient and circular products.«

## The subproject's results

The following section of the report is the result of conversations and discussions at workshops and meetings with experts and committees leading to a number of observations and recommendations. Source references are included where appropriate. If no source is indicated, the assessments and recommendations are based on the knowledge and experience of the work group and the experts on the issues addressed.

## Design

Most of a product's sustainability, resource effectiveness and ability to be part of a circular system is determined at the design phase. This applies to everything from which materials are chosen and what the production process is like to which business models the product will be part of and how products are recovered, and finally, what the reuse and recycling phase looks like. All this is affected by the decisions taken at the design table, even though the decisions have varying degrees of impact at the different stages. Those decisions involve the choice of fibres, which materials and components to include, in which country the items will be produced, how patterns are designed, which production processes are included, which quality stand-

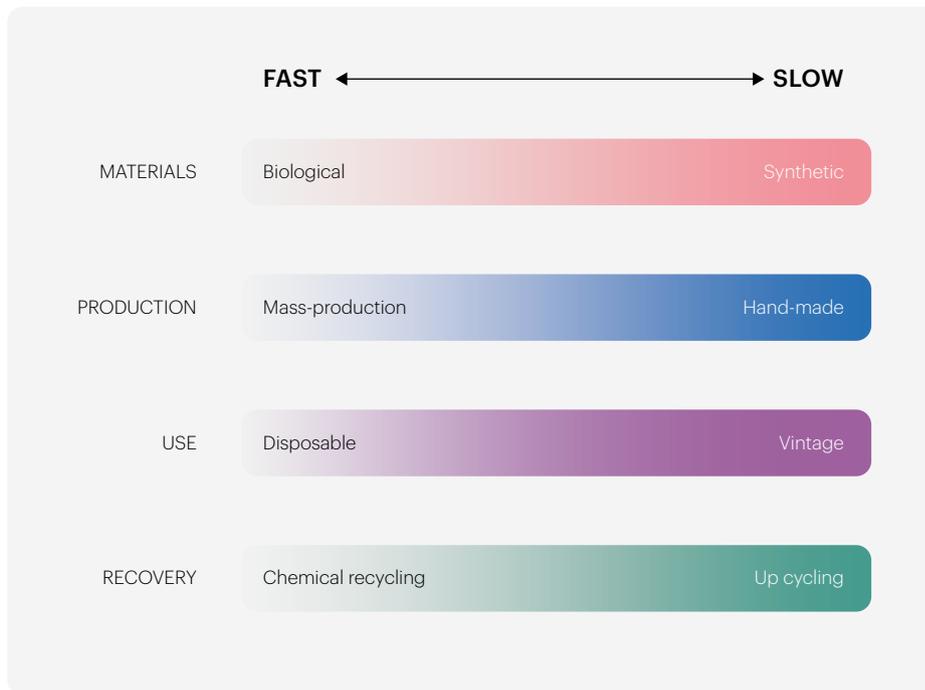
ards apply and how long the product is supposed to last etc. It is therefore crucial right from the start to have all aspects clear by asking questions such as: Is this a product that will be in the technical or biological cycle in a circular economy? Will it have a long or short life? Will it be used by multiple users?

Rebecca Earley<sup>26</sup> points out in her research that, in order to design for circularity, it is necessary to consider multiple business models and application areas right from the drawing board stage instead of just designing for functionality and use as is the case today. If we can find sustainable solutions to optimise the cycles for every type of product and alternatives to traditional consumption, we will be able to have both fast and slow fashion that is sustainable in the future.

The Swedish Trade Federation's sustainability report from 2018 states that almost four out of five consumers say it is important for them to buy from "sustainable companies". The study also shows that corporations are experiencing a growing interest in sustainability among their customers. At the same time, companies respond that one of the main reasons for not taking a more active approach to sustainability is that they are experiencing low demand from customers and consumers. This reflects the responses to the question of which parameters are the most important for customers when purchasing, on a scale from "fairly im-

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26 Earley, R., Goldsworthy, K. and Politowicz, K., 2019, *Circular design speeds: prototyping fast and slow sustainable fashion concepts through interdisciplinary design research (2015-2018)* (<http://mistrafuturefashion.com/wp-content/uploads/2019/10/K.-Goldsworthy-Circular-Design-Speeds-project.-mistra-future-fashion.pdf>; accessed 11 November 2019).



**Figure 7:** Example of optimised design strategy for different speeds. Source: Goldsworthy, K.

portant” to “very important”. What people care about most is product quality followed by price. That the product has a low climate impact is at seventh place out of nine.<sup>27</sup> A consumer survey from the Swedish Environmental Protection Agency reveals that the most important parameter at the time of purchase is style and fit. In this simple questionnaire only 6 percent said that eco-labelling and environmental information is a deciding factor. Even if the overall trend indicates increased awareness among users and consumers, it is clear that there is still a need for more concrete tools for people to actually act accordingly. More detail about this is provided in IVA’s additional study of “Sustainability in textiles from a consumer perspective”.

One solution could be to give customers better guidance. Labelling of garments with comprehensible environmental information showing the product’s environmental impact and how it can be reused and recycled is one alternative. It is hard for users to navigate the jungle of eco-labels that exist in the market today, which are a mix of third-party scrutiny and corporate labelling. But it is important to understand that it is expensive and complex to eco-label clothes when the products have such short lives. Even if the industry welcomes third-party scrutiny, a solution is needed that is better suited to the industry conditions.

<sup>27</sup> Svensk Handel, 2018, *Starkt ökat hållbarhetsintresse hos konsumenterna – och handelsföretagen är redo. Swedish Trade Federation Hållbarhetsbarometer 2018* (<https://www.svenskhandel.se/globalassets/dokument/aktuellt-och-opinion/rapporter-och-foldrar/hallbar-handel/svensk-handels-hallbarhetsundersokning-2018.pdf>; accessed 16 September 2019).

Consumer information should go through a variety of channels – digital platforms, education at schools, inspiration on social media, helping users and consumers set both individual and common goals etc. The lack of knowledge among consumers is still significant and solutions are needed to reach them. Good examples of this are the Vindpinad web shop which assigns points to all products in its range based on environmental criteria, or Greenstory which shows customers the concrete environmental savings they make by purchasing sustainable garments. TrusTrace is a digital platform that helps companies trace their products and communicate their impact to customers.

## Design for resource effectiveness and circularity

An agreement on common principles for design would make it easier for companies. The proposal should include design criteria based on the requirements a product needs to meet (i.e. filling a purpose and meeting requirements throughout the product's life cycle), and based on how the criteria can promote commercial opportunities in circular systems (i.e. where the design specifications themselves promote innovation and entrepreneurship).

### The design phase

- Producing design strategies that stimulate sustainable products and use, and that facilitate recirculation is important to our ability to close the circular loop.
- Tools and better support for circular design are needed. Clothes and textiles need to be adapted right from the design stage for recirculation, i.e. reuse and recycling.
- Companies need access to relevant and updated life cycle assessment data that is available to all in order to take the right decisions. These should be based on planetary boundaries and eco system services, and consider the entire life cycle of the products. One possibility could be to task the Swedish Environmental Protection Agency to study (and determine) how this type of system could be designed (and maintained).

## Education and tools for purchasing and production

Training and tools are needed to help companies move towards a circular and sustainable transition. Companies need to learn more about how to design products for different lengths of life and what is required in order to optimise product disassembly and guarantee full material recycling or composting of a garment. In order to succeed we need to focus on product optimisation – i.e. choosing the right processes, production processes, treatments and which substances to include to enable full recycling at the end of the product's life.

- General education for companies and the public sector to enable them to make better decisions, improve procurement and make better purchases, but also specific education for product buyers. Current standards are seldom adapted to different types of products or application areas, which results in unnecessary production stages and unnecessary chemicals, which in turn is a waste of resources. This could, for example, be a question of a customer having a general requirement for a product such as lightfastness, i.e. how much a fabric is bleached by sunlight, even if a particular product will not be subjected to direct sunlight. This results in fabric treatment plants adding an extra wet process, which leads to high water and energy consumption and the use of more chemicals. If there were to be an open dialogue and closer cooperation between clients and producers instead, this type of unnecessary step would be avoided.
- Through increased tolerance for and better management of defects in woven fabric, discolouration and different nuances, resource effectiveness could be increased radically. Today

fabric with weaving defects is discarded and large volumes of fabric are re-dyed or even bleached first and then dyed again to meet a client's needs.

- Business support is needed for circular design and the development of KPIs (key performance indicators) that measure and monitor aspects other than trend analysis, sell-through and margins.
- Consumer information and educating the public are also important factors in creating awareness and thus impacting purchasing behaviour.

## Policies and regulations

### Standard

To establish a common vision, a clear definition and an international circular standard will be needed for sustainable textiles and circularity.

### National framework

A national framework for the management of different materials and products in the final phase of their life cycle would be beneficial. This could involve product labels informing customers what to do with the item when it is worn out, i.e. which recycling or composting fraction it should go to. If a product consists of materials that need to be split between different fractions, this should be clearly indicated and the item should be easy for the customer to take apart. The framework should contain criteria regarding what the product is permitted or not permitted to contain to optimise recirculation. The fractions that create the highest value should be identified and we should start with these.

### Traceability and transparency

In order for transformative change to happen, designing for a sustainable value chain should be a requirement. Traceability is needed throughout the value chain to monitor

this. Communication and traceability are important components in bringing about circular flows. Traceability will enable us to create general standards that make information comparable and validated. A legal requirement for traceability and measurement will create consumer understanding and "price understanding" and put a premium on better products.

### Garment labelling

Customers should have access to relevant information at the time of purchase. A common labelling system is needed and could potentially be regulated through legislation.

### Financial incentives

The Government could drive development in the right direction through economic incentives. Manufacturing new products using recycled materials should be rewarded through, for example, tax relief. Economic mechanisms could be used to increase the supply and demand for materials that are based on residual flows (such as waste from the food or plastics industries).

### Tax relief

Tax relief could be provided to people/actors who reuse, rent and subscribe for clothes and textiles (sheets, curtains and towels for example) to kick-start the transition. This relief could then be gradually removed; the more actors entering the market, the greater the market share these business models will take.

### Legislation for reliable circular flows

European chemicals legislation should be overhauled to guarantee reliable circular flows. Studies are needed to define what a reliable flow looks like and how to measure it. This would involve everything from defining risk-free levels, the effects of combining different chemicals, and measuring short-term and long-term exposure, to studying substances used in particle form.<sup>28</sup>

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<sup>28</sup> If, for example, jewellery is made from old tyres, it is important to remember that this material could contain toxic substances and in its new form would be worn close to the body.





## Business models

»To achieve resource effectiveness and circularity, today's business models need to be transformed.«

In order to achieve resource effectiveness and circularity, today's business models need to be transformed. This is true regardless of whether an actor decides to start offering add-on services and products or just wants to adapt the existing core business to new circular conditions. We need to rethink and reconstruct many of our processes, structures, habits and behaviours. To guarantee long-term sustainable success, we need to have a holistic perspective on what we are doing; understand how all of the parts interact and impact each other and ensure that our value chains are sustainable for the long term. Including and working in cooperation with all stakeholders is crucial, because no one actor can create the necessary change alone. All of these aspects must be included when new business models are developed.

Many of today's business models are based on over-production and over-consumption. Hopefully in the future we will not want a wardrobe crammed full with unused clothes or purchase mistakes, but instead have a smaller, carefully curated wardrobe that requires less space, is easier to take care of and can be updated in various ways and at a different pace depending on the user. Hopefully traceability and transparency will enable customers to make informed and conscious choices, and clothes that are phased out from the wardrobes of conscious customers will never end up in the bin but instead be considered valuable resources in the future.

The same applies to the considerable textile flows in hotels, hospitals and work clothes. These models need to be reviewed and made more resource-effective, circular and sustainable. How can we make sure that procurement includes circular criteria and how can we update collections and products without throwing away last season's items? And how can we ensure that worn out textiles do not go to incineration but instead identify flows for these so they can be redesigned and sold again or go to recycling? These flows

usually consist of large volumes of the same type of garment and material and traceability is provided through the labels used by laundries. These flows are therefore very well-suited to lead the way in creating closed cycles for textiles.

## Business models for resource effectiveness and circularity

To create a resource-effective textile sector we need to build up optimised circular systems where companies and organisations can contribute solutions and products in the various parts of a greater ecosystem. This will create new business, relationships and partnerships, and companies/organisations will embrace larger parts of the chain – some will focus on and become specialised in a small part, while others will cover larger parts of the system through their own operations. It will be important to have a diverse range of enterprises and solutions in the future. The common denominator is that all actors will participate and contribute to creating a resource-effective and circular textile flow.

## What needs to happen in the private sector

### BUSINESS MODELS

#### Buying precision

- Buying precision will play an important role and can be facilitated by digitalised and faster production through automation and on-site production, as well as through slower purchasing processes based customised solutions and pre-orders. Stores of the future – both physical and digital – will look different and be operated in new ways. AI as a tool and using algorithms to increase buying precision will play an important

role. Physical stores will probably no longer be over-filled with products or have a large inventory, but will instead serve as showrooms, experience centres and service hubs.

### **New customer segments**

- We need a new way to divide up customer and market segments based on alternative business models. For example: customer group A buys new clothes, customer group B rents new clothes, customer group C rents used clothes and pays a lower price and customer group D buys second-hand clothes.

### **The second-hand market**

- The second-hand market needs to be developed and have a higher status. Today many people think of used items as smelly or dingy clothes. Meanwhile the number of upscale second-hand options continues to increase, such as Varié (both digital and physical shops) or Judits Second Hand and Arkivet in Stockholm, to name but a few. Digital platforms and apps for reuse and resale of clothes will probably increase in number, including apps that drive commerce between users. Running a second-hand shop is costly as all garments are unique and need to be handled individually. There are also overheads for styling, photography, communication, pricing etc. If digital tools and solutions for sorting, pricing and photography can be developed, there is great potential for successful second-hand operations.

### **A number of recommendations for selling used items have been produced in a report from Mistra Future Fashion<sup>29</sup>**

- Make the second-hand market feel like a first-hand purchase experience through marketing, product placement, trend focus, communication, pricing and delivery.

- Promote a better understanding of the various consumer segments in the second-hand clothing market and adapt operations accordingly.
- Use technical and logistics innovations and build strategic partnerships with service suppliers (such as insurance, transport/shipping and IT) to make business models more cost-efficient.
- Use the influence of the fashion industry to create fashion trends in the second-hand market and in doing so, increase awareness and change pre-conceived notions about used clothes.
- Prioritise sustainability in a credible way and communicate this to the consumers.
- Prioritise dialogue with customers and education to create awareness about the positive effects of second-hand consumption on the environment and about how to care for products.

The second-hand customer segment varies significantly from “treasure hunt” consumption, with garments going up in value on Blocket (Sweden’s equivalent of eBay) or finding unique bargains and more up-market garments from Vestaire Collective or Real Real for those who want cheaper prices in more curated environments. In other words, we are going to see a second-hand segment with varying price levels, styles etc., just as is the case with today’s new clothes brands and retail.

### **Repairing and updating clothes**

- Today many actors offer free repair, which is a good way to teach users that repairing is smart. In the future actors should charge for this service which means there is commercial potential here. Traditional tailoring shops that carefully and expertly tailor

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29 Sweet, S. and Wu, A., 2019, *Second-hand and leasing of clothing to facilitate textile reuse* ([http://mistrafuturefashion.com/wp-content/uploads/2019/10/S.Sweet\\_-\\_second-hand-and-leasing-clothing-textile-reuse.-mistra-Future-fashion-2019.13.pdf](http://mistrafuturefashion.com/wp-content/uploads/2019/10/S.Sweet_-_second-hand-and-leasing-clothing-textile-reuse.-mistra-Future-fashion-2019.13.pdf); accessed 9 November 2019).

garments will regain a higher status. There only a few of them left, but hopefully more will emerge in the future. Dry cleaners will also probably increase in number and expand their service to laundering, altering and repairing garments. They could even perhaps serve as pick-up hubs for rental services. Availability and practical solutions are important to grow this area further, and digitalisation will be helpful. Perhaps delivery service actors for online food purchases could pick up dry cleaning (or clothes for recycling) on their return trips?

#### Sales patterns and spare parts

- Another alternative is to sell patterns with spare parts for customers who want to tailor, update or repair their clothes – especially in the work clothes segment (where there are currently a few initiatives under way). This would enable customers to easily tailor clothes as needed; for example, repair pockets or shorten or lengthen the legs of trousers for different seasons. If these garments were also part of a rental service, laundries could provide this service.

#### Design for a long life

- If clothing companies can find ways of updating garments, the various stages of the item's life could be taken into account and prepared for right from the design phase, either by the company itself or the customers. If this service is offered by companies they could generate revenue multiple times from the same garment and increase the value of the product after each stage. The research has focused, for example, on how to use digital printing in stores to renew garments. This could be a resource-efficient and cost effective way to update clothes.<sup>30</sup>

#### Redesign

- There are interesting business models to explore to update clothes based on large return flows, such

as Re:textile, a project at Science Park Borås where Berendsen work clothes and Cheap Monday have partnered through R:textile to collect and update discarded Berendsen clothes which are then sold in Cheap Monday shops. Rave Review is another company that alters old clothes and textiles to create new clothes and collections. There may in the future be a need for material brokers who can connect sellers and buyers. Here Rave Review could, for example, send out a request for the type of fabric they are interested in for future collections. Rekotex, a small start-up, has launched a similar service but for post-production leftover fabric. Brands can place available fabric on their platform, which other designers or companies can purchase in a type of brokerage service. Residus, a relatively new fashion brand, makes clothes from surplus post-production fabric.

#### Local production

- If we can create more local production opportunities we can pave the way for new business models with the potential for updating and redesigning clothes. This would also make it possible for brands to adjust garments that are not selling instead of selling them off or discarding them..

#### Leasing and subscription

- Leasing and subscription of clothes are other business models of interest that are growing. The models that will probably do the best are multi-brand solutions where customers have a wider range to choose from, such as Something Borrowed, It's Released and Sabina & Friends in Sweden. Renting out hotel and hospital textiles is already a well-established business model and it would be interesting to see how this concept could be grown. A solution within the private sector where individuals, for example, rent towels and bed linens

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<sup>30</sup> Earley, R., 2019, *Circular design researchers in residence* (<http://mistrafuturefashion.com/wp-content/uploads/2019/10/R-Earley.-circular-design-researchers-in-residence.-Mistra-future-fashion-report.pdf>; accessed 9 November 2019).

from laundries could be a possibility in the future. Today we already accept the fact that the towels and sheets we use at hotels are used by others without considering them of lesser value. We should apply this attitude to renting textiles and buying second-hand. If we can change attitudes, we can develop and grow other marketplaces where private individuals share and rent from each other, in the same way as Hygglo does for tools.

### **Recommendations for leasing according to the report from Mistra Future Fashion<sup>31</sup>**

- Offer high-quality products in a leasing system and at the same time introduce everyday clothes and promote leasing as a way of consuming fashion.
- Have flexible pricing and lease terms to create attractive solutions and thus increase acceptance and awareness among consumers.
- Partner with service providers to develop leasing system solutions, including insurance products, web shop platforms and transport logistics.
- Work with industry partners to build confidence and commitment among investors to secure long-term capital for exclusive leasing models.
- Build a base of loyal customers who can be advocates for this type of clothing use and build awareness.

### **Wardrobe consultants**

- A new service that would be interesting to develop further is private consultants for a more sustainable wardrobe – advice on everything from how to clear out, to how to build a curated wardrobe. This could either be in the form of independent stylists or a service offered by companies, online, in store

or at home. Training for store personnel would be required.

Confidence, accessibility and convenience are important components in order for new services such as renting and leasing to become established because it is difficult to get customers to change their behaviour and venture into something new.

## **Innovation**

### **Profit from functions**

- The big questions is how companies can profit from something other than their product's physical attributes, like generating revenue from the function a garment provides. This is where new solutions and services such as leasing and subscription come in. Hopefully in the future we will have established communities for sharing garments – both commercial and individual solutions.

### **Digital tools and solutions**

- There is a significant need for new technology to make many of the new business models profitable. They could involve digital tools to manage a wardrobe, assistance bringing a wardrobe to life, help giving clothes a longer life, ease in switching to a new size within the same clothing chain, help matching colours, and help with photography and publishing images etc. Digital solutions will play an increasingly important role. Front runners exist, such as Atacac which sells products based on virtual images and essentially produces no physical garments until customers have pre-ordered them.

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31 Sweet, S. and Wu, A., 2019, *Second-hand and leasing of clothing to facilitate textile reuse* ([http://mistrafuturefashion.com/wp-content/uploads/2019/10/S.Sweet\\_.-second-hand-and-leasing-clothing-textile-reuse.-mistra-Future-fashion-2019.13.pdf](http://mistrafuturefashion.com/wp-content/uploads/2019/10/S.Sweet_.-second-hand-and-leasing-clothing-textile-reuse.-mistra-Future-fashion-2019.13.pdf); accessed 9 November 2019).

## PROJECTS RELATING TO PURCHASING PRECISION

The project called Clothier was funded by Vinnova which was run by Stockholm University in cooperation with Stockholm Fashion District, Sweden Fashion Council, H&M and Metapic. Clothier provides a separate app or integrated solution on its website, where customers can vote for products/prototypes in the early stages before purchasing. These could be images or early 3D prototypes from designers in a fast and easy flow. This gives fashion producers fast feedback on products and what is popular, which increases their purchasing precision.

The project called inFashion was funded by Vinnova and by Stockholm University in cooperation with Sweden Fashion Council, H&M and RISE. AI provides a powerful mechanism for computers to learn to identify patterns in very large quantities of data. The project uses the technology to find and render clothes in images online and perform a digital fashion trend analysis. This result is more exact and faster analysis, which better enables the industry to meet demand and reduce over-production.

The Shoppable Vids project is financed by Vinnova and run by Stockholm University in cooperation with Studio Bon and inDigital, among others. The project is using modern AI to create a tool for post-production of video to support automatic tagging of wearable fashion and accessories in video clips posted online. The article of clothing in the video is clickable to enable links to various social media and ecommerce channels. Similar to in the Clothier project, the data collected from, for example, an online fashion show can provide early feedback on what customers want, which increases buying precision.

- Production processes are being transformed by automation and 3D printing. Production could take place in Sweden where high labour costs are otherwise an obstacle to local production. We are, however, still waiting for technology and software to be developed, such as AI for sewing robots and avatars based on what the industry needs.

### Local production hubs

- Another scenario is to enable development of local hubs/remake centres where customers could build their own garments using AI and 3D printers. Digimode, a project of the Swedish School of Textiles in Borås, has tested this in on-demand production with items then being 3D printed locally (see fact box). Production infrastructure is needed in Sweden to make this work on a commercial scale.

### Artificial intelligence

- Ecommerce could drive development in the right direction through improved purchasing precision thanks to central warehouses and AI. But we need to overcome the problem of the high return ratio in ecommerce and find alternatives to the expedited

## AVATARS AND DIGITAL FASHION

More and more solutions are emerging that allow users to scan their body or input basic information about their bodies and measurements to create a digital avatar. The avatar is then dressed in a garment using a physique-based 3D simulation. The user can then see the garment in a 360 degree view.

Digital fashion is a project of Houdini, Berge Consulting, the Swedish School of Textiles at the University of Borås, TEK0 Solutions and others. Together they have produced a digital tool to sell customised made-to-measure sports and fashion clothing that is locally produced by Syverket in Borås. Based on an avatar of themselves, customers can make changes to selected garments and get a garment that is tailored specifically for them.

shipping based on air freight offered today. A better purchasing experience in the digital world could help here, where shoppers could have the virtual experience of a store, changing room and products



with an avatar representing themselves (see fact box). Better measurement and size information will also be developed and several solutions are already emerging. Significant improvements could be made by reading and analysing data and engaging customers in order to reduce overproduction (see fact box).

## Policies and legal requirements

- The issue of VAT on new business models needs to be addressed as this sometimes prevents the desired effect from being achieved.
- In general economic incentives could be used to encourage more actors to test new business models. In certain cases laws are needed to bring about necessary change to important aspects, such as producer responsibility.
- Encourage solutions that are circular, i.e. resource-efficient, good for the environment and fully recyclable.
- Public, tax-funded actors that support industry should be tasked with promoting circular business models.
- Remove subsidies on products or solutions that prevent circularity.

New types of transportation and shipping solutions should emerge when new business models are implemented. This is something worth looking into further and that the Mobility subproject describes in its report.

## What needs to happen in the public sector

Transformation in all parts of society will be needed in order to make circular flows happen. The public sector could take action to support the change that is needed: in Sweden the public sector market has a turnover of SEK 683 billion, which is equivalent to 17 percent of GDP. Municipalities are the most common procurement authority. In 2017, 234 procurements of clothes, shoes, bags and accessories took place involving an average of 4.1 contractors submitting tenders per call.<sup>32</sup>

Public procurement could show the way for new business models where, rather than traditional purchasing, the functions of clothes and textiles are purchased where this is beneficial in terms of resource effectiveness, environment and cost. It would then be possible to use public procurement to leverage changed behaviour.

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32 National Public Agency for Procurement and Swedish Competition Authority, *Statistik om offentlig upphandling 2018* ([https://www.upphandlingsmyndigheten.se/globalassets/publikationer/rapporter/statistikrapport\\_2018\\_webb.pdf](https://www.upphandlingsmyndigheten.se/globalassets/publikationer/rapporter/statistikrapport_2018_webb.pdf); accessed 16 September 2019).

## Business models

### Purchase functions instead of products

- The circular economy commission report *Från värdekedja till värdecykel* (From value chain to value cycle) points to public procurement as an important tool to move towards a circular economy by, among other things, extending the life of products, and purchasing functions instead of products.<sup>33</sup>

### Updated guide for procurement

- The current guide for “Sustainable delivery chains”<sup>34</sup> is divided into different levels, where the advanced level is only a baseline for sustainability in general and where nothing relating to circularity is specifically addressed. An updated procurement guide is therefore needed.

### Circular strategy

- The national procurement strategy mentions circular procurement as a strategic tool for Sweden’s transition towards a circular economy. The Nordic Council of Ministers’ 2017 study “Circular Public Procurement in the Nordic Countries”<sup>35</sup> describes four approaches that could broaden the circular perspective in public procurement. The approaches work in a circular way at all levels: from procurement of products with circular properties based on sustainability criteria and, through procurement, create or promote circular systems. Among other things, the report describes a two-year project carried out by Herning Municipality in Denmark which looked into implementing a circular economy.

One of the more successful tests involved leasing and renting of work clothes to increase reuse and recycling. The Proteko design school helped the project to develop criteria for contractors submitting tenders. The result was substantial financial and environmental savings, which demonstrated that textiles had the greatest potential for circular models.

## Policies and regulations

### Purchasing criteria

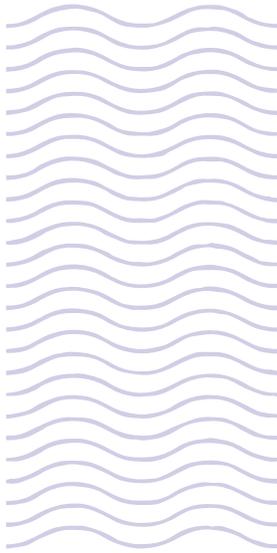
- Expanding the purchasing criteria would be a step in the right direction, such as including a life cycle perspective, the ability to reuse and recycle, cost per use, climate impact and emissions criteria. Support for the procurement process would also help, e.g. simpler tools and better support in the form of sustainability experts at the National Agency of Public Procurement. In food procurement there is, for example, a product library of templates containing criteria for each product. This could be a useful model for textiles as well.

There are good opportunities to meet the future challenges and create opportunities through public procurement and to leverage it to drive innovation. The public sector could in this way share in the innovative power of enterprise and drive development and renewal.

33 SOU 2017:22, *Från värdekedja till värdecykel – så får Sverige en mer cirkulär ekonomi* ([https://www.regeringen.se/49550d/contentassets/e9365a9801944aa2adce6ed3a85f0f38/fran-vardekejda-till-vardecykel-2017\\_22.pdf](https://www.regeringen.se/49550d/contentassets/e9365a9801944aa2adce6ed3a85f0f38/fran-vardekejda-till-vardecykel-2017_22.pdf); accessed 16 September 2019).

34 National Public Agency for Procurement, *Hållbara leveranskedjor* (<https://www.upphandlingsmyndigheten.se/hallbarhet/stall-hallbarhetskrav/kontor-och-textil/textil-och-lader/textil-och-lader/hallbara-leveranskedjor/#avancerat>; accessed 16 September 2019).

35 Nordiska Ministerrådet, 2017, *Circular Public Procurement in the Nordic Countries* (<https://norden.diva-portal.org/smash/get/diva2:1092366/FULLTEXT01.pdf>; accessed 16 September 2019).



## Recycling and industrial symbiosis

»We will need a wide range of solutions and recycling methods for different types of fibres made from both mono-materials and mixed ones. We also need to develop synergies between different industries to close the textile cycle.«

Recycling is a crucial factor in being able to ensure a circular textile flow. A wide range of solutions are needed, i.e. both mechanical and chemical recycling and recycling methods for different types of fibres made from both mono-materials and blended ones. It will not be possible to meet the future raw material requirements with virgin fibres alone. Also, our society could extract greater value from worn out clothing than is achieved through incineration. Solutions that give old textiles new life or use more recycled materials can also be found outside the textile industry; both inflows and outflows could be created through new industrial symbiosis, where waste from one industry becomes a resource for another. One example is the textile industry working more closely with the plastics industry. Today, there are a few solutions for chemical recycling that can enable recycling of blended fabrics. Regenerator, Worn Again and Blend Re:wind are three examples, even if they are so far only at the lab level. Infinited Fiber Company in Finland has identified a process to recycle textiles from cotton an endless number of times without loss of fibre quality, but the company is still operating on a small pilot scale. Swedish Re:newcell is the enterprise that has made the most progress. With a pilot facility with a capacity for 7,000 tonnes/year, it is already planning for the next stage to increase capacity.

Development of new business models will hopefully give rise to industrial symbiosis. New ecosystems will emerge around servicification, such as repairing, renting, remaking, i.e. where we create new products with used textiles as the raw material. This is already emerging, although it is still on a small scale. Laundries, tailoring, insurance, transportation and local production hubs are all needed to scale

up these concepts. Synergies exist with a number of other sectors. Vegetable waste products can become fibres that are spun into fabric or 3D printed to create other products. Companies are for example producing textiles from surplus biomass. PET bottles and other plastic materials can become polyester and recycled polyester can become plastic again. Vinnova has been commissioned by the Government to study ways to promote industrial symbiosis and in 2018/2019 it focused specifically on textile flows.

#### SYNERGIES BETWEEN TEXTILES AND PLASTICS

There is great potential for synergies between the textile and plastics industries. Synthetic fibres – the most common fibres in our clothes and fabrics – account for more than 60 percent of global fibre use in the textile industry. Partnerships are needed to close the cycle for both textiles and plastic. Recycled material from plastic products could be a source of raw material for textiles, and worn out fabric that is collected and recycled could be a resource in the plastics industry. The two industries have similar challenges to solve, such as creating standards for polyester and other plastic materials to promote recycling. Textiles and recycled plastic can become composites and new materials in other industries as well, such as the automotive and aviation industries. For industrial symbiosis to be effective, a common system and marketplaces are needed where companies can purchase volumes of collected and recycled resources on a continual basis. There is also a common interest in chemical recycling.

## Recycling and synergies to close the cycle

Recycling is not the ultimate solution; we need to optimise the cycle by first and foremost encouraging the reuse of products and materials.

In Sweden we consume around 14 kilos of textiles per person and year, just over half of which is thrown away in household waste and incinerated in the district heating system together with other combustible waste fractions. There are many explanations for this: it is not easy to find textile collection locations; people do not know what to do with their worn textiles or what happens to them and people think that the textiles they pass on should be clean, “nice” and have no holes or tears (which is not the case – torn textiles can be recycled, the only requirement is that they are not damp or chemically contaminated). It is also hard for consumers to determine what is “nice” and what sells in a specific market. Some skills are needed to determine which garments will sell.

The textiles collected annually in Sweden – just under 4 kg per person, or the equivalent of 38,000 tonnes – are largely sorted in Europe where there are large sorting plants and actors such as Soex, Boer and Texaid. Soex, for example, has a plant that sorts 400 tonnes per day. There is no such plant in Sweden.

Technology development is needed that can support traceability and efficiency. Investment and risk capital are also needed to scale up new innovations from grams to tonnes and to be able to process recycled textile pulp at the national level, which is desirable. For this to happen we need

### EXAMPLE: WARRANTEE RETURNS

Renewal Workshop is a relatively new initiative with customers such as Prana and North Face. The company accepts returned garments under a guaranteed return policy, mends them and resells them as second-hand products. This is a new type of actor in the ecosystem and it can be considered a service supplier that also adds value through rebranding.

to stimulate a market for sorted materials and develop new markets. Although there are numerous partnerships in Sweden in this area, even more openness is needed in industry with an open source approach through different networks and constellations. And last but not least, support is needed in the form of policies and legislation.

## Business models

### Design for recycling

- A garment normally consists of multiple components including fabric, lining, thread, buttons, zips, interfacing, washing instruction labels etc. These components usually consist of different fibres and materials, making the garment difficult to recycle. A product made from a mix of materials has to be taken apart before the various materials can be recycled. Depending on which materials are to be recycled and using which method, there may be a limit to how many times fibres can be recycled before they become too short and can no longer be spun into thread. There are different solutions and scenarios to remedy this, such as designing garments with mono-materials or that can be easily taken apart.

### Recycling schedule

- Produce a schedule for the materials that are suitable for different types of recycling (e.g. mechanical or chemical) based on both quality and resource-effective key ratios/indicators. The schedule could also show how many times fibres can be recycled and become fabric again and go on to be recycled into something else – e.g. composite materials or insulation – or when it is time for incineration/energy recovery. It would also be interesting to evaluate the external flows from other industries that could be measured in the textile flow, such as paper, agricultural residues or synthetic flows.

### Good collection systems

- Collection and sorting of worn out textiles plays a key role in making textile recycling efficient. It is therefore important to have good collection systems that

can ensure that the materials are in a hygienic and dry environment and that sorting is as automated as possible. For large-scale collection, the system needs to be accessible and convenient for its users. Collection stations where people usually are, such as supermarkets, clothing shops and parcel pick-up locations, or through sorting into fractions at the household level, are potential solutions for lower-value clothing. A digital app or platform to support garment collection would be a step in the right direction to show users which collection options exist locally, how much compensation is offered and where the clothes they drop off will go.

#### Raise the value of collected textiles

- Half of the volume collected today has very low or little value. The reuse fractions “cream” and “next best quality” account for the second half of the volume, but represent a full 97 percent of the total value of the sorted materials. There is therefore a significant need to encourage innovation to increase the value of the low-value volumes.<sup>36</sup>

## Innovation

#### Automated sorting

- To reach the 2025 goal proposed by the Swedish Environmental Protection Agency of a collected volume of 85,000 tonnes/year and at the same time benefit from and develop the inherent value of the volumes, large-scale collection, sorting and models are needed for reuse and recycling. There are two initiatives under way today to develop and build capacity in textile sorting. Both initiatives use near infrared (NIR) technology with an automated method

of determining the types of fibres in a material. NIR technology can also determine the content of mixed materials. In its WargoTex project Wargön Innovation has established a test and demo facility for reuse, redesign and recycling of material flows.<sup>37</sup> In a project called SIPTex, IVL Swedish Environmental Research Institute and Sysav plan to establish a large-scale sorting plant in 2020 in Malmö for materials sorting.

#### Digital labelling

- Technical innovation in material sorting using digital labelling is crucial to ensure that the sorting process is reasonably profitable. There are various technologies for traceability using, for example, QR codes, RFID labels or DNA woven into yarn. Sorting technologies for reuse and recycling should also be developed and automated. Substantial investment is also needed to make the actual material recycling process effective.

## Synergies

#### Mapping of waste flows

- We need to have a greater exchange of materials between different industries and sectors. Analysis is needed to identify important and relevant flows and new streams – both industry flows and post-consumer flows. Potential industry partnerships could be formed between the forest industry, agriculture and the food, engineering, construction and automotive industries.
- Synergies need to be developed with actors from, for example, the public sector (to harness the power of public procurement), the financial sector and

36 “The industry’s profitability today is entirely dependent on the ‘cream’ fraction”, says Maria Ström, Director at Wargön Innovation.

37 Wargön Innovation, *Etablering av test- och demo-anläggning för textila resurser* (<https://wargoninnovation.se/projekt/wargotex-development/>; accessed 16 S2019).

engineering industry. Tools, standards, traceability and transparency are crucial to close the cycle and achieve full-scale recycling.

#### **Potential resource streams for textiles**

- From agriculture to food – vegetable waste products become fibres that are made into fabric or used in, for example, imitation leather. Milk products have also been introduced into the market. Success here requires large waste streams. Flows of potato peelings and residual products from breweries are among the interesting options to look at more closely.
- Forest companies – There is already a natural and established connection.
- From plastics – Today, for example, PET bottles become polyester, but there are other large streams from other industries to investigate further.
- Items collected from laundries and the public sector could be used to make new textile fibres.

#### **Potential resource flows from textiles**

- A large quantity of composites become new materials for other industries, such as the automotive and aviation industries. Another material is glass fibre, which is moulded with plastic. Instead of glass, it could be possible to use worn out fabric and thus find a recycling flow for this low-value material.
- Synthetic materials could be used for polyester products other than textiles.
- Reused clothes, fabric, sheets, towels etc. can become new products when their fibres are too short for recycling. There is potential here for partnerships between charity organisations, the healthcare sector, the furniture industry and the automotive industry.

## **Policies and regulations**

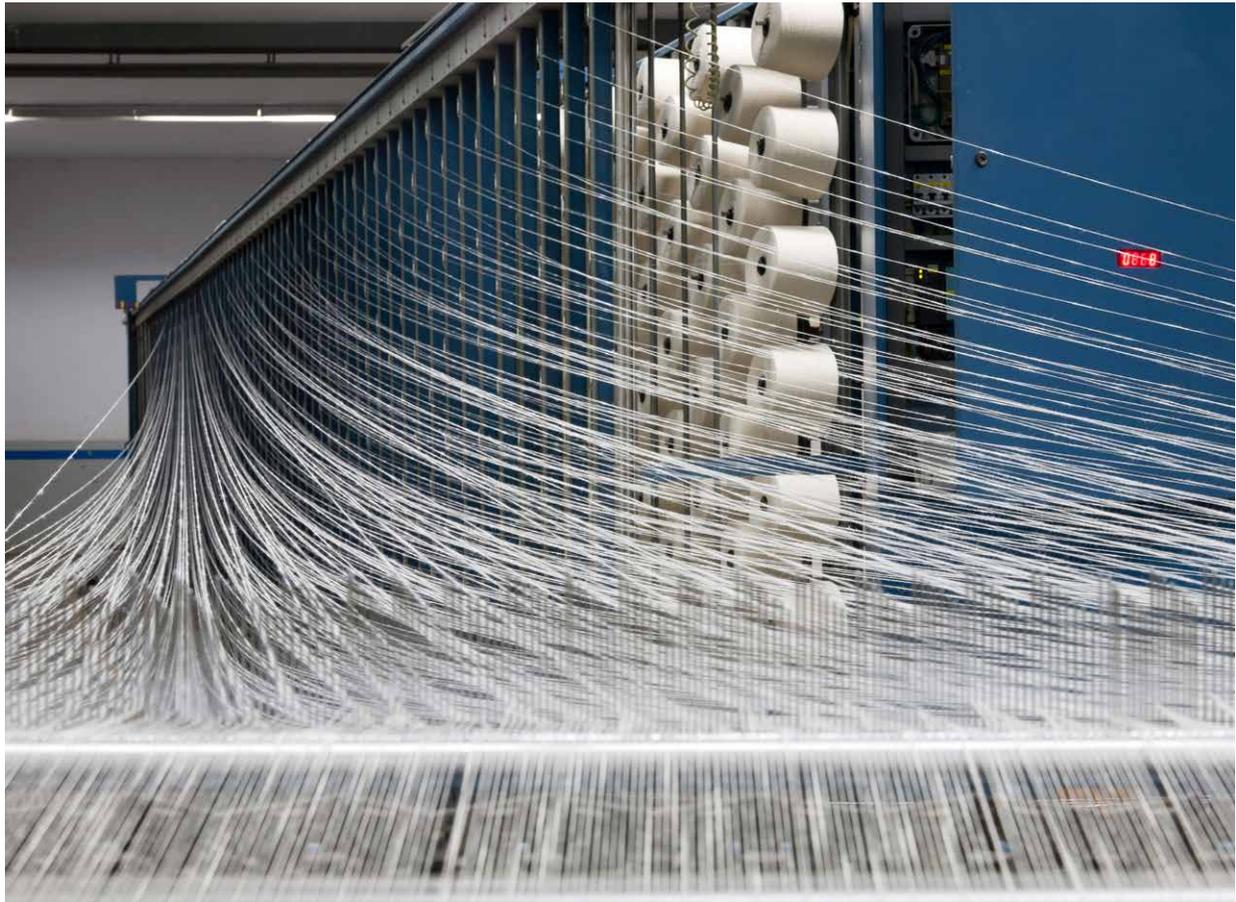
### **Producer responsibility**

- With producer responsibility, a value placed on materials and tax on incineration and waste, a larger percentage of the material volumes could be returned into the system. One proposal is to have a consortium driving this, with both public and private sector actors working together. One option is to create a bank for materials that can be reused or recycled, providing a structured way to guarantee accessibility and capacity. Mandatory producer responsibility is needed to ensure the necessary volumes exist to create sufficiently large material flows. Producer responsibility could focus on materials and ensure that they are managed in the best possible way to optimise use and value. There are numerous studies looking at various solutions. Important issues to address:
  - Financing – What should the fees be and can design requirements be attached?
  - Which channels should be included – imports, manufacturing, ecommerce etc.?
  - Regulations – The EU has introduced a new regulation within its Waste Directive and this will be introduced in a couple of years into Swedish legislation. It is therefore a good idea to take this into account now when designing Swedish producer responsibility.

Textile & Fashion 2030 in cooperation with RISE IVF, TEKO, the Swedish Trade Federation and the Swedish Recycling Industries' Association have already started a Vinnova project addressing producer responsibility.<sup>38</sup>

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38 Vinnova, *Producentansvar i cirkulära flöden inom textil- och modebranschen* (<https://www.vinnova.se/p/producentansvar-i-circulara-floden-inom-textil--och-modebranschen>; accessed 16 September 2019).



#### **Circulation requirement**

- New types of requirements are needed for what happens to products after use. A circulation requirement should be introduced; spare components should be able to be ordered and broken components replaced, such as torn sleeve linings or pockets. When a product is worn out, it should be able to be taken apart.

#### **Control mechanisms that promote recycling**

- Reward increased use of regenerated fibres from residual flows (not just from the textile industry). This could be done through economic incentives with control mechanisms promoting recycling.

#### **Remove customs obstacles**

- We also need to look at the customs obstacles that are currently making it more difficult or impossible for trading in used clothes or materials to take place between countries.



## **Innovative environments**

»If Sweden wants to remain at the forefront, we need to ensure that promising innovations have the necessary conditions in which to grow and help our country retain and develop research and commercial enterprise within our borders.«

By innovation we mean knowledge that is turned into new value, i.e. the development of products, services or organisations in both the private and public sectors. Innovation solutions in this area could range from industrial robots, payment systems and energy efficiency to leadership, business models and healthcare.<sup>39</sup>

In Sweden we are good at creating a climate and an environment for research and innovation, but we are not as good at scaling up the results. If Sweden wants to continue to be at the forefront, we need to ensure that promising innovations have the necessary conditions in which to grow and help our country retain and develop research and commercial enterprise within our borders.

Having innovative environments within and across different industries is key here. These environments could, in a very simplified description, consist of networks where, within a limited geographical area, there is access to 1) universities to provide expertise as well as academic excellence in a given area; 2) public funding and risk-sharing in research and innovation projects; and 3) a multitude of enterprises in the given sector. The latter also means access to a

functioning market with customers for innovative products and services. This is particularly important in promoting the growth of SMEs.

To succeed in transforming the textile industry into a resource-effective and circular flow we need to redesign products, processes, relationships and business models. This requires innovation in all areas. In order for innovations to be developed, we need creative environments where they can be nurtured, tested and implemented. It is crucial to have good support from business leaders, the research community, the Government and testbeds, as well as financial support.

There are currently excellent innovation environments and incubators within textiles such as Modeinkubatorn, Science Park Borås with the Government initiative Textile & Fashion 2030, Wargön Innovation, RISE IVF testbeds etc. Knowledge transfer from these types of environments is also important, as well as scaling up successful products and, most importantly, getting more companies to focus actively on innovation. It is important to get entire organisations behind innovation.<sup>40</sup> Individuals can generate ideas, but a team

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39 The Royal Swedish Academy of Engineering Sciences (IVA), 2011, *Innovationsplan Sverige*.

40 Conversation with Erik Valvring, innovation leader, Science Park Borås at Borås University.

is needed to develop them further and an organisation is needed to implement them. Companies that invest in innovation and have a strategy for innovation are also the ones that will have the greatest success and generate the most profits, but they also take the greatest risk of investing time and money in ideas that come to nothing, because not all projects succeed. Companies need to be bold enough to test new things but also humble enough to make adjustments along the way and accept failure.

Companies have different types of innovation strategies. In some cases new technology may control and drive innovation or customer demand may influence innovation (fashion is a strong example of this). Then there are those that read the market and are fast followers – they see what others are doing and then optimise internally to do what others are doing, but better.

According to a report entitled “The State of Fashion 2019”, on-demand and just-in-time production will increase drastically in the years to come. It is estimated that local production will double between 2018 and 2025.<sup>41</sup>

If this is correct it could lead to companies reacting more quickly to trends and making production cycles and collections smaller and faster, which could reduce the risk of buying mistakes and over-production, and increase the level of customisation.

There is progress being made in business model innovation. China has the Beijing-based online platform YCloset where users can register for a joint wardrobe for a monthly fee and rent clothes and accessories free of charge. It was founded in 2015 and is now available in around 40 cities in China, including Beijing, Shanghai, Guangzhou and Shenzhen. The platform has partnered with more than 100 fashion brands that offer the rental service.

It can be a challenge to focus on innovation as part of the core business, especially in the implementation phase. It may be better to hive off a company to test and drive a new business model. This makes it possible to define new customers and adapt an offering to them, and allow the business to grow from outside.

## Innovative environments that support resource effectiveness and circularity

### Areas where innovative environments will play a key role:

#### Digitalisation

- Artificial intelligence, apps, platforms and technology can all help to support development of new business models and solutions that promote resource effectiveness and circularity.

#### Transportation

- New modes of transport; for example, the use of automated vehicles for “last mile” delivery to customers or between individuals.

#### Upscaling

- New production processes for all stages of production – from new materials to automated manufacturing and on-demand production.
- Role of recycling in general – chemical and mechanical.
- Support from regulations as well as economic incentives

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<sup>41</sup> McKinsey & Company, *The State of Fashion 2019: A year of awakening* (<https://www.mckinsey.com/industries/retail/our-insights/the-state-of-fashion-2019-a-year-of-awakening>; accessed 16 September 2019).

**Symbiosis**

- Find new partnerships between industries where waste from one industry becomes a resource for another.
- Support new markets for collected and sorted materials.

**Education**

- Education in the private and public sectors and civil society.

## Business models

**Optimisation of processes**

- Innovation can also be about making small changes to processes and skills, such as through increased acceptance and better management of fabric weaving defects, discolouration and different shades, as well as establishing relevant standards to avoid unnecessary processing stages. Through increased knowledge and dialogue among buyers and providers, significant savings can be made for both the environment and the bottom line.

**On-demand manufacturing**

- We need new solutions and models, such as on-demand manufacturing. One way could be for customers to pre-order a product and then wait for it to be produced and delivered. At the Swedish company Atacac, customers order virtual products that are presented through 3D visualisation. Through this system no samples need to be made and shipped. Customers who buy before production has started pay the lowest prices as they there are no warehouse or over-production costs to cover. The highest price is paid by customers purchasing garments that have already been produced and are in store or in Atacac's warehouse. This type of on-demand production has great future potential and customers can expect different delivery times depending on the production process. If a

garment can be 3D printed or produced through an automated process, the process can be fast, but it will be slower in traditional craft production. The Digimode project run by the Swedish School of Textiles at the University of Borås in cooperation with Houdini and Syverket has tested the faster version of on-demand production where garments are 3D printed. Sporting attire company Adidas has "speed factories", and Nike's Flyknits shoes are largely made through automated processes. These processes avoid expensive labour costs and can increase production speed. Amazon has just patented a new technical platform to use robots for the cutting fabric in order to accept customised orders.

**Digital shopping experience to increase customisation**

- Increasing customisation and the digital shopping experience will be crucial in reducing the number of returns in ecommerce today. Close to 50 percent of the products customers order are returned, and considering the fact that major ecommerce actors are currently discarding returned products, there is an enormous waste of resources to address and remedy. Swedish start-up SizeNot is looking at this. With the help of an AI service it is aiming to change both the way the off-the-peg industry and end-customers view today's sizing system for clothes.

**Traceability and transparency as drivers**

- Traceability and transparency are potential key factors to drive innovation. If customers are able to see how and where a product is created and what impact it has had, and use this information to compare products, companies will be more eager to change the way they produce and sell clothes. This would reward good choices from both companies and customers.



## The financial sector

»Financing and investment in new technology and business models is a key success factor in the transition to circular models.«

The financial sector (e.g. pension funds, banks and insurance companies) are constantly looking for profitable enterprises in various industries, whether there are circular aspects to the business they are investing in or not. The more stable the cash flow of a business, the lower the risk of the investor losing money. There is also venture capital where greater risks are taken in order to achieve a higher return on invested capital. However, today regulations are often designed to make it cheaper and therefore more profitable from a business and financial perspective to use virgin input goods than to use recycled materials.

Financing and investment in new technology and business models is a key success factor in the transition to circular models. Several links in the chain are missing in the circular flow of textiles in Sweden and to close the circular flow by putting these in place, bold entrepreneurs, driven individuals and not least investments are needed.

## Fibre production

In the future we will need to find new fibres to meet an increased demand for resource-efficient, sustainable materials. There are several innovative materials in the pipeline but they are still far away from large-scale production. Growth requires investment. One example of a new Swedish spinning technology is Tree to Textile. The company is developing a new, innovative textile fibre process that is sustainable and has a lower cost than conventional processes and fibres, which is crucial in order to reach greater production volumes globally. The next stage is industrialisation and

building a demonstration facility for textile fibre production somewhere in the Nordic region. Another example is Södra's new initiative called Once More™ which can turn large volumes of used textiles made from cotton and blended fabrics into new clothes and textiles. It is now possible to use recycled cotton and cotton separated from polyester, cotton and polyester being the dominant blended fabric on the market. The cotton fibres are subsequently mixed in when dissolving pulp is produced at the company's plant in Mörrum.

## Textile production

If we want local textile production we will need to expand the infrastructure for it because today the majority is taking place outside Sweden, with only limited production in Sweden and mainly focused on soft furnishings. Automation, 3D printing and other digital solutions could boost local production again. But in order to bring this up to a commercial scale, upscaling investment is needed.

## Business models

Some parts of the circular ecosystem need to be strengthened to accelerate development towards more circular business models. Control mechanisms should be developed to reduce the financial risk for relevant actors looking to test new solutions. The Government could go in with targeted support from, for example, Almi.

## Collection

Collection is not the most difficult part of the chain, but it needs to be scaled up and one way to make this happen is through producer responsibility.

## Sorting

Sorting is a bigger challenge that requires both technology development and upscaling. At this time there is no large-scale plant to handle the substantial flows we are aiming to collect, and sorting textiles today involves a considerable amount of manual labour.

## Reuse

Enterprises that offer second-hand merchandise and that redesign products will play a vital role in prolonging the life of products. More of these are needed and above all they need to be profitable. Today it is difficult for companies to break even.

## Recycling

We need to find recycling flows for worn out garments and not just textile to textile. Today only a small percentage of worn out textiles that are collected are recycled. We need a wide range of solutions, and Re:newcell and its recycling method have a function to fill as one of them. Investment is needed in a variety of areas in order to achieve large-scale recycling.

**Challenges:** Ann-Charlotte Mellquist from RISE has looked at the financing challenges for circular business models.

This has resulted in a report<sup>42</sup> which shows, among other things, the challenges that arise when a company decides to rent out products instead of selling them. One of the main challenges is the effect on the value of assets and inventory on the balance sheet, and on cash flow because of the longer term nature of return on investment. This in turn affects the monitoring process and performance measures need to be reviewed and adjusted to the new conditions. It is important for the financial sector to be involved, but more is also required of the parties involved. Actors need to have deep insight and understanding of business models and goods or services, as well as for the customers. It involves taking more risk initially and being aware of the need to learn along the way because there is often not much to make comparisons with. The risk is also higher as it may take longer for investors to obtain a return on their investment. The products may also be of low value and cannot therefore be used as collateral. Alternative solutions need to be identified, such as using customer contracts as security..

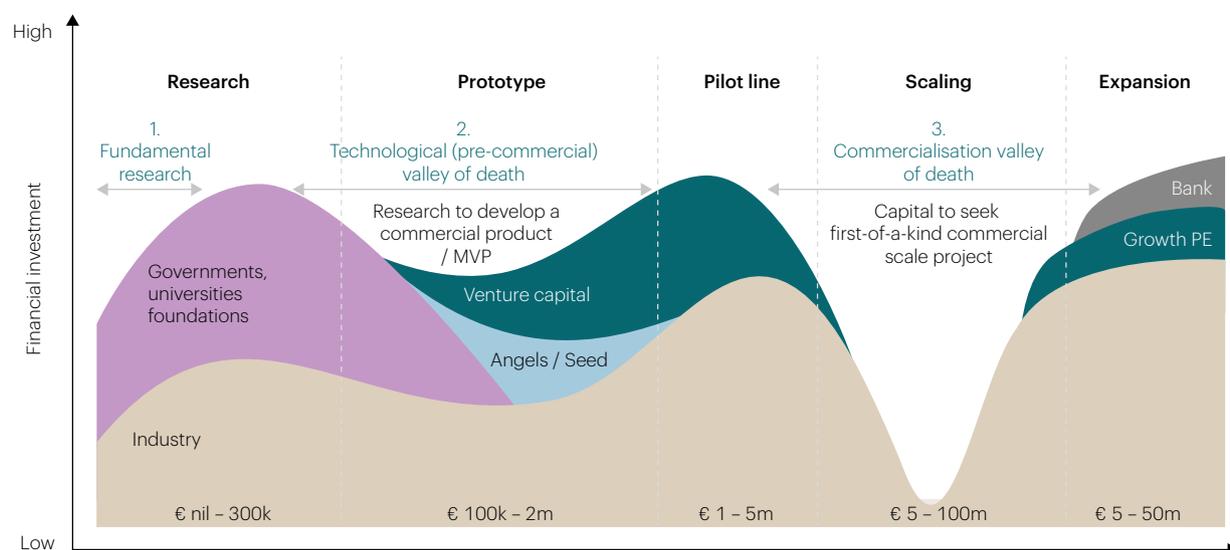
## The significance of the financial sector's role

It is difficult to secure financing for new business models and solutions based on sustainability and circularity. Representatives from the investor side themselves say that there is not enough capital at the early stages for new companies or innovations. People talk about the "valley of death" for new solutions and innovations when it is time to scale up to the commercial level. There is considerable public funding available for the research and pilot phases, but when actors subsequently want to take the next step and need larger investments, there is a gap in the capital market; the capital requirements are often too large for government subsidies, too small for public investment banks (such as the European Investment Bank or the Nordic Investment Bank) and institutional investors, and too new and unknown for

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42 RISE, *Slutrapport Finansiering cirkulära affärsmodeller – risker och möjligheter* ([https://www.ri.se/sites/default/files/2019-07/Slutrapport%20Finansieringsprojekt\\_Final\\_190613.pdf](https://www.ri.se/sites/default/files/2019-07/Slutrapport%20Finansieringsprojekt_Final_190613.pdf); accessed 16 September 2019).

**Figure 8:** “The valley of death” in financing of innovation in the upscaling phase.  
Source: SOU 2015:64 – En fondstruktur för innovation och tillväxt.



commercial banks. Private venture capital is not reaching these actors either. In a Swedish state public report (SOU 2015:64) this situation is described as a market failure where Government action may be motivated because societal benefits are being lost.<sup>43</sup>

## Policies and regulations

### National strategy for a circular economy

- In an international comparison, the Dutch banks have made the most progress in sustainability initiatives and supporting the transition. This is largely thanks to the government in the Netherlands adopting a national circular economy strategy. The same applies in Finland and Germany.

### Road map for sustainable investments

- A road map is needed for sustainable investments in line with a national circular strategy adopted by the Swedish Government. We would like to propose assigning investment funds, or if necessary new actors, to manage sustainability risk and evaluate societal benefits.

### Industrial parks

- Industrial parks could be one of the solutions going forward to encourage entrepreneurs to stay in Sweden, encourage enterprises to set up in one area, and potentially overcome development obstacles and help to make Sweden more attractive. In eastern Germany, for example, there are interesting industrial parks with established infrastructure, energy supply, water treatment and transport solutions.

<sup>43</sup> SOU 2015:64, 18 June 2015, *En fondstruktur för innovation och tillväxt* (<https://www.regeringen.se/rattsliga-dokument/statens-offentliga-utredningar/2015/06/sou-201564/>; accessed 17 October 2019).

Regional development banks are also part of the infrastructure and are actively seeking investment opportunities. It is difficult to secure capital to scale up industrial activity in Sweden. Germany is better at industrial investment and has good support from German Trade and Invest (GTAI) which provides co-financing up to 40 percent of the investment from the state, government and EU. Could the Swedish Government go in and provide support in the same way? Can we have more locations in Sweden designated as support areas according to the EU and therefore receive EU funding? Germany may have an advantage in that it has relatively independent and large states that compete with each other on investment. Meanwhile Sweden is also competing with each and every German state for these investments. Industrial parks in Sweden would also benefit significantly from green electricity and sound production processes. We want to see the Swedish Government taking the lead, especially in light of the fact that it has talked about new industrialisation.

The subproject would like to see industrial parks in Sweden that are able to offer the following:

- Energy and steam
- Water treatment with guaranteed capacity

#### RE:NEWCELL

The capital requirement quickly increases when innovative companies are about to take the step from lab to commercial production. The problem is that access to capital is low before companies have a commercially viable product. But capital is needed in order to prove viability. Banks see too much risk, venture capitalists do not have enough muscle and public funding is focused on supporting innovation at earlier stages. Re:newcell has first-hand experience of this problem and believes that the supply of capital in Sweden – from both private and public actors – is poorly adapted for scaling up promising green industrial technology here; enterprises are either too small, too large, too close to the market or carrying too much risk.

- Environmental permits that apply to and are managed by the park as a whole, not individual enterprises
- Transport connections – rail, road and perhaps even waterborne
- Broadband.

If the above is in place, companies would not need to look for capital for substantial, non-innovative investment or spend expensive resources on the administration required in the start-up permit process.

- An alternative to establishing industrial parks would be to mobilise more of the existing SIPs (strategic innovation programmes) into a joint programme, for example, between the following:
  - Produktion 2030 (<https://www.vinnova.se/e/strategiska-innovationsprogrammet-for-produktion-2030/>),
  - RE:Source (<https://www.vinnova.se/m/strategiska-innovationsprogram/resource/>), och
  - Possibly also Viable Cities (<https://www.vinnova.se/m/strategiska-innovationsprogram/Viable-cities/>).
- Expand the EU's innovation fund to also support circular solutions, and not just focus on the climate as is the case today..

## Innovation

### Regions could create business clusters

- If municipal or regional authorities created clusters of companies it would potentially make it easier to obtain loans through, for example, the Nordic Investment Bank which has more confidence in a region or municipality.

### Consortium for joint financing

- It would be a good idea to assess the possibility for several companies to form a consortium and

jointly apply for funding. This would enable them to reach the European Investment Bank's investment limit, which is usually EUR 50 million and upwards. A consortium could look at the possibility of making better use of the EIB's new regional textile funding programme, RegioTex. Västra Götaland Region is currently the selected region in Sweden.

#### **Financing adapted to new requirements**

- Existing government initiatives need to be adapted to new requirements. For example, the Government's Saminvest programme could invest in several new resource-effective textile initiatives in Sweden. Saminvest invests in privately managed venture capital funds on a commercial basis but with a wider purpose of making indirect investment in Swedish growth companies more attractive and accessible. Almi Greentech makes many sound investments but needs more muscles to support capital-intensive upscaling and create resilience. Other public financing and innovation actors need to be better at incorporating sustainability in their risk assessments and showing the value of the benefit or harm to society of a certain business activity. If Sweden is to be a circular nation even more private funding will be needed.

#### **Resource credit council**

- Export credits are guarantees or beneficial loans that governments offer to companies to facilitate international business to promote domestic exports. Sweden should review what it provides export credits for so that this does not work against Sweden's climate goals and our commitments under the Paris Agreement. It would also be of interest to consider what a credit council for resource effectiveness would look like. It would enable the Government to provide support through risk relief rather than funding, which could be a simpler process as government funding is regulated by the EU.

#### **Hub for financial models**

- Create a hub for innovative financing models, gathering representatives from the various parts

of the financial sector. This could be a forum to support non-traditional business cases for which it is hard to secure investment and where actors can jointly identify potential solutions to problems relating to safety, prospective customers, customer data, equipment leasing, alternative repayment plans etc. This type of forum could be located at the Stockholm Sustainable Finance Centre (SSFC) where it could be linked to practitioners. At the SSFC academia and private and public sector actors work together to accelerate the implementation of smart and green solutions through capital investment in line with the UN Sustainability Goals and the Paris Climate Agreement. Other potential partners could be Vinnova, Almi and incubators.

## **Business models**

#### **Involve investors at the start-up phase**

- Start-ups are harder to assign a value to and have no credit history. This presents a significant challenge to investors. The challenge is even greater if a company is also based on a new type of business model that has never been tested. A possible partial solution could be to invite investors to participate in the development of new business models for mutual learning, increased understanding for a new business model and an exchange of knowledge and ideas. SEB bank is, for example, already helping its customers to identify new business models that involve options such as leasing instead of purchasing their machinery.



## Appendix: Action plans

»We need to go from theory  
to practice to create the  
transformation we want to see.«

The action plans listed below are proposals based on the work group's workshop discussions. The action plans contain summarised concrete proposals for activities in various areas to close the textile cycle. Some of these are already under way, while others need to be launched and assigned owners. There are proposals for this in each plan.

#### **Action plans already under way**

- Standards for circularity
- The Progress Model
- From waste to fashion
- Circular Textile Industrial Park – preliminary study
- Business development and local production chains

#### **Action plans waiting to get started**

- Vision 2050
- Platform for circular flows  
(needs financing to get started)
- Education in product development and design
- Public procurement
- Investment hub
- Resource credit council
- Report on recycling flows
- Identification of industrial symbiosis

## Design for sustainability

### **Standard for circularity**

A project to develop standardisation of the environmental aspects of textiles in order to close the textile cycle and in doing so ensure that all affected parties can participate in profitable and sustainable development through standards. This should be in line with free movement of goods etc. in the EU's internal market, national legislation and research to promote innovation for new business models and to reduce energy consumption and climate and environmental impact.

**WHAT:** Textile standard for circularity.

**HOW:** Work groups at SIS, which is partially funded by the Swedish Environmental Protection Agency, will produce

standards to increase sustainability in the textile industry. This will include several aspects – from joint definition of terms to standardising recycling technology and using digital information carriers in garments for traceability.

#### **The project/standardisation will help to**

- clarify requirements/criteria for measurability and transparency in sustainability in textiles
- provide guidance and spread information
- clarify and facilitate practical implementation of legislation/ordinances/directives
- accelerate sustainable transformation
- improve measurability and transparency and thereby also facilitate regulatory oversight
- reduce climate and environmental impact
- allocate textile products via established jointly agreed flows
- promote research and innovation for new business concepts and indirectly provide incentives and thereby also new job opportunities

#### **Examples of potential standards/areas for standardisation within the project**

- Guidance for working on sustainability in the textile value chain
- Policy document with clear indicators (sustainability factors) for sustainable companies
- "User phase" – prolonged product quality for extended life
- Product and eco labelling
- Guidance for flow schedule for textile waste and infrastructure
- Guidance for waste sorting and textile management at recycling stations, laundries and within municipal and county authorities
- Material recycling requirement for textile products
- Requirements for recycled textiles
- Criteria for recycling methods – description of methods and flow schedule
- Fraction labelling – material identification

**WHO:** Swedish Institute for Standards (SIS), Swedish Environmental Protection Agency

## Business models based on sustainability, resource effectiveness and circularity

### The Progress Model

Produce a strategy and tools to enable actors in the fashion and textile industry in Sweden to work together to help ensure that the Global Goals in Agenda 2030 are met. How can different authorities, organisations and initiatives jointly support companies in making the transition? The focus is on meeting companies where they are in their sustainability work and supporting them to take the next step.

**WHAT:** Support for companies to take the next step in their sustainability work.

**HOW:** Prioritise the UN's Global Goals, strategy for cooperation and producing the "Progress Model" tool (self-assessment/planning/evaluation)

**WHO:** Textile & Fashion 2030

**TIMEFRAME:** The work has started  
– Finished at beginning of 2020

### Education in product development and design

Produce courses to teach the best way to design for sustainability and circularity.

Design for:

- Specific function and length of life
- Efficient use of materials
- Resource-efficient processes
- Reuse and recycling

**WHAT:** Courses in designing for sustainability in textiles and fashion.

**HOW:** Produce course structure and materials.

**WHO:** Textile & Fashion 2030.

**TIMEFRAME:** Autumn 2020.

### Business development and local production chains

At the Science Park in Borås a number of projects are under way involving cooperation among textile and fashion companies to test, for example, new circular business models and small-scale production in a local value chain. The Swedish School of Textiles and the recently established DO-Tank are offering a unique environment where companies can test new structures and produce prototypes.

**WHAT:** Development of circular business models for textile and fashion companies.

**HOW:** Offering project support and test environments for company projects.

**WHO:** Science Park in Borås, Re:textile, Circular Hub and Textile & Fashion 2030.

**TIMEFRAME:** Ongoing.

### Public procurement

To bring about circular flows all parts of society need to go through transformation, not least the public sector. The public sector could take the lead to support the change that is needed. The Circular Economy Delegation at the Swedish Agency for Economic and Regional Growth has public procurement as one of its three focus areas. The subproject would like to see, among other things, support for implementation of new purchasing criteria. One idea is to also look into using the IVL Swedish Environmental Research Institute online platform for circular procurement. The purpose of the new website is to provide companies and procurement departments with information and practical guidance.

**WHAT:** Sustainability has a higher priority than price.

**HOW:** Educate and inspire; tools as support; design new standards

- Circular thinking: What happens to end products?

- Extended life: Look at price/usage and not at individual prices
- Reformulate the Public Procurement Directive
- Conducting procurement according to the waste ladder
- Review rules for purchasing reused textiles
- Reduce use of single-use items
- Save certificates in connection with procurement so they are available when a product is sold on or goes for recycling (traceability through, for example, RFID or DNA in yarn)
- Develop and increase use of innovation procurement (educate, support, simplify)
- Due diligence: What are the consequences if the criteria are not met?

**WHO:** National Public Agency for Procurement and Region Skåne (textile procurement coordinator).

**FOLLOW-UP:**

- Establish goals for advocating for public procurement
- Environmental Objectives Council measure – legislation and goals for public procurement

## Investment Hub

**PURPOSE:** Scale up innovations to the commercial phase.

**WHAT:**

- Swedish Fashion for Good in Stockholm or Borås, an experiment hub for financing new business models and innovation
- Funding and support for upscaling of new industrial processes or business models that are in line with circularity
- Matching of investors and entrepreneur; a contact hub for various actors in the value chain
- Education of both investors and companies to create a knowledge hub for the various actors
- Help bringing in investors – for example government funding to support good loans –

an example is Business Finland which provides start-ups with 50 percent of the investment needed for a new enterprise

- Could include an investment fund for companies working on the transition, e.g. to replace their energy source with renewable energy or waterless water processes.

**WHO:** Swedish Private Equity & Venture Capital Association (SVCA), Norrskan, Almi, Inkubatorn i Borås, Textile & Fashion 2030 and others.

## Resource credit council

Credit for initiatives that increase resource effectiveness and circularity treated in the same way as export credits.

**PURPOSE:** Scale up circular solutions

**WHAT:**

- Transition loans for circular solutions (similar to export loans)
- Issue C vouchers (circular vouchers)
- Provide loan guarantees for circular solutions as risk relief
- Financing with a commercial focus

**WHO:** Swedish Agency for Economic and Regional Growth, Business Sweden, Swedish Export Credit Agency (EKN)

## Recycling and industrial symbiosis

### Recycling flows report

Report describing when it pays to recycle and which type of recycling is the most suitable. Essentially, a type of waste ladder – a “recycling ladder”. The Swedish Environmental Protection Agency in cooperation with other Nordic actors

has made a waste calculation based on a life cycle assessment.<sup>44</sup> Based on this, an easily comprehensible chart of optimal recycling flows could be produced.

**WHAT:** Describe optimal recycling flows for different materials and product streams

**HOW:** Produce a calculation model and a feasibility study based on existing reports and calculations uträkningsmodell och en genomförbarhetsstudie

**WHO:** Swedish School of Textiles in Borås, RISE, Swedish Environmental Protection Agency

## Identification of industrial symbioses

Take stock of the material streams and resource flows that exist in Sweden for cellulose, animal fibre and synthetic materials. We know that a transition to increased resource effectiveness and circularity is crucial in a future where the price of virgin raw materials is increasing and where resources are running out or are unsustainable in other ways.

**WHAT:** Analyse and document the resource and waste flows in industry and identify potential areas for industrial symbiosis or where there may be other solutions within the framework of a circular economy.

**HOW:** The project hopes to identify key product and material flows in Sweden and determine the economic value that these flows represent, and to define circular opportunities – both commercial and environmental. This process could then result in a report.

**WHO:** Circular Economy Delegation.

**TIMEFRAME:** Deadline December 2020

## Projects: From waste to fashion

After a successful first test of recycling worn out polyester tie-down straps from Axel Johnson International into new resources for Filippa K, the project group would like to scale up the initiative. Due to the significant volumes of discarded polyester and the increasing demand for recycled polyester in consumer products, we see significant potential here for a large-scale circular business model. The project, which started as an example of industrial symbiosis between two companies in the Axel Johnson Group, has substantial potential to grow and be an example of a transition to a more circular economy.

**WHAT:** Create a circular flow for polyester where waste from one industry becomes a resource for another.

**HOW:** Phase 2 will involve upscaling and a large-scale test to prove the commercial potential of this circular model. It will include the following: (1) Identify and create the ecosystem needed to collect, process, recycle and sell the polyester granules. This could include partnerships further downstream in the delivery chain to test more potential end users; (2) Create demand for the recycled polyester; (3) Identify a profitable business model for the project; (4) Develop ideas on conceptualisation/branding of the process.

**WHO:** Axfoundation, Axel Johnson International, Filippa K and Elco among others

**TIMEFRAME:** The project has started and is expected to be finished in Q1 2021.

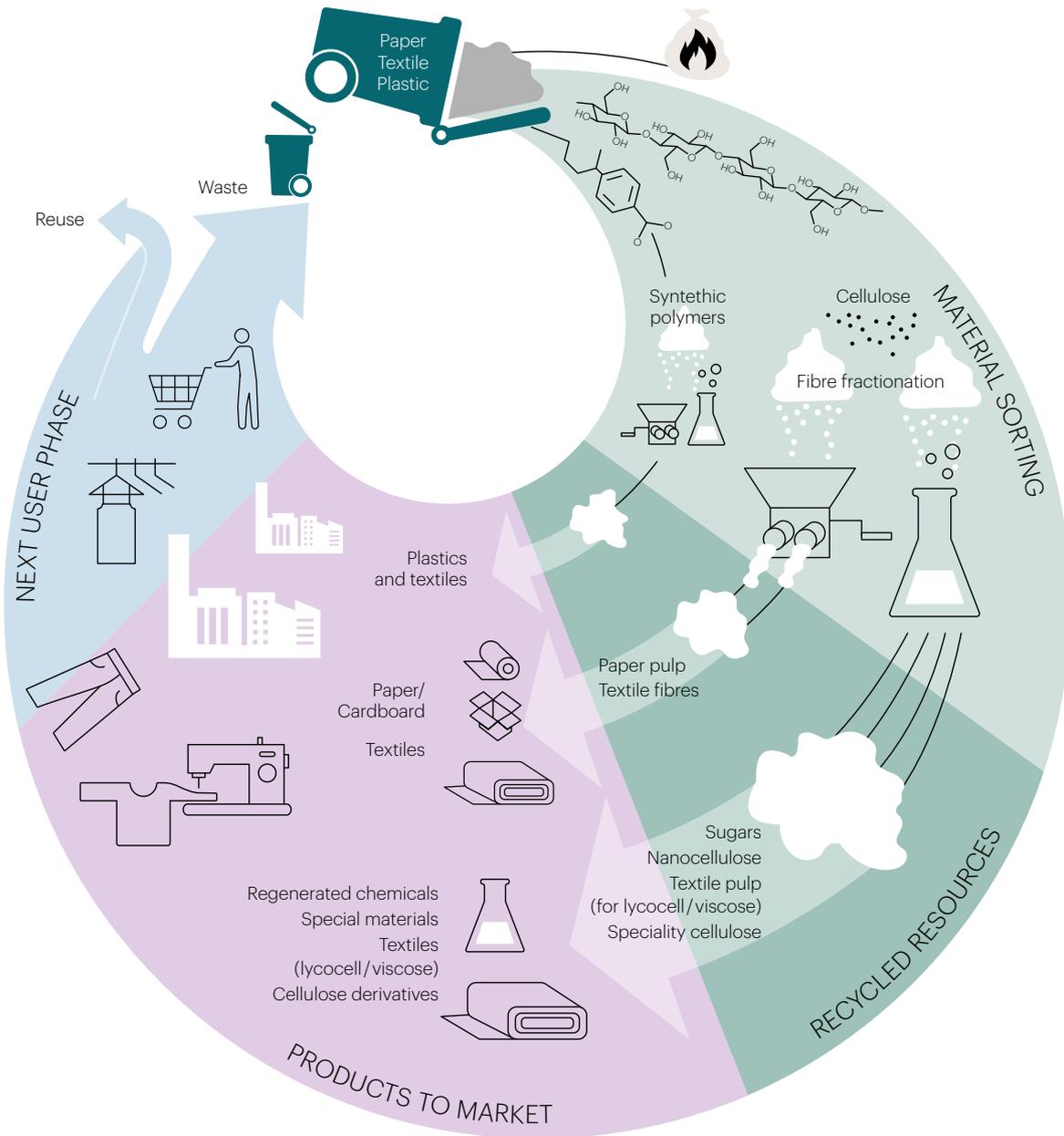
## Platform for circular flows

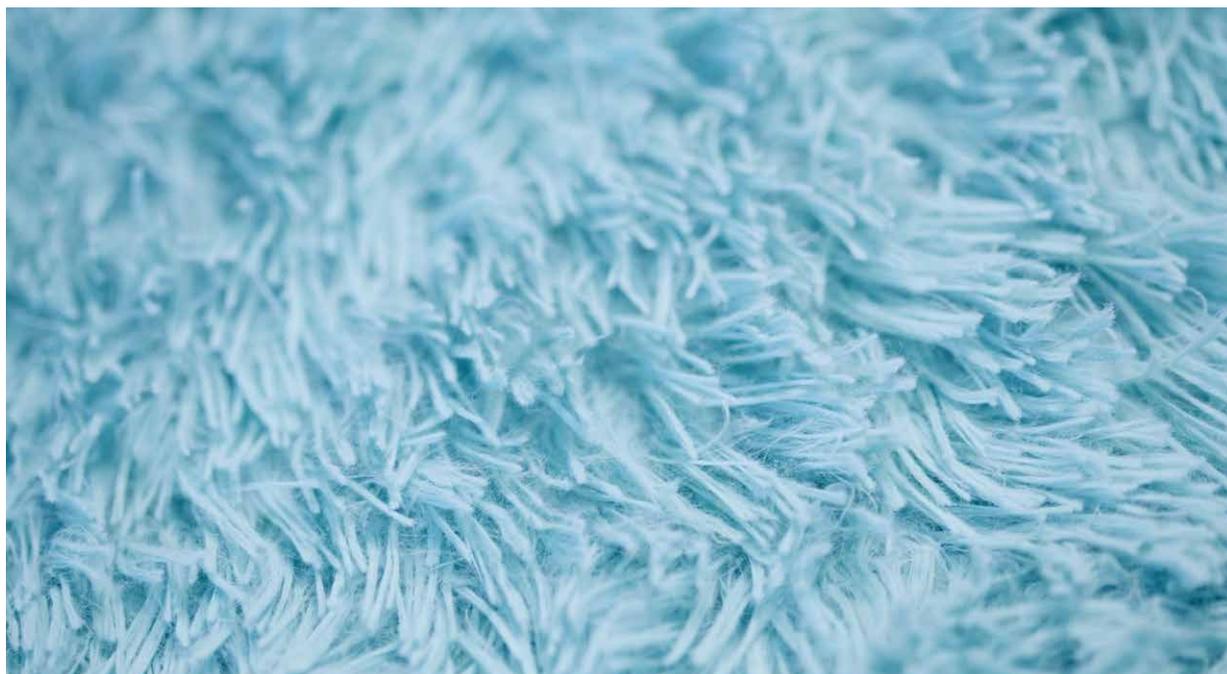
**WHAT:** The TexChain initiative involves establishing a marketplace and a forum that enables commerce (buying and selling) in residual textile flows from industrial production. A key aspect is also the ability

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<sup>44</sup> Swedish Environmental Protection Agency, Gaining benefits from discarded textiles (<https://www.norden.org/en/publication/gaining-benefits-discarded-textiles> accessed 12 December 2019).

**Figure 9:** Illustration of similarities between the waste management processes for paper, textiles and plastics in different sectors. If we look at waste in these three sectors from a molecular perspective it is possible to generalise and examine a material like cellulose (from paper and cellulose-based textiles such as cotton, lyocell and viscose) or synthetic polymers that could be updated in the future when the size of the flows is in line with our bioeconomics expertise. Source: RISE.





to test and develop products and solutions based on residual flows, providing the necessary conditions for sustainable and circular flows. Close cooperation between different industry organisations.

**WHO:** Wargön Innovation, The Loop Factory and TEKO are working on the project structure.

**TIMEFRAME:** The goal is to launch a project in 2020.

## Innovative environments

### Circular Textile Industrial Park – preliminary study

**WHAT:** Create a creative environment

The idea is to support refining of materials in waste from various industries, i.e. material recycling. This could also help start-ups that need to test new technology (e.g. Re:newcell in its younger days).

**HOW:** Collection of textiles, paper and plastic bottles etc. from the “pant” return-for-cash system.

**Sorting:**

1. Reuse
2. Recycling (chemical) – PET, cotton, cellulose
3. Recycling (mechanical)

**Industrial park stakeholders:**

1. Technology companies developing technology – driving and developing parts of the chain
2. Business partners – Utilise development, cooperate (municipalities, companies)
4. Partners – municipal authorities, research actors, industry organisations, SIPTex, larger regions

The locations that would be suitable for this today are Wargön and Kristinehamn, but there are certainly more locations. The purpose of the preliminary study is to identify the



vital components in an industrial park of this kind, including a refinery for recycled materials and resource optimisation across industries.

**WHEN:** Preparations in autumn 2019 for a 2020 preliminary study – Which companies and other stakeholders are interested? Cooperation with the Plastics subproject?

## Vision 2050

Our aim is to present a narrative for a resource-effective, circular, sustainable and profitable cycle for textiles in Sweden in 2050 as the vision and goal we should be working towards. This narrative could lead to a brochure and digital stories. As we work on this vision for the future, we would like to present the opportunities that exist through a joint project with actors from the entire ecosystem, each developing and producing their own prototypes and presenting them in an exhibition that could

tour the world, e.g. at Swedish embassies. This would be a Swedish “front runner” project, where we not only show the opportunities that exist in industry, but also how successful we are here in Sweden are at working together towards common goals.

**WHAT:** Future vision for textiles in Sweden

**HOW:** Brochure and exhibition

**WHO:** The vision for the future is presented via the national platform, Textile & Fashion 2030’s “Exposé” exhibition concept.

**TIMEFRAME:** The future vision deadline is June 2020; launch of front runner project in spring 2020.



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