

abstract

description and impact assessment of an EPR scheme for Sweden

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1 swedish mandatory extended producer responsibility (EPR) for textiles: background and description

This section starts with a brief discussion on why extended producer responsibility (EPR) is relevant for textiles, followed by a **concrete description of a mandatory EPR system for textiles tailored for the Swedish context**. It subsequently provides an **impact assessment and analysis of the described EPR system**. The section concludes with a reflection of critical aspects of the proposed EPR system, in light of the characteristics and potential of EPR concept, critical aspects for fiber-to-fiber recycling of textiles as well as characteristics of textiles and the Swedish market.

1.1 why is extended producer responsibility relevant for textiles?

A characteristic of most of the product groups that have been subject to EPR programs is its end-of-life management has been viewed as problematic, in terms of quality, e.g. toxic substances, difficulty of handling due to its structure, complex materials, and/or quantity, i.e. volume of waste from the products. Textile products covered in this study, clothes and household textiles, are unique in that it has not been viewed as a problematic waste in a functioning waste management system. Despite that, there have been strong interests in exploring the potential of introducing an EPR approach for textile, not least in the Nordic countries (Naturvårdsverket, 2016a). And as discussed further, a well-designed and well-implemented EPR system indeed has good potential of contributing to the reduction of environmental impacts important for textile products, enhancement of resource efficiency and closure of material loops.

When discussions on EPR for textiles were initiated at the Nordic level as a policy measure for waste prevention, the main environmental impacts they seek to address are those arising from production phase (Tojo et al., 2012). By enhancing the closure of material loops via reuse and fiber-to-fiber recycling, we should be able to reduce, at least in part, the use of raw materials and various activities related to production, which in turn should reduce environmental impacts associated with them and enhance resource efficiency. Moreover, producers can play an essential role in designing the products so that they are easy to reuse/recycle. It is of particular relevance when one of the main bottle necks facing fiber-to-fiber recycling is the type of materials currently used for textile products.

This is very much in line with the generational goal of the Swedish environmental policy, which seeks to guide environmental action at all levels of society (Naturvårdsverket, 2016c). Among the practical meanings of the goal, of particular relevance are:

- *Material cycles are resource-efficient and as far as possible free from dangerous substances,*
- *Natural resources are managed sustainably, and*

- *Pattern of consumption of goods and services cause the least possible problems for the environment and human health.*

1.2 description of a swedish mandatory EPR system for textiles

The mandatory EPR system for textiles in Sweden described and assessed in this report encompasses inducement of changes not only downstream but also upstream. The EPR system consists of the following elements, discussed in more detail in sections 1.2.1-1.2.9:

- **Take-back requirements**
- **Financing mechanisms that reflect the actual cost of recycling specific fibers**
- **Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies**
- **Waste diversion targets**
- **Collection convenience and information requirements**
- **Preparation for reuse/recycling targets**
- **Consultation with existing actors**
- **Monitoring and control**
- **Mandatory nature**

This section describes each element in details, clarifying, among others, the reasons behind the selection of the approach such as experiences in the past, characteristics of textiles, context specific to the Swedish market and society and the like. In doing so, the description also includes discussions on concrete means of implementing the suggested elements.

Each sub section starts with a short description of the element we propose (highlighted in a text box), followed by the reasons behind the selection as well as discussions on concrete means of implementing the respective elements. Section 1.2.10 provides a summary of the discussions on reasons and concrete means of implementation.

1.2.1 take-back requirements

Producers (manufacturers and importers who put the product on the market in question for the first time) bear physical and financial responsibility of end-of-life management of their products, which include collection, sorting, preparation for reuse and recycling of textiles. Producers have by law possibility of carry out this responsibility on their own or in collaboration with other producers and/or other entities in society.

Among various potential policy instruments to be included in an EPR program (see Appendix 4), take-back requirement is included in the vast majority of existing EPR programs (OECD, 2016a). It is fairly common in an EPR system that producers are assigned both physical and financial responsibility for activities after end-of-life products are collected separately from other waste streams. However, regarding the assignment of responsibility for collection from households, there exist a variety of approaches. A good example is the transposition of the original EU Directive (2002/96/EC) on waste electrical and electronic equipment (WEEE)¹ into the EU Member States' domestic legislation. Due partly to the flexibility incorporated in the WEEE Directive regarding the selection of actors for collection of WEEE from households, the choice of the EU Member States ranged from single actors (e.g. only producers, only municipalities) bearing both physical and financial responsibility to several actors (municipalities, producers, distributors) sharing physical responsibility, sometimes with other entities responsible for financing (Sander et al., 2007).

On one hand, the long experience of municipalities in management of municipal solid waste as well as citizens' familiarity with their roles, make municipalities a strong candidate for actors responsible for collection. As found in the extensive discussions regarding who should be responsible for packaging waste in Sweden, some even argues that municipalities should re-gain responsibility for collection even where producers were legally responsible for collection earlier. However, this does not allow producers, who would have to meet the diversion targets and take care of the collected waste stream later (see sections 1.2.5 and 1.2.7), to have control over the quality of the collection operation which affects the quality of the collected materials. Although the municipal waste management system in Sweden is working well in general, the aspiration of municipalities varies (Tyson, 2005; Sydsvenskan, 2016). Moreover, it would make it difficult for companies who already have their own systems for material closure to continue their initiatives.

In addition, assigning responsibility for collection to municipalities may create uncertainties regarding the ownership of waste, and consequently the flow of separately collected materials. Unless there is legislation requiring the municipalities to hand in all the EPR-flow to producers, municipalities may sell economically lucrative parts of the flow to other actors (e.g. recyclers in another country) while producers receive only the remaining, economically not profitable parts. This has created conflicts in EPR programs for electrical and electronic equipment (EEE) (Tojo & Manomaivipool, 2011) and paper (Sydsvenskan, 2012). Another solution could be to have a stringent rules regarding collection operation and monitor and enforce the rules, as found in the system for packaging waste in Belgium (Spasova, 2014).

Furthermore, municipalities that own (mostly through their municipal companies) incineration plants may face conflict of interest when having to sort textile waste. Textile wastes are generally dry and not toxic, i.e. an excellent input materials into incinerator. Some of the municipalities may feel the dilemma of not wanting to lose this waste stream

¹ Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), which is repealed by the Directive 2012/19/EU.

when input materials into incineration have been already decreasing with various recycling activities for other waste streams.

There are also issues when actors responsible for physical management of end-of-life products are different from those who pay for the operations. When other actors – often municipalities, due to their historical role of taking care of municipal solid waste – are physically responsible for collection, producers generally do not wish to bear financial responsibility as they have to pay without having control over the quality and efficiency of the operation (ENDS Europe, 2008; ENDS Europe, 2000). When the cost for collection is shared between the producers and municipalities, how to decide the overall cost at what point are among the issues of contention, as experienced in the Blue Box system in Ontario, Canada, for instance (Armstrong, 2014).

In order to avoid the issues pertaining to leaving the responsibility for collection to municipalities, as well as to allocate physical and financial responsibility to different actors, the EPR system discussed in this report suggests that producers bear both physical and financial responsibility for management of used textiles from collection stage onwards. Meanwhile, producers have the possibility of collaborating with other producers or other actors to carry out their responsibility.

According to Elander et al. (2014) and Palm et al. (2015), 87 percent of textiles collected for second-hand uses were collected voluntarily by charity organizations, and many municipalities collaborate with them, either formally or informally. In addition, individual brands have established their own collection mainly in their shops (Nudie Jeans, n.d.; Naturvårdsverket, 2016a; Tojo et al., 2012). Instead of building up new collection infrastructures from the scratch, producers could build on existing forms, and could take various forms.

Care should be taken so that it is easy for consumers to understand and access collection points, and that existing actors who have been working on collection are duly consulted, as elaborated further under sections 1.2.6, 1.2.8 and 1.2.9.

Furthermore, legislation stipulating the system must explicitly provide the possibility of individual implementation as well as the collective implementation, as done in a number of existing EPR laws for EEE, packaging and the like. In a situation where individual and collective physical solutions co-exist, means should be established to account for products that come into the collective scheme through, for example periodic sample analysis.

1.2.2 financing mechanisms that reflect the actual cost of recycling specific fibers

In case the infrastructure for take-back (collection, sorting, preparation for reuse and recycling) is run collectively by two or more of producers, financial mechanisms should be set in such a way that reflects the actual cost of conducting fiber-to-fiber recycling of specific fibers. The financial contribution could be made either based on the amount and type of products producers put on the market (market-share model), or based on the amount and types of discarded products that come into the collection stream (return-share model).

One of the core rationales for introducing an EPR system is to for producers of products to receive feedback regarding end-of-life management of their products, so that they include end-of-life consideration when designing their products (upstream changes). For that to happen, it has been argued that producers either directly engage in end-of-life management of their products, or they bear so-called individual financial responsibility in a collectively organized systems – those who work on upstream changes and therefore reduce environmental burden and cost of end-of-life management needs to be rewarded financially.

Although the concrete design varies, producers in most of EPR programs for products such as packaging, EEE and batteries to date implement the take-back responsibilities assigned to them together with other producers (OECD, 2016a). They typically participate in something called a producer responsibility organization (PRO), who organizes various tasks necessary to carry out obligations given to the producers.

A PRO is typically financed by fees paid by its members (producers). How the size of the fee is determined is agreed upon by its members and differs depending on, among others, the type of products (e.g. types and materials used, size and weight, life length), the power relation of the members as well as their ambition. In light of creating a system where producers receive incentives for upstream changes to enhance fiber-to-fiber recycling, a key issue is to incorporate the design features of the products in the fee structure. That is, the fee is differentiated based on the actual cost of specific fibers.

Considering the general characteristics of textile products (i.e. relatively simple products in terms of material use and structure, compared to, for instance, EEE or cars), we can draw a good fee model from some of the existing EPR systems for packaging. EXPRA, an umbrella organization for PROs for packaging from 17 countries, includes in its “best practice for packaging EPR” the following:

The financial contribution of each obliged company must be calculated based upon the amount and type of packaging they put on the market and the real cost of

operations – including awareness campaigns and potential revenues from the secondary raw material market (EXPRA, n.d.).

It also provides a detailed fee system based on packaging materials conducted by its member companies (EXPRA, 2016). In addition to the weight and the type of materials, some of the EPR systems for packaging also took into consideration criteria such as volume, size and content of recycled materials (PRO Europe, 2004).

In line with the packaging materials, a differentiated fee structure can be developed for textile products based on actual cost of handling the respective materials (type of textile fibers used in a product) at its end-of-life and its weight. Products with mixed textile fiber would most likely be more expensive than products with single fibers, and that should give incentives for producers to find solutions on both ends, i.e. to change the selection of the materials and to investigate in an efficient solution for sorting mixed fibers.

A distinctive difference between packaging and textile products which have a big implication to financial mechanism is their longevity. Unlike packaging materials whose expected life time is within one year, textile products have in general much longer life. While there is some co-relation between clothes coming into one's wardrobe and those leaving the wardrobe, there is also some accumulation. There are also others that come into another person's wardrobe without going through any formal economic transaction. Consequently, what is put on the market does not correspond to what is coming into collection site for reuse and recycling, not only in terms of weight/volume but also its type.

For this, financial mechanisms of EPR systems for products with longer life that often uses collective infrastructure, such as EEE, can be looked into. While there exist various solutions, those relevant here are so-called 1) a market-share model, or 2) a return-share model. In a typical market-share model, a unit fee is set based on the product category, which is paid when a producer puts a new product on the market. Similarly to a Pay-As-You-Go pension fund, the fee paid today is used for the end-of-life management of products collected today. In a return-share model, producers pay for the cost of end-of-life management based on what is actually collected. Especially in the context of WEEE where fee structure of market-share model has generally not been reflecting the end-of-life design feature of products, it is argued that a return-share model would more accurately reflect the actual cost of recycling, thus more incentives for design changes. Although not the majority, there exist a handful of examples where return-share models has been used in EPR systems for EEE, such as Japan, a few states in the US, and Switzerland (van Rossem, 2008).

For textiles, while a market-share model does not accurately capture different types of textiles coming back to waste stream, it is most likely feasible to differentiate the fee based on the textile materials used in the new products put on the market. A return-share model, despite its advantage of reflecting the actual end-of-life cost, has the disadvantage of monitoring the end-of-life flow to identify the brands and materials, either by periodical sampling or by going through all the collected used textiles. However, depending on the development of identification technology currently under development,

as well as need of sorting between reuse and recycling stream, periodical sampling or going through all the collected used textiles may not be unrealistic. Thus, the choice of financial model can be left in the hands of producers based on feasibility.

Regarding reuse, it is very difficult to incorporate the reuse value in the market-share model, as the value of the second-hand products depends on many aspects other than the types of textile fibers used. It is also difficult to deal with reuse in return-share model – producers should agree on how the potential profit be calculated and shared.

For cases where producers have their own physical infrastructure, they would naturally have their own financial solutions; therefore there is no need to think about fee differentiation. However, there is a high likelihood that even when producers have their own system for reuse and recycling, some of their products may end up in a collective system established by other producers. Therefore, unless producers running their individual solutions can guarantee that all their products would be returned to them, these producers need to provide some financial contribution to the collective system based on, for instance, periodical sampling analysis. The experience from the EPR system for information and communications technology (ICT) equipment in Switzerland can shed some lights for practical arrangement on this.²

1.2.3 financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies

If producers would agree as a common benefit, on top of fee that covers the cost of used-products management, additional fee could be collected to support research and development (R&D) on sorting various types of used textiles products, including detection of materials, chemicals and combination of materials in the recovered textiles, as well as on recycling of sorted fibers.

In order to achieve the reuse/recycling targets put on the producers (see section 1.2.6), producers need to find cost efficient solutions for fiber-to-fiber recycling. As it stands now, there has been shortage of cost-efficient technical solutions that enables sorting of mixed fibers, a prerequisite for the majority of fiber-to-fiber recycling. In order to enhance fiber-to-fiber recycling, it is also important to detect impurities, chemicals and other contaminants in this process.

A number of research projects, among others, within the framework of Mistra Future Fashion Phase 2, are on their way to improve the situation. If producers would agree as a

² Under the EPR system for EEE in Switzerland, the management of the ICT equipment is organized by the industry association called SWICO. While some of the producers participating in SWICO system leave all the end-of-life management to SWICO, part of the producers have a dual system. The latter take back parts of the used equipment directly from their customers, while leaving the rest to the collective system. While they have an independent account within the SWICO system to cover the cost of end-of-life management, they pay into the collective systems for the products coming into the collective stream based on periodical sampling (Tojo, 2004).

common benefit, on top of a fee that covers the cost of end-of-life management, an additional fee could be collected to support R&D in this area.

There exist many examples where individual producers invest in the development of new recycling technologies, especially at an early stage when the introduction of an EPR system is on the horizon. Examples include EPR systems for cars and EEE in Sweden and Japan (Tojo, 2004). In the Japanese EPR system for EEE, in which prominent individual domestic manufacturers have been directly running at least one recycling plant, over the last 15 years since the EPR program came into force, producers continue to invest in improving recycling technologies.

France is the only country that has introduced a mandatory EPR system for textiles so far. The PRO for textiles in France, which is financed by the contributions paid by producers, importers and distributors of textile and footwear products³, currently uses about 5 percent of its total budget for research and development. The PRO's scientific committee annually calls for innovation projects related to textiles, footwear and recycling and selects most innovative projects. By 2015, the PRO has helped financed in total of 22 projects (Freeman, 2016).

All in all, there exist a number of examples where individual producers use their own resources to enhance recycling technologies. There is also at least one concrete example where PROs whose membership is limited to producers have been using the fee collected from its members to invest in the development of recycling technologies. If producers joining a PRO for textiles in Sweden agree, there is certainly a possibility to increase their fees to invest in the development of recycling technologies.

1.2.4 waste diversion target

In order to enhance the source separation of textile waste currently discarded as residual waste, a waste diversion target for textile products needs to be met by producers. Considering the current practice in Sweden, such targets could be set at the following level: the amount of textile waste found in residual waste to be reduced to maximum 5 kg per person per year by 2020, and 2.5 kg by 2025.

Based on the studies of Hultén et al. (2016) and Elander et al. (2014), the situation surrounding end-of-life management of textiles in Sweden in recent years is as follows: in comparison to the weight of new textile products put on the market, roughly 25 percent are separately collected for reuse and recycling and around 60 percent are incinerated as part of residual waste. As of 2014, the amount incinerated is 72 000 tons, corresponding to ca 7.5 kg per person per year (Hultén et al., 2016). The pick analysis by Hultén et al. (2016) found that 59 percent of textile waste discarded as residual waste could be reused,

³ The French EPR system for textiles in France covers clothing textiles, household linens and shoes.

and 58 percent of textile waste in residual waste were made of cotton, suggesting a good potential for fiber to fiber recycling.

Diverting textile waste from residual waste is the prerequisite for the enhancement of both reuse and recycling. We therefore suggest a waste diversion target as follows: the amount of textile waste found in residual waste is to be reduced to maximum five kg per person per year by 2020, and maximum 2.5 kg by 2025. This corresponds to the reduction by 1/3 by 2020, and 2/3 by 2025, in comparison to the figure from 2014. Based on the system described in this report where producers are responsible for physical operation and financing of end-of-life management from collection onwards (see section 1.2.1), the entity that has the obligation to meet the target is the producers.

In many EPR systems, e.g. the EU WEEE Directive, the EU Directive for batteries⁴ and EPR systems for packaging in many of the European countries, a collection target instead of a waste diversion target is set in achieving essentially the same (waste diversion). The existing legislation typically put the amount of products put on the market as a proxy for expected amount of waste, and uses it as the denominator when calculating the collection target. While this works quite well for products with short life such as packaging (see section 1.2.1), it faces challenges when products' expected life is longer than a year. To remedy this problem, the EU Directives on EEE and batteries uses the average put-on-the market-figure of three preceding years/ two preceding years and the year when the collection rate is counted, when calculating the collection target (Article 7, Directive (2012/19/EU), Article 10 and Annex I, Directive (2006/66/EC)). However, as found in many of the EPR systems for EEE, this way of target setting faces difficulties when products have second/third life, especially when transaction between the owners do not take place in an official channel. Moreover, higher collection rate could be achieved with a higher consumption and discard rate of textile products, but this does not necessarily mean resource efficiency improvement. In this case, despite the higher collection rate, absolute quantity of used textile products going into residual waste may still be increasing, and the resource intensity in the economy goes up.

The ambition of the target is similar to the Swedish EPA's proposal – 60 percent reduction of textiles in residual waste compared to 2015 level. However, we suggest the target setting in absolute terms, due mostly to the ease of monitoring. Moreover, as it is a target setting for legislation in one country, there is no need to consider the differences in the current consumption and disposal pattern in absolute terms, as was experienced in the case of the EU WEEE Directive.⁵ We propose an interim goal of 2020 to promote the development of collection infrastructure and information provisions to citizens as early as possible.

Some of the systems do not put any collection or diversion target, e.g. EPR systems for EEE in Switzerland and Japan. However, investment for fiber-to-fiber recycling requires a

⁴ Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC.

⁵ The original WEEE Directive set the collection target of 4 kg per person per year from private household, instead of percentage target. This attracted various criticisms, among which includes the lack of consideration to the different level of consumption in different Member States.

steady flow of incoming materials with a level of quality. Given the current low collection rate and inclusion of a good amount of textiles with potential for fiber-to-fiber in residual waste, it is deemed necessary to include a waste diversion target.

1.2.5 collection convenience and information requirements

In setting up collection sites, producers must see to it that the collection sites are available for at least every 5 000 inhabitants, and for those consumers who are not covered by this, ensure that other measures that enhances the convenience of the consumers (e.g. setting up the collection sites close to the shopping areas, train stations, curbside collection via vehicle several times a year) are provided. In whichever way, collection should be at least free of charge for consumers. Collection sites must be equipped in such a way that it should allow consumers to bring textile products both for reuse and recycling. Producers must see to it that information regarding their responsibility, as well as information that enhance the participation of consumers in collection and sorting (e.g. location of collection sites, what needs to be sorted) are provided to the consumers.

The requirement of equipping the collection sites for both reusable and recyclable textile products should be met not only by collection sites organized by the producers, but other actors involved in collection.

Provision of convenience, information and financial incentives are among the key factors that enhances collection/waste diversion by consumers in an EPR system (Tojo et al., 2003). Various EPR laws include convenience requirements, with different levels of clarity. For instance, the original EU WEEE Directive (2002/96/EC) provides a general requirement that final folders should be able to return the WEEE free of charge, and that “the availability and accessibility of the necessary collection facilities” are considered, “taking into account, in particular the population density (Article 5.2(a)). Based on the poor results of collecting especially small appliances, the revised Directive (2012/19/EU) further mandates retailers of more than 400 m² to accept very small appliances free of charge without consumers having to buy anything (Article 5.2(c)).

Despite such a general requirement, experiences of consumers in some of the EPR programs have not been very good. For instance, in the EPR system for EEE in Sweden, despite the statutory requirements on producers to be responsible for collection onwards,⁶ the main PRO managed to negotiate with the municipalities who take care of collection

⁶ This was the situation when Sweden transposed the original WEEE Directive (2002/96/EC) in its national legislation (Förordning (2005:209) om producentansvar för elektriska och elektroniska produkter). When the original directive was replaced with the current WEEE Directive (2012/19/EU), a significant change was made on the Swedish legislation as well, including the formulation of responsibility. The latest Swedish EPR legislation on WEEE (Förordning (SFS2014:1075) om producentansvar för elutrustning) still places responsibility on producers to make sure that private households have access to a collection system that has necessary permit when their products become waste (Article 40), but also makes it very clear that municipality is among the actors for such a collection system, by exempting municipal collection system from obtaining a permit (Article 45).

from households in reality. This meant that, while some citizens living in a collective housing may be equipped with a collection site nearby due to the efforts of their housing associations, other citizens need to bring their WEEE to municipal recycling centers. Although the availability of municipal recycling centers is 1 per 10 000 inhabitants on the average in Sweden, a deeper look into statistics by municipality suggest that the availability varies from no recycling station to 6.8 per 10 000 inhabitants (Afvall Sverige, 2015).

Some states in the US provide more specific convenience requirements, (Product Stewardship Institute, 2014) such as “one collection site or service in each county, and at least one for any city with a population of at least 10 000” (Product Stewardship Institute, 2014). An evaluation of the performance of EPR program in various states shows that strong convenience standard is among the most significant factors that influence the performance (Product Stewardship Institute, 2014).

The examples above are from EPR programs for EEE, and the characteristics of EEE and textiles vary. Unlike some of the EEE, especially the bulky ones, textile products are generally light, not bulky and not fragile. It is not difficult to store them for some time. Therefore, the convenience needed for consumers may not be as high. Meanwhile, these characteristics, together with the fact that they are not particularly toxic, make it an easy candidate to mix them into residual waste. Therefore, we propose a convenience target requirement of having collection sites available for at least every 5 000 inhabitants, and for those consumers who are not covered by this, ensure that other measures that enhances the convenience of the consumers (e.g. setting up the collection sites close to the shopping areas, train stations, curbside collection via vehicle several times a year) are provided. In whichever way, collection should be at least free of charge for consumers.

Another important element regarding textile products is the distinction between reuse and recycling. As the collection of used textile products in Sweden have been predominantly conducted by charity organizations (Carlsson et al., 2011; Elander et al, 2014), it would take a while for consumers to realize that they could also bring textile products that they consider cannot be reused, but whose fibers could be recycled. The judgement between whether a used textile products is suitable for reuse or recycle is not always easy to make, either. In order to avoid confusions of consumers, it would be good to have each collection site equipped with collection facilities for both reusable and recyclable clothes. Whether there are two separate containers or everything could be put in one is left in the hands of producers.

The requirement of equipping the collection sites for both reusable and recyclable textile products should be met not only by collection sites organized by the producers, but other actors involved in collection. This is regardless of if the other actors are collaborating with the producers (thus part of the EPR system) or not. The reason for this additional requirement is the same as why this requirement is given to the producers: avoidance of confusion, and consequent disappointment, of consumers.

Regarding individual producers who provide take-back services in their shops, most likely some of the products will end up in the collection sites organized via collective schemes. Utilizing, for example periodic sampling, we could determine some compensation paid by the individual producers.

Finally, consumers need to be informed about the new responsibility given to the producers. Information is often considered as a necessary condition, albeit not a sufficient condition, in inducing consumer's behavior.

1.2.6 preparation for reuse/recycling targets

Out of the products collected, producers must meet preparation for reuse/recycling targets, which consist of a) preparing the collected textile products for reuse of the whole products or its part, b) fiber-to-fiber recycling, and c) recycling in other forms (down cycling), but not energy recovery. Given the existing very high figure, the overall preparation for reuse/recycling target is set to be 95 percent by 2020. Out of recycling (b and c above) 50 percent should be achieved by fiber-to-fiber recycling by 2025. The recycling target should be increased over time to enhance the innovation in the product design (e.g. types of textile fibers used, composition), as well as in the downstream technologies (e.g. fiber identification, sorting, recycling). Rules regarding how to count the reuse/recycling targets must be set.

Similarly to EPR programs that contains products both for reuse and recycling, an EPR program for textiles also benefits from targets for preparation for reuse and recycling. The EU Waste Framework Directive (2008/98/EC)⁷ defines the two concepts as follows:

'preparing for re-use' means checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing (Article 4.16)

'recycling' means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations (Article 4.17)

The reasons for using the term "preparation for reuse" instead of "reuse" is to avoid the difficulties of accounting second-hand products that are circulated in the economy without coming into the waste stream.

According to Elander et al. (2014), out of 30 000 tons of used textiles separately collected from the other waste streams in Sweden in 2013, it is estimated that more than 76

⁷ Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.

percent were reused, and 13-20 percent were recycled. Based on this, even including the consideration of the fluctuation in the market, the combined target of 95 percent for preparation for reuse and recycling should be quite feasible. The Swedish EPA provides a very similar target, but 90 percent by 2025. Given the figure above, we consider 95 percent by 2020 would be reasonable.

It is very important to include “preparation for reuse” as a way of meeting this target. If the target is limited only to recycling, it may create a situation where recycling is encouraged at the expense of reuse.

Regarding recycling, as of today, the prevailing method for material recycling in Sweden has been down cycling, in which used textiles are used for rags, stuffing materials and the like (Naturvårdsverket, 2016a). Considering the aspiration on closing the material loops, as well as on-going research on fiber-to-fiber recycling, we propose that fiber-to-fiber recycling constitutes 50 percent of recycling by 2025. In order to continue to provide incentives to producers to make changes upstream and downstream, it would be good to increase the target over time.

As the proportion of reuse among the collected used products is very high at this moment and it is deemed that the reuse will continue so long as there is a viable second hand market, no specific target for reuse within the overall “preparation for reuse/recycling targets” is proposed.

Finally, statistics regarding waste is known to be questionable. One of the issues highlighted is the non-standardized way of counting what constitutes, for instance, recycling. Some count everything that goes into recycling plant as recycling, while others consider only those that are actually processed as recycled materials in the recycling plant as recycling. The latter is deemed better, which is an indicator much more relevant for closure of material loop than the former.

1.2.7 consultation with existing actors

When setting up collection and recycling systems, producers must consult with existing actors who have been carrying out collection of reusable textile products as well as textile waste. Such actors include, among others, charity organizations, second-hand shops and municipalities.

According to a study commissioned by the Swedish EPA, there exist some forms of collection activities for used textiles in 98 percent of the Swedish municipalities today (Palm et al., 2015). Another study also commissioned by the Swedish EPA shows that as of 2013, charity organizations have been collecting 87 percent of used textile products (Elander et al., 2014). Among the collection activities taking place in the municipalities, the most common form is to collaborate with the charity organizations, formally or

informally (Palm et al., 2015). This current situation surrounding the collection of used textiles makes it essential for producers to consult with these existing actors who have been carrying out collection activities when setting up the infrastructure for collection and recycling.

In addition to various learnings producers could benefit, there could be opportunities for collaboration with these actors, which is already taking place when individual producers set up their own collection network voluntarily (Naturvårdsverket, 2016a). Meanwhile, experiences in the existing EPR programs indicate that having different actors engaged in the same activity tend to be challenging, as illustrated in section 1.2.1. When agreements are made between producers and existing actors to collaborate, care should be given so that it will not compromise the performance of the system in the long run.⁸

1.2.8 monitoring and control

Government authorities must make sure that rules are followed, and that in case they are not followed, there are tangible consequences (e.g. payment of fine, introduction of tax). This is essential in order to avoid free riders, keep a good level playing field, and have an effective implementation of various requirements proposed.

In order to ensure that all the producers of textile products putting their products in the Swedish market fulfill their responsibilities, a producer register system needs to be created. Such a system could also facilitate monitoring by requiring producers to register the amount of products put on the market, which would facilitate the monitoring of overall performance. When more than one PROs are created, or individual solutions and collective systems co-exist, it may be helpful to create a clearing house to coordinate collection activities.

A common challenge facing EPR systems is how to reduce free riders. In order to establish a level playing field, all the producers should bear the responsibilities allocated to them (OECD, 2016a). In addition, many of the existing EPR programs have the weaknesses of lacking enforcement of sanctions in the event certain obligations, e.g. achievement of specified recycling rate, has not been met. For instance, even when producers of plastic packaging in Sweden failed to meet the mandatory recycling rate of 30 percent for seven years in a row (Naturvårdsverket, 2005b; Naturvårdsverket, 2010), no sanction was given.

Regarding free riders, different solutions could be considered depending on how the system is organized. If only one PRO is established and most of the producers join, members tend to report on free riders. In this case, members of the PRO and the national

⁸ The one in disadvantageous position in such a contract could be both. As mentioned in section 8.2.1, municipalities in Ontario, Canada have a long-term dispute with industry due to the perceived low payment the municipalities receive from the industry. Meanwhile, when the first EPR system for packaging was developed in Germany, the unfairness of the contracts some of the producers needed to make with some municipalities (e.g. unreasonably long contract period) was highlighted (Tojo et al., 2003).

authorities could collaborate in the identification of the free riders, e.g. as found in the example of EPR system for batteries in the Netherlands, see Tojo (2004).

However, especially in situations where more than one PROs exist in a country or a number of producers run their own system in parallel to the collective system, it becomes more difficult to grasp the free riders. Also, it may not be ideal for the authority to rely on the reporting of fellow competitors to identify free riders.

Considering these, and based on the existing experiences in, for instance, EPR system for EEE and batteries in Europe, it may be beneficial to establish a system for register. Such a system could also be utilized to grasp the amount of products the respective producers put on the market to monitor the changes of material flow over time. However, given that textile products on the Swedish market are almost exclusively imported, most of such information could be gained from the existing trade statistics: if so, it would be good to avoid the overlap.

Regarding the fulfillment of waste diversion target, in light of the existence of systems organized by individual producers, it may become necessary to do not only pick analysis to check the overall diversion achievement, but also periodic check of the detailed content of textile waste stream, in order to grasp the magnitude of waste products sold by these producers.

When different requirements laid out in the legislation are not met, in addition to “naming and shaming”, a concrete signal for remedy must be given to actors failing to meet the requirements. It could take the form of fine, threat of an introduction of a tax and the like.

1.2.9 mandatory nature

In order to establish a level playing field for all the involved actors, it is considered important to establish a mandatory system, instead of a voluntary system.

Last but not least, in order to make sure that all the involved entities have a level playing field, we propose that the system will be based on legislation and not left to voluntary commitments. Implementation of voluntary EPR programs have been limited, and doubts have been raised on the effectiveness of voluntary environmental initiatives in general (OECD, 2016a).

With the existing experiences of implementing EPR programs for other products in Sweden, as well as existing of initiatives by individual producers and on-going discussions on introducing an EPR system for textiles, it would most likely not be very difficult to introduce a mandatory EPR system for textiles. With the on-going discussions on circular economy at the EU level, existence of one country (France) already having an EPR system in Europe, introduction of an EPR system in Sweden would most likely be welcome at the European policy arena as well.

What may be most difficult is gaining political acceptance from the existing actors. As mentioned in various subsections earlier, care should be made so that the new system will not kill the existing initiatives by, among others, charity organizations and producers. However, as they are also part of the on-going discussions and some collaboration that started to develop, their opposition does not seem to be insurmountable.

1.2.10 Summary of the system discussed

In this section, we provide the short description of each of the nine elements suggested in Section 1.2.1 to 1.2.9 (e.g. what is highlighted in brown box in the beginning of each section), as well as a summary of main reasons for the respective elements.

Element 1 – Take-back requirements

Producers (manufacturers and importers who put the product on the market in question for the first time) bear physical and financial responsibility of end-of-life management of their products, which include collection, sorting, preparation for reuse and recycling of textiles. Producers have by law possibility of carry out this responsibility on their own or in collaboration with other producers and/or other entities in society.

Take-back requirements on producers are among the most common policy instruments found in an EPR program. Meanwhile, the content of take-back requirements – whether responsibility for take-back starts from collection onwards, and whether producers receive full physical and financial responsibility for collection – differ among existing EPR programs for other products.

In order to avoid issues pertaining to leaving the responsibility for collection to municipalities, as well as to allocate physical and financial responsibility to different actors (as described in details in Section 1.2.1), the EPR system discussed in this report suggests that producers bear both physical and financial responsibility for management of used textiles from collection stage onwards. Meanwhile, considering the existing activities for collection already taking place, flexibility should be given regarding how producers carry out the take-back requirements. They should be able to carry out the responsibility on their own, to collaborate with other producers or other actors to carry out their responsibility, or to combine several measures.

Element 2 – Financing mechanisms that reflect the actual cost of recycling specific fibers:

In case the infrastructure for take-back (collection, sorting, preparation for reuse and recycling) is run collectively by two or more of producers, financial mechanisms should be set in such a way that reflects the actual cost of conducting fiber-to-fiber recycling of specific fibers. The financial contribution could be made either based on the amount and type of products producers put on the market (market-share model), or based on the amount and types of discarded products that come into the collection stream (return-share model).

In many of the existing EPR systems, producers collaborate in the end-of-life management of their products, often by having an organization carrying out their responsibility on their behalf (referred to as PRO – producer responsibility organization) (OECD, 2016a). The producers in this case do not have direct involvement in end-of-life management of their products, which reduces the possibility for them to gain feedback regarding design-for-end-of-life. A key mechanism to enhance feedback mechanism is to design the fee system of the PRO so that the size of the fee reflects the actual cost of end-of-life management (Tojo, 2004). For the EPR system that seeks to promote fiber-to-fiber recycling, the size of fee should be differentiated in line with the actual cost of fiber-to-fiber recycling.

The life of textile products is in general not short. In light of experiences of products with long life, two financial mechanisms could be considered – a market-share model or a return-share model. Both of the approaches have strengths and drawbacks, and producers could decide which approach to take.

Element 3 – Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies:

If producers would agree as a common benefit, on top of fee that covers the cost of used-products management, additional fee could be collected to support research and development (R&D) on sorting various types of used textiles products, including detection of materials, chemicals and combination of materials in the recovered textiles, as well as on recycling of sorted fibers.

In order to achieve the reuse/recycling targets put on the producers, as described in section 1.2.6, producers need to find cost efficient solutions for fiber-to-fiber recycling, which is currently lacking. While experiences in existing EPR system for other products indicate that often individual producers invest in the development of new technologies, there is also at least one example where a PRO uses part of the fee collected from its members for the development of recycling technologies. If producers in a PRO agree as a common interest, the latter approach could be taken.

Element 4 – Waste diversion targets:

In order to enhance the source separation of textile waste currently discarded as residual waste, a waste diversion target for textile products needs to be met by producers. Considering the current practice in Sweden, such targets could be set at the following level: the amount of textile waste found in residual waste to be reduced to maximum 5 kg per person per year by 2020, and 2.5 kg by 2025.

Currently around 60 percent of end-of-life textile products in Sweden are incinerated as part of residual waste, 59 percent of those in residual waste could be reused, and 58 percent of the same are made of cotton (Hultén et al., 2016; Elander et al., 2014). This indicates high potential for achieving more reuse and recycling of currently discarded textile products if they are diverted from municipal waste.

As of 2016, the end-of-life textile products incinerated as residual waste is approximately 7.5 kg per person (Hultén et al., 2016). The target mentioned above could be considered

to gradually reduce textile products that end-up in municipal waste, a prerequisite for the enhancement of reuse and recycling.

Element 5 – Collection convenience and information requirements:

In setting up collection sites, producers must see to it that the collection sites are available for at least every 5 000 inhabitants, and for those consumers who are not covered by this, ensure that other measures that enhances the convenience of the consumers (e.g. setting up the collection sites close to the shopping areas, train stations, curbside collection via vehicle several times a year) are provided. In whichever way, collection should be at least free of charge for consumers. Collection sites must be equipped in such a way that it should allow consumers to bring textile products both for reuse and recycling. Producers must see to it that information regarding their responsibility, as well as information that enhance the participation of consumers in collection and sorting (e.g. location of collection sites, what needs to be sorted) are provided to the consumers.

Provision of convenience, information and financial incentives to consumers are among the key factors that enhances collection/waste diversion in an EPR system (Tojo et al., 2003). Experiences in existing EPR system for other products suggests the importance of setting concrete requirement to enhance convenience. Free-of-charge collection would at least do not provide financial discentives to consumers to bring textile products they wish to discard in an appropriate place. Further, in light of existing collection for reuse set up mainly by charity organisations which are well known to consumers, in order not to confuse and discourage consumers to bring textile products which are in their eyes not reusable but may be recyclable, collection sites should allow consumers to bring both (i.e. textile products for reuse, and that for recycling). Finally, as a necessary, though may not be sufficient, condition, information to the consumers regarding the collection system should be provided.

Element 6 – Preparation for reuse/recycling targets:

Out of the products collected, producers must meet preparation for reuse/recycling targets, which consist of a) preparing the collected textile products for reuse of the whole products or its part, b) fiber-to-fiber recycling, and c) recycling in other forms (down cycling), but not energy recovery. Given the existing very high figure, the overall preparation for reuse/recycling targets is set to be 95 percent by 2020. Out of recycling (b and c above) 50 percent should be achieved by fiber-to-fiber recycling by 2025. The recycling targets should be increased over time to enhance the innovation in the product design (e.g. types of textile fibers used, composition), as well as in the downstream technologies (e.g. fiber identification, sorting, recycling). Rules regarding how to count the reuse/recycling targets must be set.

It is estimated that out of 30 000 tons of used textiles separately collected from the other waste streams in Sweden in 2013, more than 76 percent were reused, and 13-20 percent were recycled (Elander et al., 2014). The target proposed in this report reflects upon this very high figure. In order to provide a clear signal to the market and facilitate closure of material loop, it is considered important to set a target specific to fiber-to-fiber recycling within what is recycled, and is increased overtime. Given the current lack of clarity

regarding what constitutes recycling, a clear guidance as to how to count recycling – those that are actually processed as recycled materials – should be provided.

Element 7 – Consultation with existing actors:

When setting up collection and recycling systems, producers must consult with existing actors who have been carrying out collection of reusable textile products as well as textile waste. Such actors include, among others, charity organizations, second-hand shops and municipalities.

Existing studies indicate that 98 percent of Swedish municipalities engage in collection of used textiles, most commonly collaborating with municipalities (Palm et al, 2015), and that charity organizations collect 87 percent of used textile products in Sweden (Elander et al., 2014). Consultation with these actors who have been engaged in collection of used textile products are deemed essential to enhance smooth and not-confusing implementation of new systems introduced by producers, as well as to enhance learning from existing actors.

Element 8 – Monitoring and control:

Government authorities must make sure that rules are followed, and that in case they are not followed, there are tangible consequences (e.g. payment of fine, introduction of tax). This is essential in order to avoid free riders, keep a good level playing field, and have an effective implementation of various requirements proposed.

In order to ensure that all the producers of textile products putting their products in the Swedish market fulfill their responsibilities, a producer register system needs to be created. Such a system could also facilitate monitoring by requiring producers to register the amount of products put on the market, which would facilitate the monitoring of overall performance. When more than one PROs are created, or individual solutions and collective systems co-exist, it may be helpful to create a clearing house to coordinate collection activities.

Element 9 – Mandatory nature:

In order to establish a level playing field for all the involved actors, it is considered important to establish a mandatory system, instead of a voluntary system.

It is considered important to include elements 8 and 9 when looking at experiences of existing EPR systems, as described further in Section 1.2.9.

2 swedish mandatory extended producer responsibility (EPR) for textiles: impact assessment

In this section, we seek to assess how the mandatory EPR system as described in section 1.2 would potentially perform. The potential performance will be assessed against the eight policy objectives developed in line with the main policy goal we seek to address – enhancement of resource efficiency through closure of material loops in the Swedish textile industry, as well as two other aspects we consider relevant. The functions of the nine different elements of the Swedish mandatory EPR system for textiles, as described in details in section 1.2, is assessed in regard of the eight policy objectives.

2.1 potential of nine different EPR elements in achieving policy goals

This section describes how the nine elements of the mandatory EPR system for textiles in Sweden as discussed in section 1.2 might influence the achievement of the respective eight policy objectives.

Each sub section starts with the discussion of which specific elements may have influence on the respective policy objectives, followed by a table summarizing the impacts of that particular element. The overall potential effect of the policy package discussed in this report is found at the bottom row of the respective tables (row “Overall policy package”).

2.1.1 increased collection of used textile products (post-consumer textiles)

As discussed in section 1.2, collecting potential materials for reuse and recycling by diverting them from residual waste is the first essential step for further closure of material loops. Thus the proposed EPR program includes a number of measures to achieve this objective, as shortly discussed below:

- **Take back requirements**
In the EPR system described in this report, the requirement is given to the producers and it starts from the stage of collection from households onwards. This is essentially to maximize the control producers have on the quality of collection, which would affect what needs to be done in the subsequent stages. Assigning producers this responsibility, both in terms of physical management and its financing thus should enhance collection of used textile products.
- **Waste diversion targets**
This, often in the form of collection targets (for reasons why we chose the diversion targets, see section 1.2.4), is a typical policy measure used in combination with take-back requirements. Together with the development of collection infrastructure through take back requirements and collection convenience and information requirement, the progress in waste diversion targets should provide a good proxy for measuring the progress for collection.

- **Collection convenience and information requirements**
This covers two (if we consider requirement of free-of-charge for consumers as economic incentives, three) of the most important factors that encourage consumers to collect. Compared to many existing EPR programs, this proposal includes several concrete forms of enhancing the convenience of inhabitants (i.e. requirement of having one collection site per 5 000 inhabitants, requirement to provide facilities for both reusable textiles and recyclable textiles at each collection site).
- **Consultation with existing actors**
This requirement should contribute to the establishment of a good functioning of the system, including the building of a good collection system.
- **Monitoring and control**
Even when the policy contains various measures to enhance collection/waste diversion, lack of monitoring and enforcement would reduce their effectiveness. Authorities should come with a tangible sanction in case of failure of meeting the requirements to ensure progress.
- **Mandatory nature**
Together with good monitoring and control by the responsible authorities mentioned above, the fact that the system is mandated by law, instead of based on voluntary initiatives, provides additional strengths for the effective implementation of the program.
- **Financing mechanisms that reflect the actual cost of recycling specific fibers and preparation for reuse/recycling targets**
These two elements concern used products that are collected and are not likely to have any direct impact on the achievement of higher collection rate. However, when producers invest in the development of fiber-to-fiber recycling technologies, they may have more incentives to collect more textile products for recycling to benefit from economy of scale. Therefore, financing mechanisms that contribute to the **development of fiber-to-fiber recycling technologies** may have some indirect impact on collection.

Table 1 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective increased collection of used textile products (post-consumer textiles). The overall rating is “large positive impacts”.

Table 1 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective “increased collection of used textile products (post-consumer textiles)”

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers			X		
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies				X	
Waste diversion targets					X
Collection convenience and information requirements					X
Preparation for reuse/recycling targets			X		
Consultation with existing actors				X	
Monitoring and control					X
Mandatory nature					X
Overall policy package					X

2.1.2 increased reuse of used textile products

Although reuse is not the main focus of the policy measures in this study, considering the superiority of environmental performance of reuse over recycling, we seek to design the EPR system that promotes reuse as well, and at least not exerts negative influence on reuse.

- Take back requirements, waste diversion targets, collection convenience and information requirements and consultation with existing actors**
 The take back requirements mandate producers to, among others, have part of the textiles they have collected to be ready for reuse. Together with the other three elements, it should provide a good starting point to increase the amount of used textile products to be reused, which would otherwise be discarded as residual waste.
- Reparation for reuse/recycling targets**
 Together with the recycling target, a very high target (95 percent) is found in the EPR system discussed in this report. Even though both preparation for reuse and recycling targets are integrated into one and producers can meet the target

through both means, given the viable reuse market, the target most likely won't undermine reuse. However, as there is nothing within this target that make the producer prioritize reuse over recycling, the target per se most likely have limited effect on further enhancing reuse.

- **Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies**

When producers invest in the development of fiber-to-fiber recycling technologies, they most likely would wish to have sufficient amount of textile fiber to be fed into the recycling flow to secure economy of scale. This might mean that part of the flow that is suitable for reuse could be diverted into recycling stream. However, **financing mechanisms that reflect the actual cost of recycling specific fibers** most likely does not lead to the diversion from reuse to recycling stream.

- Similarly to the enhancement of collection, **monitoring and control** and **mandatory nature of the program** play important roles in securing sound implementation.

Table 2 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective "increased reuse of textile products". The overall rating is "medium positive impacts".

Table 2 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "increased reuse of used textile products"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers			X		
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies		X			
Waste diversion targets					X
Collection convenience and information requirements					X
Preparation for reuse/recycling targets				X	
Consultation with existing actors				X	
Monitoring and control					X
Mandatory nature					X
Overall policy package				X	

2.1.3 increased overall recycling of used textile products

The enhancement of the overall recycling rate of used textile products is not the explicit goal of the proposed EPR system. However, there are different elements that could facilitate this.

- **Take back requirements, waste diversion targets, collection convenience and information requirements and consultation with existing actors**
Similarly to reuse, by diverting the used textile products from residual waste stream, these four policy measures should provide a good starting point to increase the amount of used textile products to be recycled.
- **Financing mechanisms that reflect the actual cost of recycling specific fibers, financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies and preparation for reuse/recycling targets**
These three measures directly address the enhancement of fiber-to-fiber recycling, thus recycling of used textile products in general.
- Similarly to the enhancement of collection and reuse, **monitoring and control and mandatory nature of the program** play important roles in securing sound implementation.

Table 3 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective “increased overall recycling of used textile products”. The overall rating is “large positive impacts”.

Table 3 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "increased overall recycling of used textile products"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers					X
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies					X
Waste diversion targets					X
Collection convenience and information requirements					X
Preparation for reuse/recycling targets					X
Consultation with existing actors				X	
Monitoring and control					X
Mandatory nature					X
Overall policy package					X

2.1.4 increased fiber-to-fiber recycling of used textile products

Enhancement of the fiber-to-fiber recycling is one of the core policy objectives that the suggested EPR policy seeks to achieve. All the suggested policy elements interact and support this objective.

- Take back requirements, waste diversion targets, collection convenience and information requirements and consultation with existing actors**
 Similarly to reuse and overall recycling, these four policy measures seek to enhance diversion of used textile products from residual waste. This is a prerequisite for increasing fiber-to-fiber recycling of used textiles which would otherwise be incinerated.
- Financing mechanisms that reflect the actual cost of recycling specific fibers, financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies and preparation for reuse/recycling targets**
 These three measures directly address the enhancement of fiber-to-fiber recycling. The specific target for fiber-to-fiber recycling target (50 percent of recycling should be achieved by fiber-to-fiber recycling by 2025, see section 1.2.6) intends to send a strong signal to the market players to find technological solutions that are financially viable in the coming years.

- Similarly to the first three policy objectives, **monitoring and control** and **mandatory nature of the program** play important roles in securing sound implementation.

Table 4 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective "increased fiber-to-fiber recycling of used textile products". The overall rating is "large positive impacts".

Table 4 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "increased fiber-to-fiber recycling of used textile products"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers					X
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies					X
Waste diversion targets					X
Collection convenience and information requirements					X
Preparation for reuse/recycling targets					X
Consultation with existing actors				X	
Monitoring and control					X
Mandatory nature					X
Overall policy package					X

2.1.5 prevention of hazardous / unwanted chemicals

One of the bottlenecks of the enhancement of the use of recycled materials is uncertainty regarding quality. In addition to measures to secure the quality through, for instance, certification schemes for recycled materials, it is essential to enhance the quality of input materials (Tojo & Thidell, 2012).

Among the important contaminants that may be found in the recycled textile fibers are hazardous/unwanted chemicals. Various requirements in the proposed EPR system could address the reduction of such contaminants, directly or indirectly. It should be noted, however, that the suggested EPR policy most likely do not have much influence on chemicals that are used in the production process but do not retain in the finished products.

- **Take back requirements, financing mechanisms that reflect the actual cost of recycling specific fibers and preparation for reuse/recycling targets**

When producers need to take care of used textile products they put on the market, and if the fees they pay are determined based on the actual cost of fiber-to-fiber recycling, producers should be encouraged to use textile fibers that are easy to recycle. A property of such textile fibers includes reduction of hazardous/unwanted chemicals retained in the final products. Selection of fibers with quality suitable for fiber-to-fiber recycling would become even more important for producers in order to meet the proposed fiber-to-fiber recycling target.

- **Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies**

This element concerns development downstream rather than upstream, thus the its effect on prevention upstream is deemed rather limited.

- **Waste diversion targets, collection convenience and information requirements and consultation with existing actors**

These three elements mainly concern enhanced collection of used textile products for reuse and recycling. While increased collection of used textile products most likely provides further incentives for producers to enhance the quality of the collected used products, its influence here is indirect.

- Similarly to the first four policy objectives **monitoring and control** and **mandatory nature of the program** play important roles in securing sound implementation. As reduction of chemicals is not directly mandated by the policy package discussed in this report, however, their relative impact for this policy objective may be lower than the other policy objectives.

Table 5 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective "prevention of hazardous/unwanted chemicals". The overall rating is "medium positive impacts".

Table 5 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "prevention of hazardous/unwanted chemicals"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers					X
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies			X		
Waste diversion targets				X	
Collection convenience and information requirements				X	
Preparation for reuse/recycling targets					X
Consultation with existing actors			X		
Monitoring and control				X	
Mandatory nature				X	
Overall policy package				X	

2.1.6 development of technologies for sorting and (fiber-to-fiber) recycling of textiles

In light of current lack of financially viable technologies for fiber-to-fiber recycling, development of such technologies is essential for producers to meet the mandates included in the policy package discussed in this report. The EPR system described in this report includes some elements that directly address the technological development in this area.

- **Take back requirements, preparation for reuse/recycling targets, financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies and financing mechanisms that reflect the actual cost of recycling specific fibers**
The obligation for producers to take back used textile products they put on the market and meet, among others, fiber-to-fiber recycling targets would require them to find economically viable fiber-to-fiber recycling possibilities. Current lack of such possibilities would accelerate the development of technologies in this area. Financing mechanisms in which producers collectively invest in such technologies would facilitate the development. The development of such technologies for sorting of used textile products and its fibers is a prerequisite to have financing

mechanisms in which producers pay for in accordance with the recycling of respective fibers.

- Waste diversion targets, collection convenience and information requirements and consultation with existing actors**
 These three elements mainly concerns enhanced collection of used textile products for reuse and recycling. The increased collection would make it worthwhile for various actors in society to invest in sorting and recycling technologies, thus facilitate their development.
- Monitoring and control and mandatory nature**
 Similarly to the prevention of hazardous/unwanted chemicals, as development of sorting and recycling technologies per se is not directly mandated by the proposed policy package, their relative impact for this policy objective may be lower than the other policy objectives.

Table 6 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective "development of technologies for sorting and fiber-to-fiber recycling of textiles". The overall rating is "large positive impacts".

Table 6 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "development of technologies for sorting and (fiber-to-fiber) recycling of textiles"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers				X	
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies					X
Waste diversion targets				X	
Collection convenience and information requirements				X	
Preparation for reuse/recycling targets					X
Consultation with existing actors				X	
Monitoring and control				X	
Mandatory nature				X	
Overall policy package				X	

2.1.7 increased transparency of material flows

This policy objective is not the main objective of the EPR program discussed in this report, but rather has an important supplementary role and is fulfilled as a means to implement some of the policy elements.

- **Preparation for reuse/recycling targets, monitoring and enforcement and mandatory nature**

In order to check if the producers are meeting the preparation for reuse/recycling targets, a system must be established to check 1) the amount of used textile products collected by producers, 2) the amount of used textile products entering reuse market through the systems organized by the producers, 3) the amount of used textile products entering the recycling facilities through the systems organized by the producers, as well as 4) the breakdown of textiles collected by the producers that are recycled into new fiber or down cycled. However, unless producers somehow captured the systems organized by the other actors in society through collaboration and the like (see section 1.2.7), the flow of the materials in these non-producer-based systems will not be captured. Moreover, informal transaction of second-hand products will not become clear.

- **Financing mechanisms that reflect the actual cost of recycling specific fibers**

If the producers in a collective system decide to share the cost based on market-share (see section 0), the amount of different fibers contained in textile products put on the market should become available. If the producers decide to go for a return-share model, collection, preparation for reuse, fiber-to-fiber recycling and down cycling figure would become available brand-by-brand and fiber-by-fiber. In the case of the latter, the amount of textile fibers put on the market is not the information necessary to figure out how much the respective producers need to pay. However, the overall amount of textile products put on the Swedish market is available from the existing trade statistics.

- The rest of the elements are not deemed to contribute to the enhancement of the enhanced transparency of material flows.

Table 7 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective “increased transparency of material flows”. All in all, although the flow under the producer responsibility system becomes more transparent, how much the remaining flow becomes clear depends on how the existing systems and new systems introduced by the producers collaborate. The overall rating is “medium positive impacts”.

Table 7 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "increased transparency of material flows"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements			X		
Financing mechanisms that reflect the actual cost of recycling specific textile fibers				X	
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies			X		
Waste diversion targets			X		
Collection convenience and information requirements			X		
Preparation for reuse/recycling targets					X
Consultation with existing actors			X		
Monitoring and control					X
Mandatory nature					X
Overall policy package				X	

2.1.8 improved design for fiber-to-fiber recycling

Improved design for fiber-to-fiber recycling is one of the concrete upstream changes the proposed EPR system seeks to enhance. All the suggested policy elements interact and support this objective.

- Take back requirements, waste diversion targets, collection convenience and information requirements and consultation with existing actors**
 Similarly to increased reuse, overall recycling and fiber-to-fiber recycling of used textile products, these four elements seek to enhance diversion of used textile products from residual waste, thereby increase the amount of used-textile products available for producers to reuse or recycle. A steady and sizeable flow of used textiles is a prerequisite for making it meaningful for producers to change product design.
- Financing mechanisms that reflect the actual cost of recycling specific fibers and preparation for reuse/recycling targets**
 The former element seeks to provide financial incentives to producers to enhance design for fiber-to-fiber recycling. In order to achieve the latter in a cost effective way, producers would seek to not only to improve downstream technologies but also enhance upstream improvement.

- **Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies**

The availability of economically viable fiber-to-fiber recycling technologies most likely provides further incentives for producers to make their products compatible for newly available technologies. Meanwhile, if the technologies would advance so much and sorting of various types of fibers ceased to become an obstacle, it may create disincentives for producers to work on upstream changes.

- Similarly to the other policy objectives, **monitoring and control** and **mandatory nature of the program** play important roles in securing sound implementation.

Table 8 indicates the potential impacts of the elements constituting a mandatory EPR system for textiles in Sweden, relevant for the policy objective "improved design for fiber-to-fiber recycling". The overall rating is "large positive impacts".

Table 8 Potential impacts of elements constituting a mandatory EPR system for textiles in Sweden on the policy objective "improved design for fiber-to-fiber recycling"

	Large negative impact	Medium negative impact	No/ little impact	Medium positive impact	Large positive impact
Take-back requirements					X
Financing mechanisms that reflect the actual cost of recycling specific textile fibers					X
Financing mechanisms that contribute to the development of fiber-to-fiber recycling technologies			X	X	
Waste diversion targets					X
Collection convenience and information requirements					X
Preparation for reuse/recycling targets					X
Consultation with existing actors				X	
Monitoring and control					X
Mandatory nature					X
Overall policy package					X

2.1.9 overall policy effects

Table 9 summarizes the potential impacts of the mandatory EPR system for textiles in Sweden described in this study. It is drawn from the overall effect of the respective eight policy objectives discussed in details in Section 2.1 and found at the bottom row of Table 3 to 10 respectively.

Table 9 Summary of the potential impacts of a mandatory EPR system for textiles in Sweden discussed in this study

	No/ little impact	Medium positive impact	Large positive impact
Increased collection of used textile products (post-consumer textiles)			X
Increased reuse of used textile products		X	
Increased overall recycling of used textile products			X
Increased fiber-to-fiber recycling of used textile products			X
Prevention of hazardous / unwanted chemicals		X	
Development of technologies for sorting and (fiber-to-fiber) recycling of textiles		X	
Increased transparency of material flows		X	
Improved design for fiber-to-fiber recycling			X

Potential contribution of the nine policy elements constituting the proposed EPR program to the respective policy goals varies.

Except for the increased transparency of material flows, the contribution of take back requirements is ranked high for the achievement of all other policy objectives. Waste diversion targets, as well as collection convenience and information requirements, supplemented by the consultation with existing actors contribute to the diversion of used textile flows from residual waste stream. As the diversion is a prerequisite for the rest of the activities to close the material loops, they also rank high for the achievement of most of the policy objectives.

Monitoring and enforcement as well as mandatory nature of the program overall contribute to the solid implementation of other elements, thus plays an important role in the achievement of all the eight policy objectives.

Elements with most diverging impacts are two on financial mechanisms, as well as preparation for reuse/recycling targets. While the main aims of the all the three elements are to do with enhancement of fiber-to-fiber recycling, and in the case of the targets, increased reuse, they are expected to exert different levels of impacts on some of the policy objectives. The difference among the three depends mostly on whether the policy objective is to do with the downstream changes, upstream changes or both. Financing mechanisms that contribute to the development of fiber-to-fiber recycling is primarily to do with downstream changes, thus is expected to have no/little impact on, for instance, prevention of hazardous/unwanted chemicals or design for fiber-to-fiber recycling.

Meanwhile, the financing mechanisms that reflect the actual cost of specific fibers seeks to induce changes both upstream and downstream, thus is expected to have large positive impacts on policy goals related to these upstream changes.

2.2 discussion and recommendations

The impact assessment reveals that, with the presence of different elements contained in the policy, the proposed mandatory EPR system overall has a good potential to address various policy objectives. These policy objectives include both upstream changes, e.g. prevention of hazardous/unwanted chemicals, design for fiber-to-fiber recycling, and downstream changes, e.g. increased collection, overall recycling and fiber-to-fiber recycling of used textile products, development of technologies for sorting and fiber-to-fiber recycling.

As highlighted in section 2.1.9, while some of the policy elements e.g. take back requirements, monitoring and control, the mandatory nature of the program, have large or medium positive impacts on nearly all policy objectives, individual policy elements are expected to have different impacts on the respective policy objectives. Among the critical aspects identified for increased fiber-to-fiber recycling include uncertainty on ownership of used textiles/textile wastes, quality of textile fibers for recycling, use of mixed textile fibers, and uncertainty regarding the content of the collected textiles. Making producers the primary responsible actor for take-back starting from collection – thus giving them a full control over the end-of-life operation of used textile products entering in the collection systems they operate – would address many of these aspects.

Together with the take-back requirements and the preparation for reuse/recycling targets, financing mechanisms that reflect the actual cost of specific fibers is one of the critical policy elements for the inducement of upstream changes, which should help improve the quality of incoming textile materials for recycling (prevention of hazardous/unwanted chemicals, design for fiber-to-fiber recycling), as well as information regarding the content of textile. Inclusion of this element is essential in order to utilize the full potential of an EPR program and seek to enhance both downstream and upstream changes not only at the initial phase of the EPR program but continuously.

In order to close the material loops, the essential first step is capturing sufficient amount of used textile products. This is especially important in order to provide enough incentives and signals to the market to invest further on technologies enabling fiber-to-fiber recycling. In addition to take-back requirements, waste diversion targets and collection convenience and information requirements play a very important role there. In order to enhance collection, consumers should be able to understand and have access to the collection systems. This entails, among others, that when there is a facility collecting textiles for second-hand use, another facility for recycling should be accompanied. This requirement should be given not only to producer-organized systems but other existing systems such as collection by charity organizations.

An important aspect for a smooth and solid implementation is that the newly introduced system is accepted by as many stakeholders as possible. This makes it critical for producers to consult with existing actors regarding the new systems they are introducing.

Similarly to many policy measures, the devils are in the details. For instance, whether the producers jointly operate a physical infrastructure go for fee paying mechanism based on

market-share or that based on return-share have important implication on, among others, the practical operation of the system as well as transparency of material flows. The existence of targets specific to fiber-to-fiber recycling within the preparation to reuse/recycling targets most likely have significant impact on the development of technologies needed for fiber-to-fiber recycling.

Last but not least, monitoring and control is essential for the solid implementation and keeping the level playing field, which are the main rationales for introducing a mandatory program instead of voluntary one.

As proposed, if producers who are the members of a collectively organized system agree, it is possible to collect funding for R&D activities related to the development of technologies that enables fiber-to-fiber recycling. However, there could be many other ways to secure resources needed for R&D. As mentioned, when EPR programs for other products were introduced, many individual producers started to look for various technological solutions for recycling, and some producers of textile products are already doing this. Research funds could be obtained in collaboration with universities and other research entities. If member producers agree, PROs could take a lead in making such an arrangement with research institutions. Instead of prescribing that funding should be secured through the fee system, it would be better to leave it to the market and the PROs to decide.